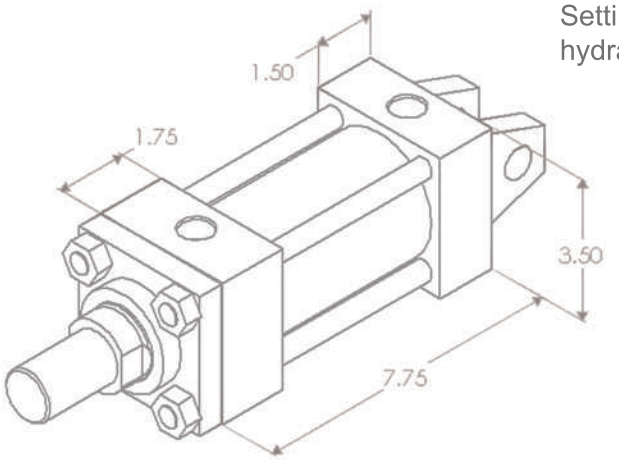
BIMBA | TRD

Hydraulic Catalog

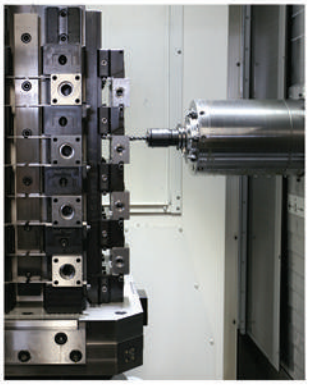
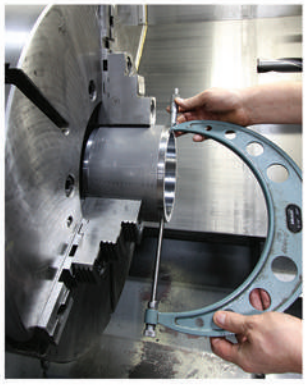


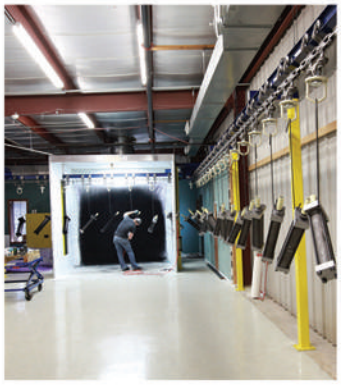
Setting a new standard for NFPA hydraulic cylinders in:

- Heavy-duty design
- CNC machined quality
- 2-3 day delivery

The TRD difference...

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



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

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

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

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

Visit us on the web: www.trdmfg.com e-mail: sales@trdmfg.com

'HH' Series - 2D DXF & DWG CAD files available, 3D Step files available for download online

'MH' & 'TAS' Series - Contact TRD for drawings

NEW THREE YEAR WARRANTY

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

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

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

TABLE OF CONTENTS

QUICK GUIDE – Design the Right Cylinder for Your Application

TRD offers a wide range of cylinder customizations and options to provide the best cylinders in the industry for any application. Here's a brief overview of common cylinder design and option considerations to assist in choosing the right cylinder for you. A cylinder that is tailored to a specific application will improve overall performance and lead to increased cylinder life.

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. Diameters are nominal and are hard chrome plated on all outside diameters.

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).
KK1 (Small Male Thread) - The KK1 is the default rod thread (if no other thread call out is made).

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.

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 size thread as a KK1, but utilizes a female tap with a stud inserted. 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. **Standard on 'MH' and 'HH' Series rods from .625" to 2.00" diameter.**

KK4 (Full Male Thread) - The strongest male rod thread possible since it's the same diameter as the rod. High Impact, high speed, higher suspected side load applications should use this option. The reason being is 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.

Cylinder Strokes: The Long and Short on What is Possible and What to Expect…

Cylinder stroke components are also made-to-order, so you are not limited to specifying a stroke in full inch increments. It is also easy to make a cylinder in a metric equivalent stroke length; just specify the required stroke length in inches (Example: 80mm stroke = 3.15"). Strokes up to 120 inches will ship per our delivery schedule (usually in 2-3 days). Longer strokes are available and 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 ± .062". TRD typically holds each cylinder component to a close tolerance, minimizing the "stack-up of tolerance" that effect the cylinder stroke.

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: 2-3 days standard!
Many times, a smaller port size will be used to limit the 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 (position 9).

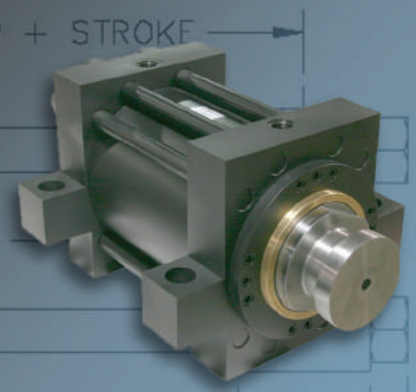
Rod "Extensions" Also Known as "C" Dimensions in the Catalog – What is Possible?

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. 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. Note: refer to Piston Rod Sizing Charts to ensure adequate column strength.
Just send your local distributor a sketch!

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!

HH Series Heavy Duty Industrial Hydraulic

1.50″ to 8.00″ Bore



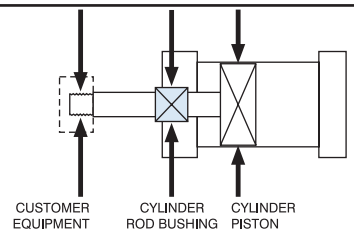
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'HH' (NFPA) CYLINDER

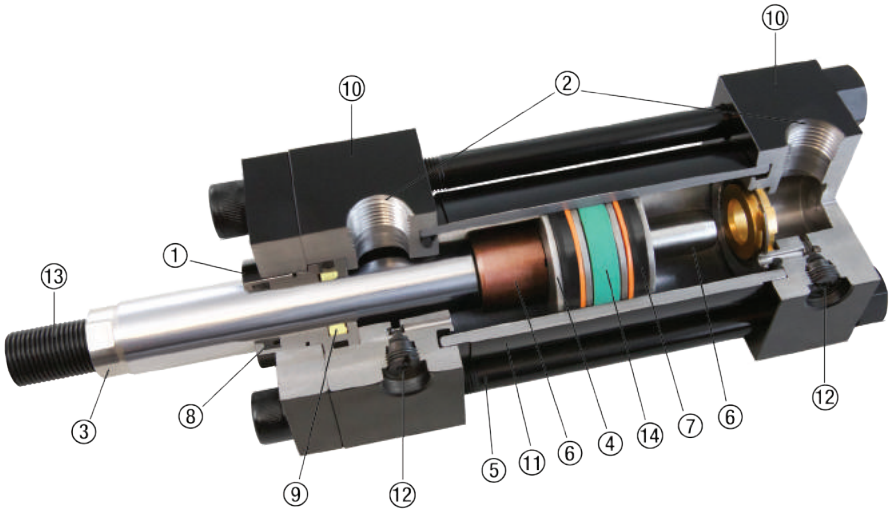
Floating Rod Bushing

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 ductile iron and PTFE coated to reduce friction and extend cycle life. Bushing design traps lubrication in effective bearing area. Bronze bushings also available.

② ***PORTS*** – NPTF and SAE ports available standard. Non-standard locations, sizes and other port styles can be made-to-order to fit any application needs.

③ ***PISTON ROD*** – Steel piston rod provides high strength and damage resistance. Induction hardened and chrome plated for maximum wear resistance and long life (100K min. yield up to 5" rod; 75K min. yield for 5 1/2" rod).

④ ***PISTON*** – Precision machined ductile iron provides high strength and an excellent bearing surface for extended cylinder life.

PISTON LOCK SCREW (PLS) – Former option but now standard on all hydraulic cylinders. 100% securely fastened to piston rod by thread lock, Dutch (Skotch) key and staking.

⑤ ***TIE RODS*** – Pre-stressed, high carbon steel tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube (100K min. yield).

⑥ ***CUSHION*** – Precision machined cushions are available at either end and provide smooth deceleration, which helps reduce end of stroke shock.

⑦ ***PISTON SEALS*** – Heavy lip design, Carboxilated Nitrile seals with back-up rings are pressure activated and wear compensating for extended life. Cast ring, EP, PTFE and fluorocarbon designs available.

⑧ ***ROD WIPER*** – Flocked nitrile wiper removes contaminants on retract stroke, helping ensure long life for all internal components.

⑨ ***ROD SEALS*** – Polyurethane seals offer high abrasion resistance and strength. Pressure activated double lip and wear compensating for extended life.

⑩ ***HEAD & CAP*** – Precision machined steel head and cap are held to tight tolerances and ensure accurate alignment for a truly square cylinder.

⑪ ***TUBE*** – Precision machined steel tube with hard chrome I.D. is honed and micro finished for extended seal life and improved cycle rates.

⑫ ***CUSHION ADJUSTMENT NEEDLE*** – Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.

⑬ ***PISTON ROD STUD*** – Standard on KK1 and KK2 threads for .625" - 2.00" rods (125K min. yield). Available up to two times standard "A" thread length.

⑭ ***WEAR BAND*** – Wear Guard Nylon (standard); reinforced PTFE for E and V seal option.

FINISH – Black urethane paint.

OPERATING PRESSURE	3000 PSI HYD (207 BAR) *Refer to mount section for specific PSI rating by bore size and mount.*

OPERATING TEMPERATURE	Standard Seals: -20°F to 200°F (-29°C to 93°C) Fluorocarbon: 0°F to 400°F (-18°C to 204°C)

Performance Options:

- ***RLH*** – Rod locks are used to hold linear cylinder loads stationary in any mounting orientation during power off condition (see pages 41-46 for more information).
- ***ST*** – Stop tubes are used to reduce rod bearing and piston stress (refer to page 53 for cylinder design guidance).
- ***CS*** – Center Supports are recommended for cylinders with long strokes in horizontal applications to prevent buckling of the cylinder and extend cylinder life.
- ***SSR*** – 17-4 Chrome Plated Stainless Steel Piston Rod provide corrosion resistance in outdoor applications and wet environments (100K min. yield up to 5" rod; 75K min. yield 5 1/2" rod).

HOW TO ORDER: SERIES 'HH' (HEAVY DUTY HYDRAULIC CYLINDERS)

HH - MF1 ___ - 250 x 10 - H2C6 - 100 - KK1 - P15 = N375 - S S S S - _____

SERIES	
HH	HEAVY DUTY HYDRAULIC

STYLE	
(BLANK)	SINGLE ROD
D	DOUBLE ROD

STROKE
0" to 120"
Made to Order.
(Use decimals for fractional strokes)

NFPA MOUNTS	
MX0	NO MOUNT (1.50" to 8.00" Bore)
MF1	HEAD RECTANGULAR FLANGE (1.50" to 8.00" Bore)
MF2	CAP RECTANGULAR FLANGE (1.50" to 8.00" Bore)
MF5	HEAD SQUARE FLANGE (1.50" to 8.00" Bore)
MF6	CAP SQUARE FLANGE (1.50" to 8.00" Bore)
ME5	HEAD RECTANGULAR MOUNTING HOLES (1.50" to 8.00" Bore)
ME6	CAP RECTANGULAR MOUNTING HOLES (1.50" to 8.00" Bore)
MP1	FIXED CAP PIVOT CLEVIS (1.50" to 8.00" Bore)
MS2	SIDE LUGS (1.50" to 8.00" Bore)
MS3	CENTER LINE LUGS (1.50" to 8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50" to 8.00" Bore)
MS7	END LUGS (1.50" to 6.00" Bore)
MT1	HEAD TRUNNION (1.50" to 8.00" Bore)
MT2	CAP TRUNNION (1.50" to 8.00" Bore)
MT4	INTERMEDIATE (CENTER) TRUNNION (1.50" to 8.00" Bore)
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50" to 8.00" Bore)
MX2	EXTENDED TIE RODS - CAP (1.50" to 8.00" Bore)
MX3	EXTENDED TIE RODS - HEAD (1.50" to 8.00" Bore)
SB	SPHERICAL BEARING (1.50" to 6.00" Bore)

BORE	
150	1.50"
200	2.00"
250	2.50"
325	3.25"
400	4.00"
500	5.00"
600	6.00"
700	7.00"
800	8.00"

CUSHIONS	
H	1
	2
	3
	4
C	5
	6
	7
	8

Call out 'H' for head cushion, 'C' for cap cushion, followed by the desired location(s).

ROD SIZE	
062	0.625" ROD DIA.
100	1.000" ROD DIA.
137	1.375" ROD DIA.
175	1.750" ROD DIA.
200	2.000" ROD DIA.
250	2.500" ROD DIA.
300	3.000" ROD DIA.
350	3.500" ROD DIA.
400	4.000" ROD DIA.
450	4.500" ROD DIA.
500	5.000" ROD DIA.
550	5.500" ROD DIA.

ROD END	
KK1	SMALL MALE THREAD
KK2	LARGE MALE THREAD
KK3	FEMALE THREAD
KK3M	FEMALE METRIC ROD THREAD
KK3X	FEMALE SPECIAL THREAD
KK4	FULL DIA. MALE THREAD
KK5	PLAIN END
KK10	ROD COUPLER END
KKM	METRIC THREAD
KKX	MALE SPECIAL THREAD

When additional thread details are required, use format:
"Rod End" = "Modification"
Example: KKX=1.00x8

PORT LOC	
P	1
	2
	3
	4
	5
	6
	7
	8
	9

Call out 'P' followed by all desired locations.

PORT SIZE	
N062	1/16" NPTF
N125	1/8" NPTF
N250	1/4" NPTF
N375	3/8" NPTF
N500	1/2" NPTF
N750	3/4" NPTF
N1000	1" NPTF
N1500	1 1/2" NPTF
S2	#2 SAE
S3	#3 SAE
S4	#4 SAE
S5	#5 SAE
S6	#6 SAE
S8	#8 SAE
S10	#10 SAE
S12	#12 SAE
S16	#16 SAE
S24	#24 SAE

SEALS
See Below for Seal Ordering Instructions

OPTIONS	
A=	EXTENDED PISTON ROD THREAD (EXAMPLE: A = 2") (MAX = 2 TIMES ST'D "A" DIM.)
ABP=	AIR BLEED PORTS (EXAMPLE: ABP=15)
AS=	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, EXAMPLE: AS = 4")
C=	EXTENDED PISTON ROD (EXAMPLE: IF C = 0.50", THEN 1" ROD EXTENSION IS C = 1.50")
CS	CENTER SUPPORT
DBB=	DRAIN BACK BUSHING (EXAMPLE: DBB=1)
EK	EXTENDED KEY PLATE
HLP	HIGH LOAD PISTON
HSS	HIGH SHOCK SEALS
LRB	LIFT RING BOSS
NR	NON-ROTATING
RBB	ROD BUSHING MATERIAL: BRONZE
RLH	"ROD LOCK READY" CYLINDER
RLH=	ROD LOCK MODEL NUMBER EXAMPLE: RLH=1002501000
SSR	STAINLESS STEEL PISTON ROD
ST=	STOP TUBE NOTE: SPECIFY STOP TUBE LENGTH (IN INCHES) SPECIFY STROKE AS ES (EFFECTIVE STROKE) EXAMPLE: HH-MS2-250X48ES-H2C6-ST=3*
4WF	FOUR WRENCH FLATS (ROD SIZES: .625"-3.50")
XX=	SPECIAL VARIATION (SPECIFY)

*The desired stop tube length adds directly to the overall cylinder length.

Note: Refer to HH Options for specifications.

HOW TO ORDER SEALS

S S S S

PISTON SEAL	
S	STANDARD (Carboxilated)
C	Cast-Ring
E	EP
T	PTFE**
V	Fluorocarbon

ROD SEAL	
S	STANDARD (Polyurethane)
E	EP
V	Fluorocarbon

TUBE SEAL	
S	STANDARD (Buna)
E	EP
V	Fluorocarbon

ROD WIPER*	
S	STANDARD (Flocked Nitrile)
M	Metallic Scraper
T	PTFE
V	Fluorocarbon

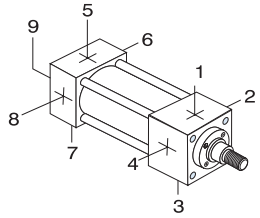
*When cylinder design calls for all EP seals, use PTFE rod wiper.
**See page 52 for seal specifications.

Port Note:
For complex port designs, multiple port locations & sizes can be ordered. Call out locations and sizes for all sets using the following format.

Example:-P15=N375 -P26=N500

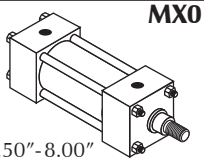
(3/8" NPTF Ports at 1 & 5 and 1/2" NPTF Ports at 2 & 6)

BSPP & BSPT ports also available.



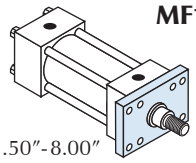
Location 9 is center of cap face.

MAXIMUM STROKE RECOMMENDATIONS			
BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION)	
		ONE SUPPORT	TWO SUPPORTS
1.50"	44 INCHES	STROKES OVER 44 INCHES	STROKES OVER 89 INCHES
2.00"	74 INCHES	STROKES OVER 74 INCHES	STROKES OVER 99 INCHES
2.50"	84 INCHES	STROKES OVER 84 INCHES	NOT REQUIRED
3.25" - 8.00"	99 INCHES	STROKES OVER 99 INCHES	

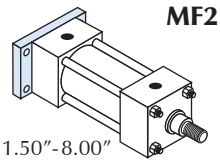


MX0
1.50"-8.00" Bores

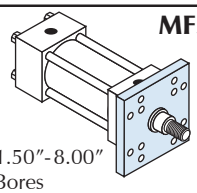
NFPA MOUNTS



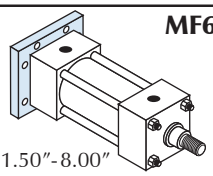
MF1
1.50"-8.00" Bores



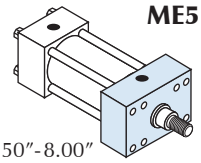
MF2
1.50"-8.00" Bores



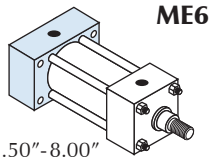
MF5
1.50"-8.00" Bores



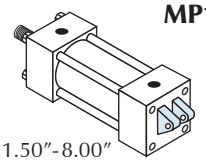
MF6
1.50"-8.00" Bores



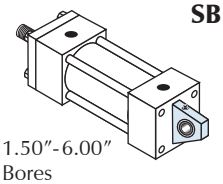
ME5
1.50"-8.00" Bores



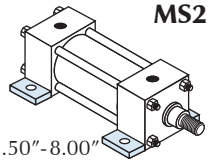
ME6
1.50"-8.00" Bores



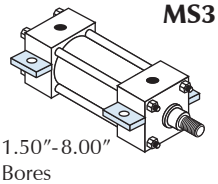
MP1
1.50"-8.00" Bores



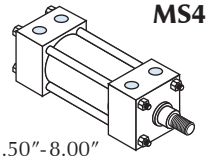
SB
1.50"-6.00" Bores



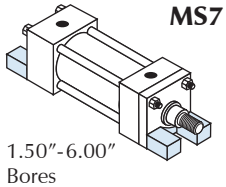
MS2
1.50"-8.00" Bores



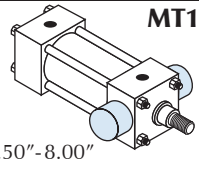
MS3
1.50"-8.00" Bores



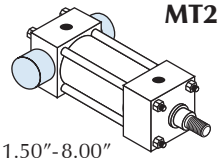
MS4
1.50"-8.00" Bores



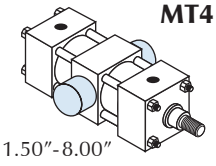
MS7
1.50"-6.00" Bores



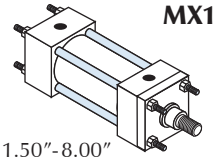
MT1
1.50"-8.00" Bores



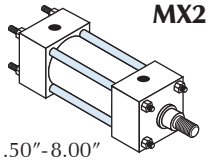
MT2
1.50"-8.00" Bores



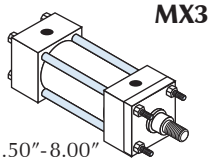
MT4
1.50"-8.00" Bores



MX1
1.50"-8.00" Bores



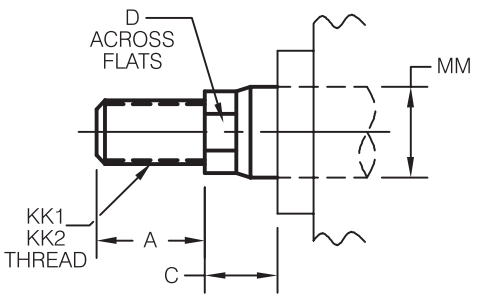
MX2
1.50"-8.00" Bores



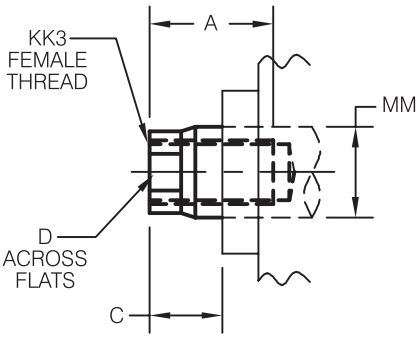
MX3
1.50"-8.00" Bores

SERIES 'HH' DIMENSIONS: THREADS

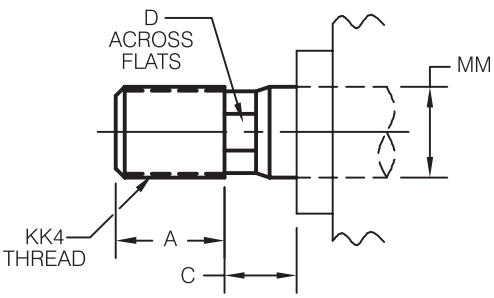
ROD END STYLE: KK1 KK2

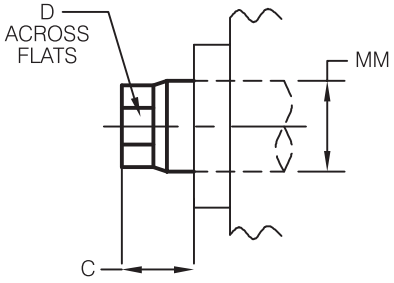


ROD END STYLE: KK3

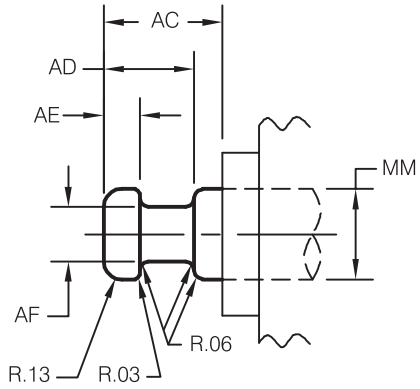


ROD END STYLE: KK4

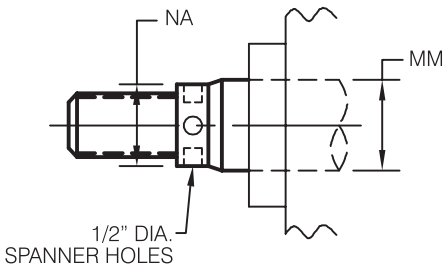




ROD END STYLE: KK5



ROD END STYLE: KK10



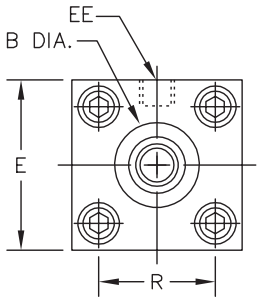
SPANNER HOLES (4.000-5.500 RODS) (SHOWN ON KK1-KK2)

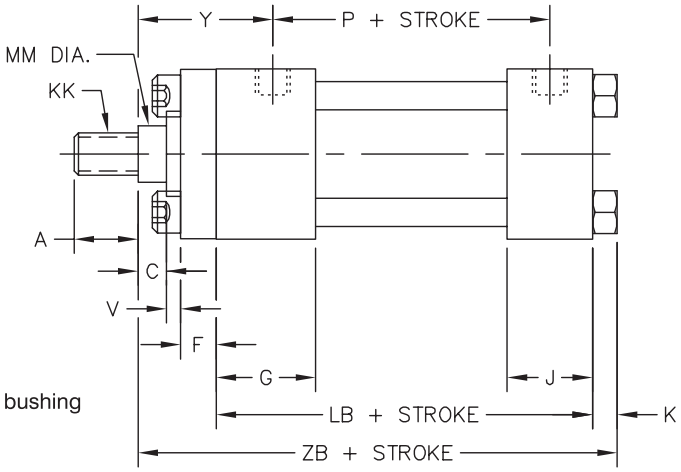
ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4	NA ±.002
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16 - 20*	1/2 - 20*	7/16 - 20	5/8 - 18	—
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 - 16*	7/8 - 14*	3/4 - 16	1 - 14	—
1.375	1.625	0.625	1.125	1.750	1.063	0.375	0.875	1 - 14*	1 1/4 - 12*	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	—
2.000	2.250	0.875	1.750	2.625	1.688	0.625	1.375	1 1/2 - 12*	1 3/4 - 12*	1 1/2 - 12	2 - 12	—
2.500	3.000	1.000	2.125	3.250	1.938	0.750	1.750	1 7/8 - 12	2 1/4 - 12	1 7/8 - 12	2 1/2 - 12	—
3.000	3.500	1.000	2.625	3.625	2.438	0.875	2.250	2 1/4 - 12	2 3/4 - 12	2 1/4 - 12	3 - 12	—
3.500	3.500	1.000	3.000	4.375	2.688	1.000	2.500	2 1/2 - 12	3 1/4 - 12	2 1/2 - 12	3 1/2 - 12	—
4.000	4.000	1.000	—	4.500	2.688	1.000	3.000	3 - 12	3 3/4 - 12	3 - 12	4 - 12	3.875
4.500	4.500	1.000	—	5.250	3.188	1.500	3.500	3 1/4 - 12	4 1/4 - 12	3 1/4 - 12	4 1/2 - 12	4.375
5.000	5.000	1.000	—	5.375	3.188	1.500	3.875	3 1/2 - 12	4 3/4 - 12	3 1/2 - 12	5 - 12	4.875
5.500	5.500	1.000	—	6.250	3.938	1.875	4.375	4 - 12	5 1/4 - 12	4 - 12	5 1/2 - 12	5.375

*Studded rod end.
(4) wrench flats are an option.
Note: Rods larger than 3.50″ dia. utilize (4) 0.500″ dia. spanner holes 0.500″ deep.

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

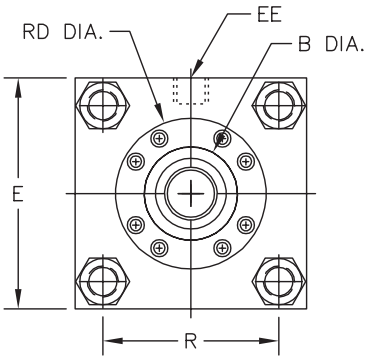
FULL SQUARE RETAINER USED ON:	
BORE	ROD DIA.
1.50	0.625
1.50	1.000
2.00	1.000
2.00	1.375
2.50	1.375
2.50	1.750
3.25	1.750
3.25	2.000
4.00	2.500
5.00	3.500

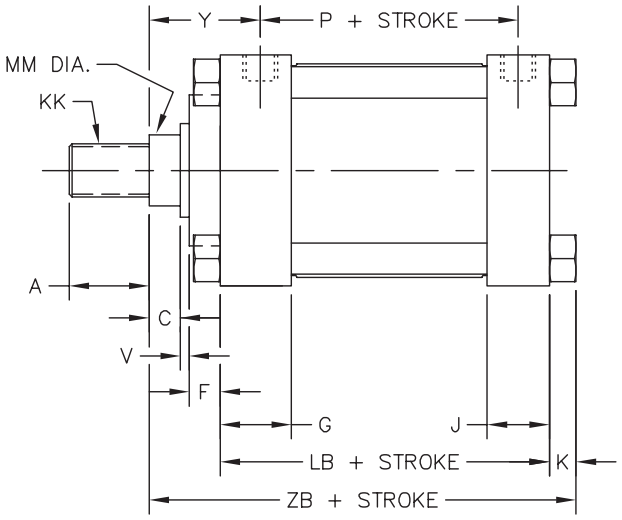




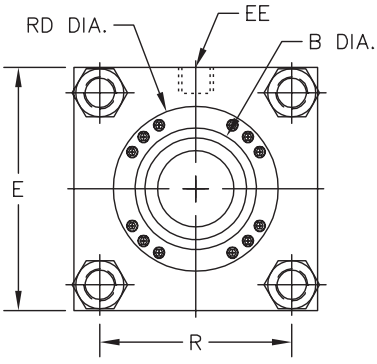
Note: Full square retainer is removable to service rod bushing

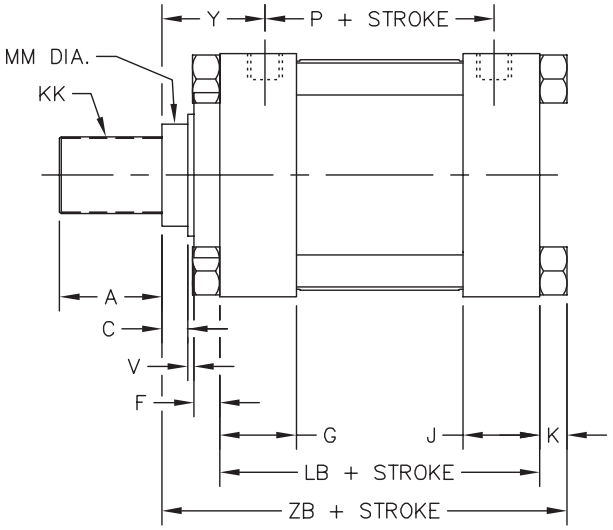
ROUND RETAINER USED ON:	
BORE	ROD DIA.
2.50	1.000
3.25	1.375
4.00	1.750
4.00	2.000
5.00	2.000
5.00	2.500
6.00	2.500





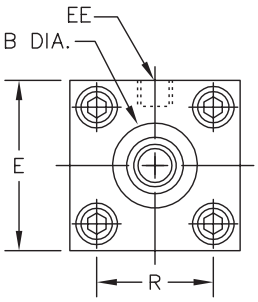
LARGE ROUND RETAINER USED ON:	
BORE	ROD DIA.
5.00	3.000
6.00	3.000
6.00	3.500
6.00	4.000
7.00	3.000
7.00	3.500
7.00	4.000
7.00	4.500
7.00	5.000
8.00	3.500
8.00	4.000
8.00	4.500
8.00	5.000
8.00	5.500

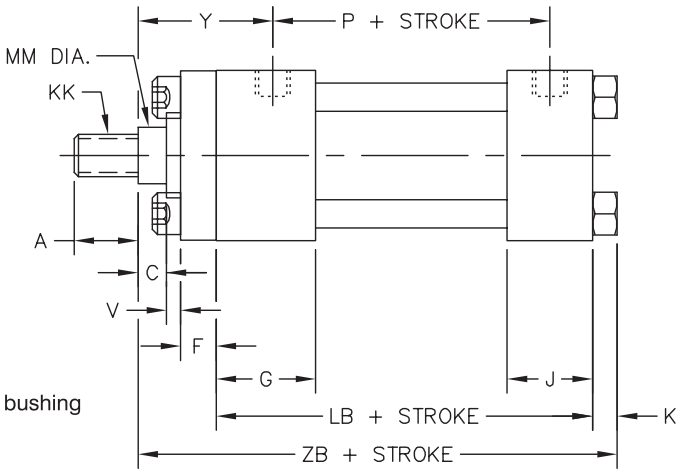




SERIES 'HH' DIMENSIONS: BASIC CYLINDER (NO MOUNT)

EASY FLIP OUT PAGE FOR REFERENCE





Note: Full square retainer is removable to service rod bushing

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	③ EE NPTF	③ EE SAE	F	G	J	K	KK	R	④ RD	V	Y	ADD TO STROKE LB	ADD TO STROKE P	ADD TO STROKE ZB
1.50	0.625	3000	2.500	0.750	1.124	0.375	1/2	10	0.375	1.750	1.500	0.375	SEE ROD END DETAIL CHART ON PAGE 8	1.625	—	0.250	2.000	4.625	2.938	6.000
	1.000			1.125	1.499	0.500									—	0.500	2.375			6.375
2.00	1.000	3000	3.000	1.125	1.499	0.500	1/2	10	0.625	1.750	1.500	0.500		2.050	—	0.250	2.375	4.625	2.938	6.500
	1.375			1.625	1.999	0.625									—	0.375	2.625			6.750
2.50	1.000	3000	3.500	1.125	1.499	0.500	1/2	10	0.625	1.750	1.500	0.500		2.550	2.625	0.250	2.375	4.750	3.063	6.625
	1.375			1.625	1.999	0.625									—	0.375	2.625			6.875
	1.750			2.000	2.374	0.750									—	0.500	2.875			7.125
3.25	1.375	3000	4.500	1.625	1.999	0.625	3/4	12	0.750	2.000	1.750	0.625		3.250	3.250	0.250	2.750	5.500	3.500	7.750
	1.750			2.000	2.374	0.750									—	0.375	3.000			8.000
	2.000			2.250	2.624	0.875									—	0.375	3.125			8.125
4.00	1.750	3000	5.000	2.000	2.374	0.750	3/4	12	0.875	2.000	1.750	0.625		3.820	3.875	0.250	2.938	5.750	3.875	8.250
	2.000			2.250	2.624	0.875									4.250	0.250	3.063			8.375
	2.500			3.000	3.124	1.000									—	0.375	3.313			8.625
5.00	2.000	3000	6.500	2.250	2.624	0.875	3/4	12	0.875	2.000	1.750	0.875		4.950	4.250	0.250	3.125	6.250	4.250	9.125
	2.500			3.000	3.124	1.000									4.625	0.375	3.375			9.375
	3.000			3.500	3.749	1.000									5.250	0.375	3.375			9.375
	3.500			3.500	4.249	1.000									—	0.375	3.375			9.375
6.00	2.500	3000	7.500	3.000	3.124	1.000	1	16	0.875	2.250	2.250	1.000		5.730	4.625	0.375	3.500	7.375	5.000	10.625
	3.000			3.500	3.749				0.875						5.250	0.375				
	3.500			3.500	4.249				0.875						5.625	0.375				
	4.000			4.000	4.749				1.000						6.438	0.250				
7.00	3.000	3000	8.500	3.500	3.749	1.000	1 1/4	20	0.875	2.750	2.750	1.125		6.580	5.250	0.375	3.750	8.500	5.750	11.875
	3.500			3.500	4.249				0.875						5.625	0.375				
	4.000			4.000	4.749				1.000						6.438	0.250				
	4.500			4.500	5.249				1.000						7.125	0.250				
	5.000			5.000	5.749				1.000						7.250	0.250				
8.00	3.500	3000	9.500	3.500	4.249	1.000	1 1/2	24	0.875	3.000	3.000	1.250		7.500	5.625	0.375	3.938	9.500	6.313	13.000
	4.000			4.000	4.749				1.000						6.438	0.250				
	4.500			4.500	5.249				1.000						7.125	0.250				
	5.000			5.000	5.749				1.000						7.625	0.250				
	5.500			5.500	6.249				1.000						8.375	0.250				

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

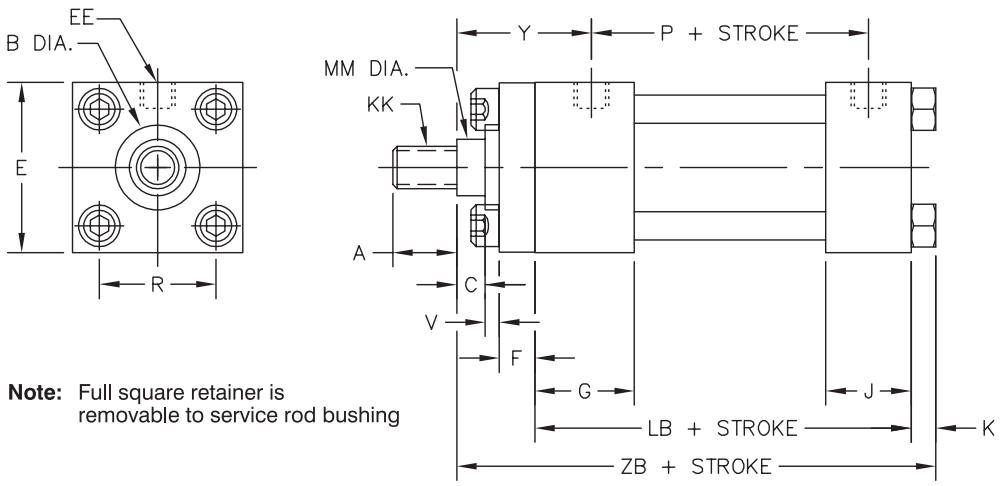
③ Standard port sizes.

④ Where no dimension is shown, cylinder utilizes a full square retainer.

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

EASY FLIP OUT PAGE FOR REFERENCE

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



Note: Full square retainer is removable to service rod bushing

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	③ EE NPTF	③ EE SAE	F	G	J	K	KK	R	④ RD	V	Y	ADD TO STROKE LB	ADD TO STROKE P	ADD TO STROKE ZB
1.50	0.625	3000	2.500	0.750	1.124	0.375	1/2	10	0.375	1.750	1.500	0.375	SEE ROD END DETAIL CHART ON PAGE 8	1.625	—	0.250	2.000	4.625	2.938	6.000
	1.000			1.125	1.499	0.500									—	0.500	2.375			6.375
2.00	1.000	3000	3.000	1.125	1.499	0.500	1/2	10	0.625	1.750	1.500	0.500		2.050	—	0.250	2.375	4.625	2.938	6.500
	1.375			1.625	1.999	0.625									—	0.375	2.625			6.750
2.50	1.000	3000	3.500	1.125	1.499	0.500	1/2	10	0.625	1.750	1.500	0.500		2.550	2.625	0.250	2.375	4.750	3.063	6.625
	1.375			1.625	1.999	0.625									—	0.375	2.625			6.875
	1.750			2.000	2.374	0.750									—	0.500	2.875			7.125
3.25	1.375	3000	4.500	1.625	1.999	0.625	3/4	12	0.750	2.000	1.750	0.625		3.250	3.250	0.250	2.750	5.500	3.500	7.750
	1.750			2.000	2.374	0.750									—	0.375	3.000			8.000
	2.000			2.250	2.624	0.875									—	0.375	3.125			8.125
4.00	1.750	3000	5.000	2.000	2.374	0.750	3/4	12	0.875	2.000	1.750	0.625		3.820	3.875	0.250	2.938	5.750	3.875	8.250
	2.000			2.250	2.624	0.875									4.250	0.250	3.063			8.375
	2.500			3.000	3.124	1.000									—	0.375	3.313			8.625
5.00	2.000	3000	6.500	2.250	2.624	0.875	3/4	12	0.875	2.000	1.750	0.875		4.950	4.250	0.250	3.125	6.250	4.250	9.125
	2.500			3.000	3.124	1.000									4.625	0.375	3.375			9.375
	3.000			3.500	3.749	1.000									5.250	0.375	3.375			9.375
	3.500			3.500	4.249	1.000									—	0.375	3.375			9.375
6.00	2.500	3000	7.500	3.000	3.124	1.000	1	16	0.875	2.250	2.250	1.000		5.730	4.625	0.375	3.500	7.375	5.000	10.625
	3.000			3.500	3.749				0.875						5.250	0.375				
	3.500			3.500	4.249				0.875						5.625	0.375				
	4.000			4.000	4.749				1.000						6.438	0.250				
7.00	3.000	3000	8.500	3.500	3.749	1.000	1 1/4	20	0.875	2.750	2.750	1.125		6.580	5.250	0.375	3.750	8.500	5.750	11.875
	3.500			3.500	4.249				0.875						5.625	0.375				
	4.000			4.000	4.749				1.000						6.438	0.250				
	4.500			4.500	5.249				1.000						7.125	0.250				
	5.000			5.000	5.749				1.000						7.250	0.250				
8.00	3.500	3000	9.500	3.500	4.249	1.000	1 1/2	24	0.875	3.000	3.000	1.250		7.500	5.625	0.375	3.938	9.500	6.313	13.000
	4.000			4.000	4.749				1.000						6.438	0.250				
	4.500			4.500	5.249				1.000						7.125	0.250				
	5.000			5.000	5.749				1.000						7.625	0.250				
	5.500			5.500	6.249				1.000						8.375	0.250				

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

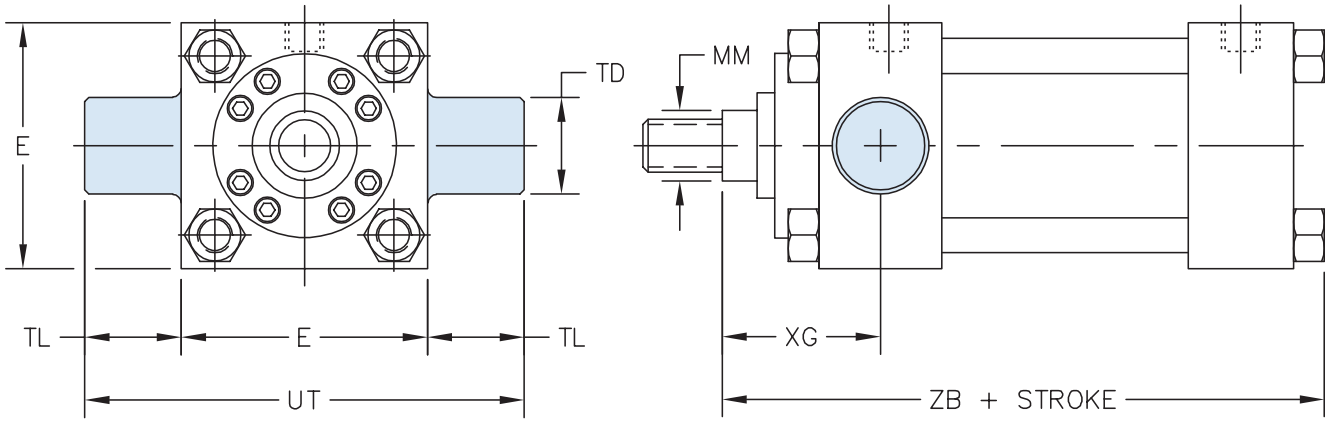
③ Standard port sizes.

④ Where no dimension is shown, cylinder utilizes a full square retainer.

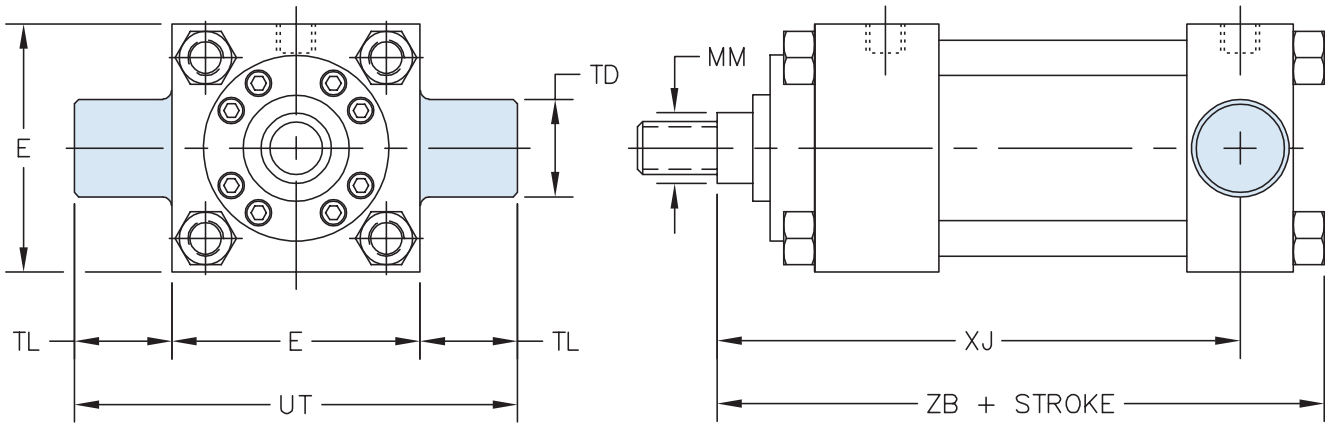
'HH' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 10)

SERIES 'HH' DIMENSIONS: TRUNNION MOUNTS

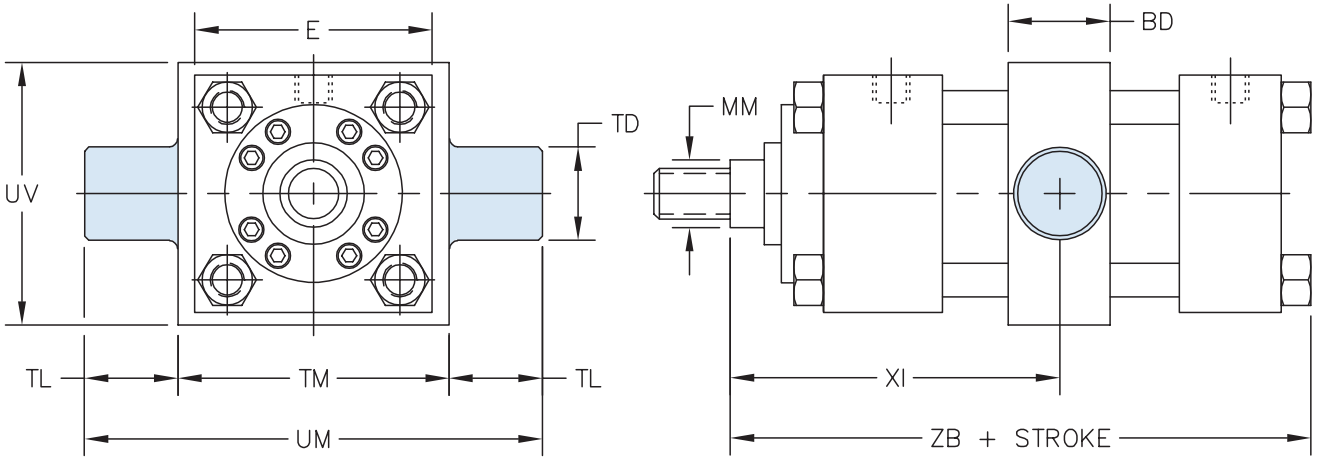
MT1: HEAD TRUNNION



MT2: CAP TRUNNION



MT4: INTERMEDIATE TRUNNION



NOTE:
'XI' DIMENSION TO BE SPECIFIED AT END OF PART NUMBER

SERIES 'HH' DIMENSIONS: TRUNNION MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING MT1 MT2	① MAX PSI RATING MT4	E	BD	② TD	TL	TM	UM	UT	UV	XG	③ MT4 XI MIN	MT4 MIN STROKE	ADD TO STROKE MT4 XI MAX	ADD TO STROKE XJ	ADD TO STROKE ZB
1.50	0.625	3000	3000	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.875	3.625	0.375	3.250	4.875	6.000
	1.000											2.250	4.000		3.625	5.250	6.375
2.00	1.000	3000	3000	3.000	1.500	1.375	1.375	3.500	6.250	5.750	3.500	2.250	4.000	0.375	3.625	5.250	6.500
	1.375											2.500	4.250		3.875	5.500	6.750
2.50	1.000	3000	3000	3.500	1.500	1.375	1.375	4.000	6.750	6.250	4.000	2.250	4.000	0.250	3.750	5.375	6.625
	1.375											2.500	4.250		4.000	5.625	6.875
	1.750											2.750	4.500		4.250	5.875	7.125
3.25	1.375	3000	3000	4.500	2.000	1.750	1.750	5.000	8.500	8.000	5.000	2.625	4.750	0.500	4.250	6.250	7.750
	1.750											2.875	5.000		4.500	6.500	8.000
	2.000											3.000	5.125		4.625	6.625	8.125
4.00	1.750	3000	3000	5.000	2.000	1.750	1.750	5.500	9.000	8.500	5.500	2.875	5.000	0.250	4.750	6.750	8.250
	2.000											3.000	5.125		4.875	6.875	8.375
	2.500											3.250	5.375		5.125	7.125	8.625
5.00	2.000	3000	3000	6.500	2.500	1.750	1.750	7.000	10.500	10.000	7.250	3.000	5.375	0.250	5.125	7.375	9.125
	2.500											3.250	5.625		5.375	7.625	9.375
	3.000											3.250	5.625		5.375	7.625	9.375
	3.500											3.250	5.625		5.375	7.625	9.375
6.00	2.500	3000	3000	7.500	3.000	2.000	2.000	8.500	12.500	11.500	8.750	3.375	6.125	0.375	5.750	8.375	10.625
	3.000																
	3.500																
	4.000																
7.00	3.000	3000	2700	8.500	3.000	2.500	2.500	9.750	14.750	13.500	10.000	3.625	6.625	0.250	6.375	9.375	11.875
	3.500																
	4.000																
	4.500																
	5.000																
8.00	3.500	3000	2500	9.500	3.500	3.000	3.000	11.000	17.000	15.500	11.750	3.750	7.125	0.250	6.875	10.250	13.000
	4.000																
	4.500																
	5.000																
	5.500																

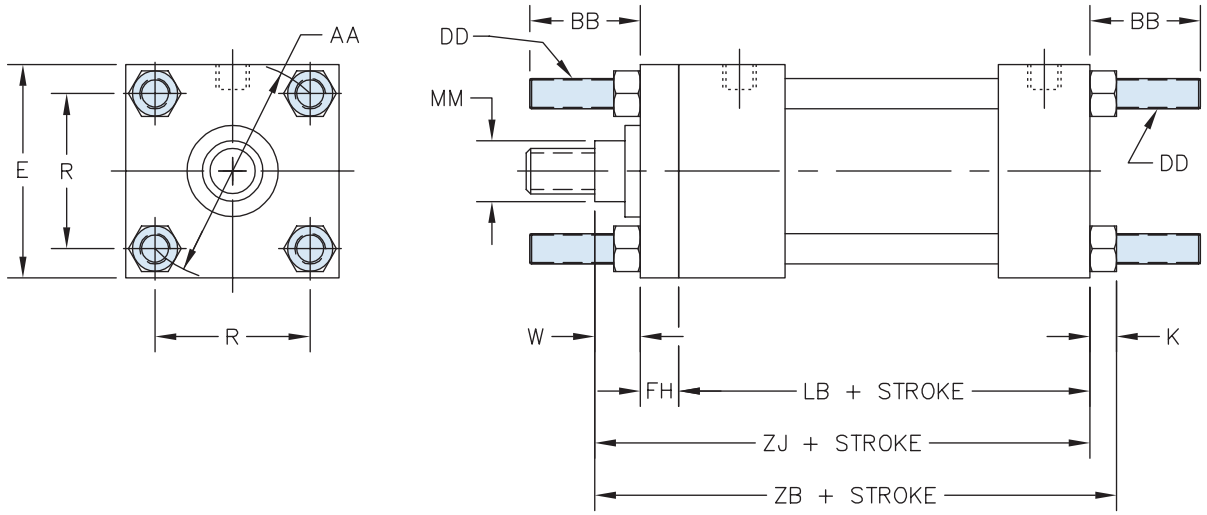
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'TD' dimension tolerance is + .000 / - .001

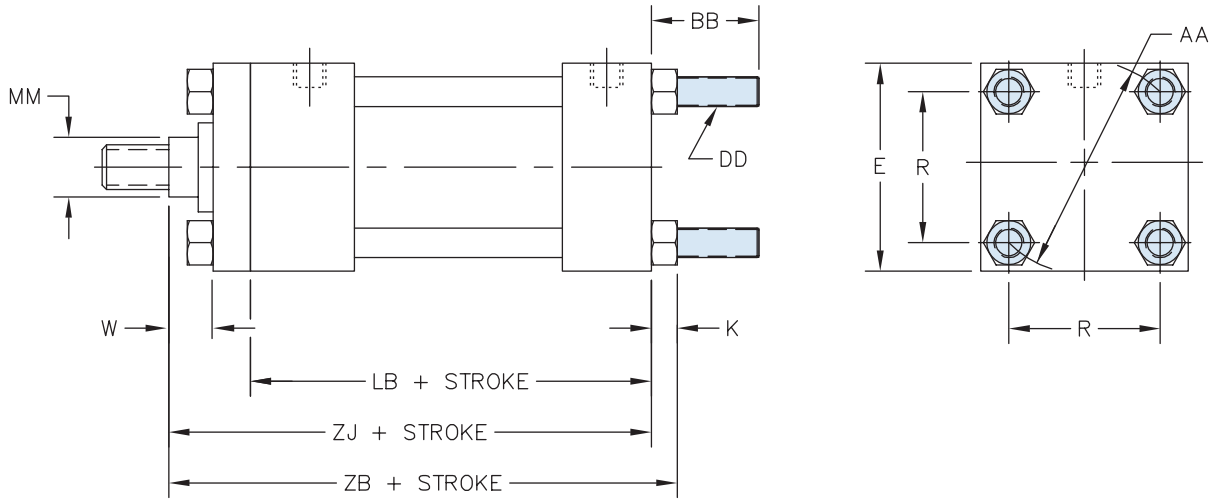
③ 'XI' dimension is the minimum that can be supplied (customer to specify 'XI' dimension).

SERIES 'HH' DIMENSIONS: EXTENDED TIE ROD MOUNTS

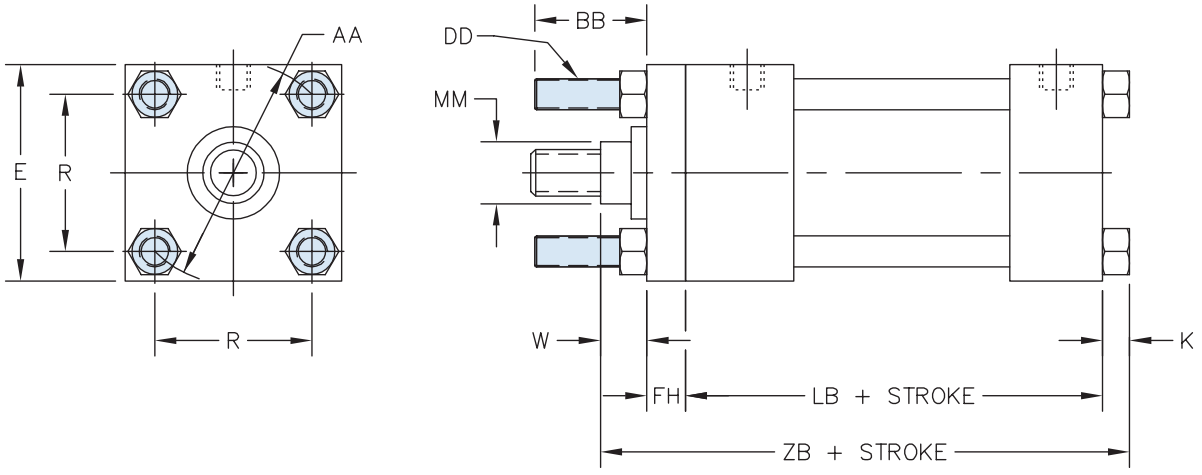
MX1: EXTENDED TIE-RODS - HEAD & CAP



MX2: EXTENDED TIE-RODS - CAP END



MX3: EXTENDED TIE-RODS - HEAD END



SERIES 'HH' DIMENSIONS: EXTENDED TIE ROD MOUNTS

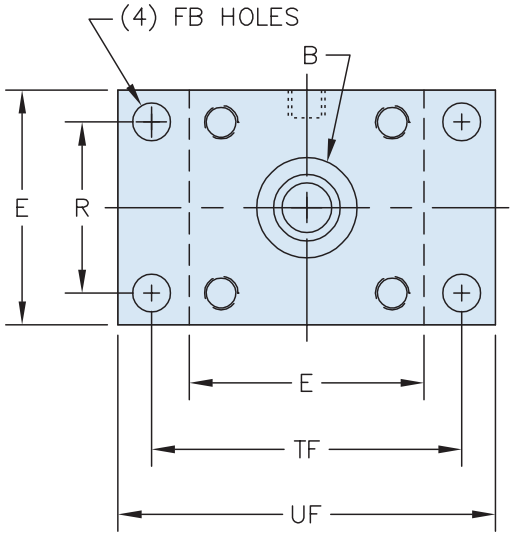
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	AA	BB	DD	FH	K	R	W	ADD TO STROKE		
											LB	ZB	ZJ
1.50	0.625	3000	2.500	2.300	1.375	3/8 - 24	0.375	0.375	1.625	0.625	4.625	6.000	5.625
	1.000									1.000		6.375	6.000
2.00	1.000	3000	3.000	2.900	1.813	1/2 - 20	0.625	0.500	2.047	0.750	4.625	6.500	6.000
	1.375									1.000		6.750	6.250
2.50	1.000	3000	3.500	3.600	1.813	1/2 - 20	0.625	0.500	2.547	0.750	4.750	6.625	6.128
	1.375									1.000		6.875	6.375
	1.750									1.250		7.125	6.625
3.25	1.375	3000	4.500	4.600	2.313	5/8 - 18	0.750	0.625	3.250	0.875	5.500	7.750	7.125
	1.750									1.125		8.000	7.375
	2.000									1.250		8.125	7.500
4.00	1.750	3000	5.000	5.400	2.313	5/8 - 18	0.875	0.625	3.813	1.000	5.750	8.250	7.625
	2.000									1.125		8.375	7.750
	2.500									1.375		8.625	8.000
5.00	2.000	3000	6.500	7.000	3.188	7/8 - 14	0.875	0.875	4.953	1.125	6.250	9.125	8.250
	2.500									1.375		9.375	8.500
	3.000									1.375		9.375	8.500
	3.500									1.375		9.375	8.500
6.00	2.500	3000	7.500	8.100	3.625	1 - 14	1.000	1.000	5.734	1.250*	7.375	10.625	9.625
	3.000									1.250*			
	3.500									1.250*			
	4.000									1.250			
7.00	3.000	3000	8.500	9.300	4.125	1 1/8 - 12	1.000	1.125	6.580	1.250*	8.500	11.875	10.750
	3.500									1.250*			
	4.000									1.250			
	4.500									1.250			
	5.000									1.250			
8.00	3.500	3000	9.500	10.600	4.500	1 1/4 - 12	1.000	1.250	7.500	1.250*	9.500	13.000	11.750
	4.000									1.250			
	4.500									1.250			
	5.000									1.250			
	5.500									1.250			

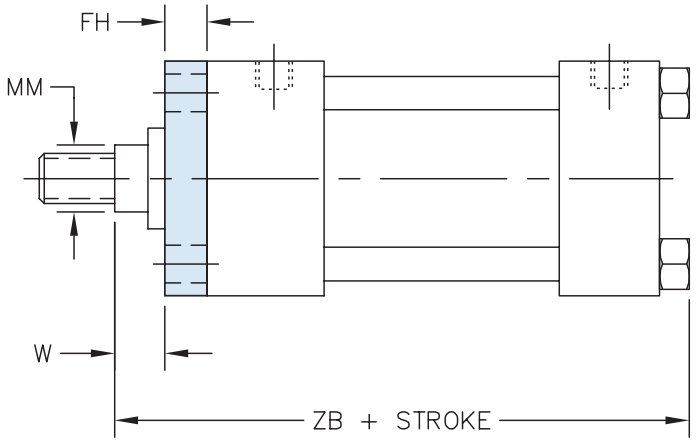
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

* On MX2 mount, dimension is 1.375" with a round retainer.

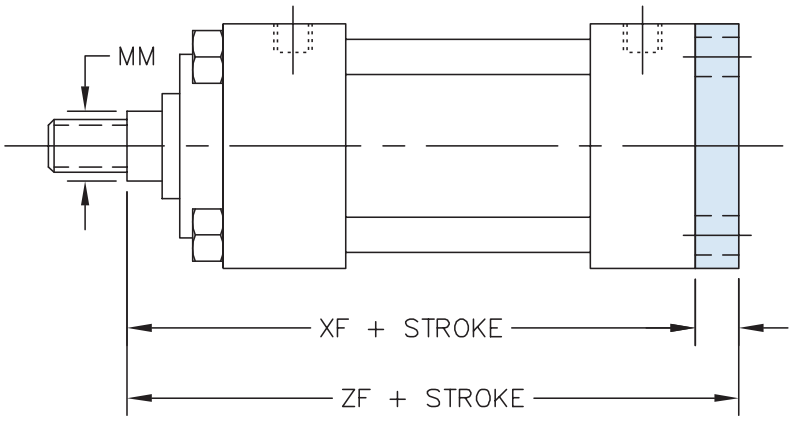
SERIES 'HH' DIMENSIONS: FLANGE MOUNTS

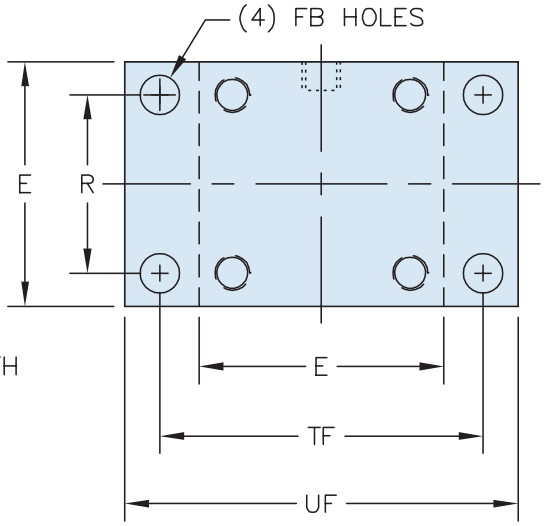
MF1: HEAD FLANGE





MF2: CAP FLANGE





SERIES 'HH' DIMENSIONS: FLANGE MOUNTS

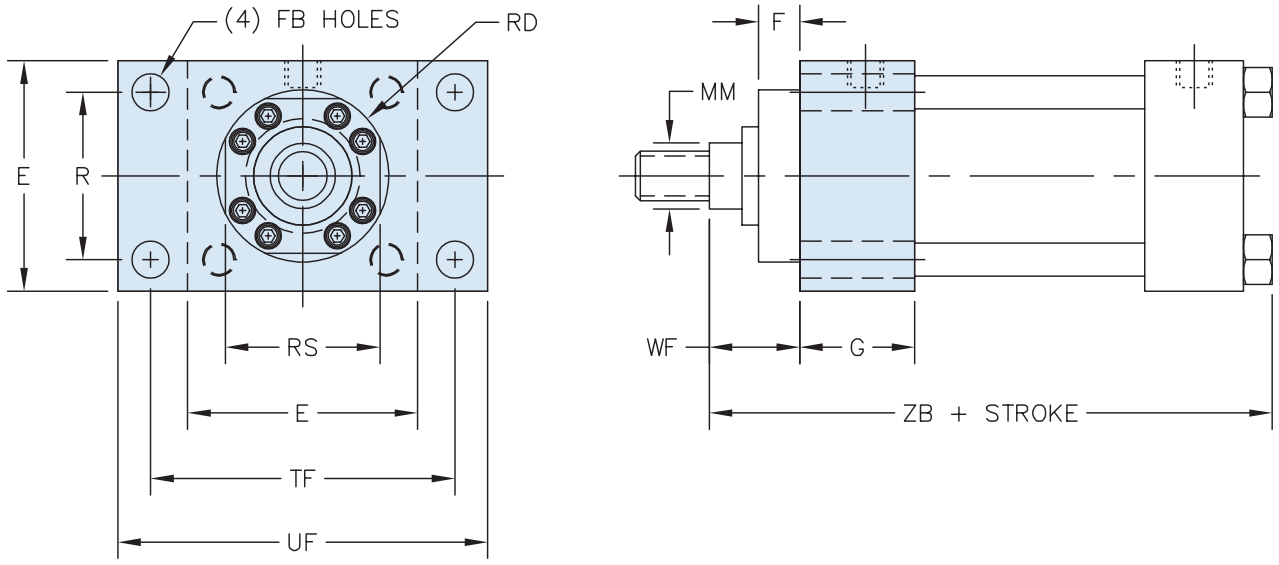
BORE	ROD DIA. (MM)	① MAX PSI RATING MF1	MF2	② B	E	FB	FH	R	RD	TF	UF	W	ADD TO STROKE XF	ZB	ZF
1.50	0.625	3000	3000	1.124	2.500	0.438	0.375	1.625	2.375	3.438	4.250	0.625	5.625	6.000	6.000
	1.000			1.499					2.563			1.000	6.000	6.375	6.375
2.00	1.000	3000	3000	1.499	3.000	0.563	0.625	2.047	2.625	4.125	5.125	0.750	6.000	6.500	6.625
	1.375			1.999					3.250			1.000	6.250	6.750	6.875
2.50	1.000	3000	3000	1.499	3.500	0.563	0.625	2.546	2.625	4.625	5.625	0.750	6.125	6.625	6.750
	1.375			1.999					3.250			1.000	6.375	6.875	7.000
	1.750			2.374					3.875			1.250	6.625	7.125	7.250
3.25	1.375	3000	3000	1.999	4.500	0.688	0.750	3.250	3.250	5.875	7.125	0.875	7.125	7.750	7.875
	1.750			2.374					3.875			1.125	7.375	8.000	8.125
	2.000			2.624					4.250			1.250	7.500	8.125	8.250
4.00	1.750	3000	3000	2.374	5.000	0.688	0.875	3.820	3.875	6.375	7.625	1.000	7.625	8.250	8.500
	2.000			2.624					4.250			1.125	7.750	8.375	8.625
	2.500			3.124					4.625			1.375	8.000	8.625	8.875
5.00	2.000	3000	3000	2.624	6.500	0.938	0.875	4.953	4.250	8.188	9.750	1.125	8.250	9.125	9.125
	2.500			3.124					4.625			1.375	8.500	9.375	9.375
	3.000			3.749					5.250			1.375	8.500	9.375	9.375
	3.500			4.249					5.625			1.375	8.500	9.375	9.375
6.00	2.500	3000	3000	3.124	7.500	1.063	1.000	5.734	4.625	9.438	11.250	1.250	9.625	10.625	10.625
	3.000			3.749					5.250						
	3.500			4.249					5.625						
	4.000			4.749					6.438						
7.00	3.000	2800	3000	3.749	8.500	1.188	1.000	6.580	5.250	10.625	12.625	1.250	10.750	11.875	11.750
	3.500	2800		4.249					5.625						
	4.000	2800		4.749					6.438						
	4.500	2600		5.249					7.125						
	5.000	2600		5.749					7.250						
8.00	3.500	2400	3000	4.249	9.500	1.313	1.000	7.500	5.625	11.813	14.000	1.250	11.750	13.000	12.750
	4.000	2200		4.749					6.438						
	4.500	2200		5.249					7.125						
	5.000	2200		5.749					7.625						
	5.500	2200		6.249					8.375						

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

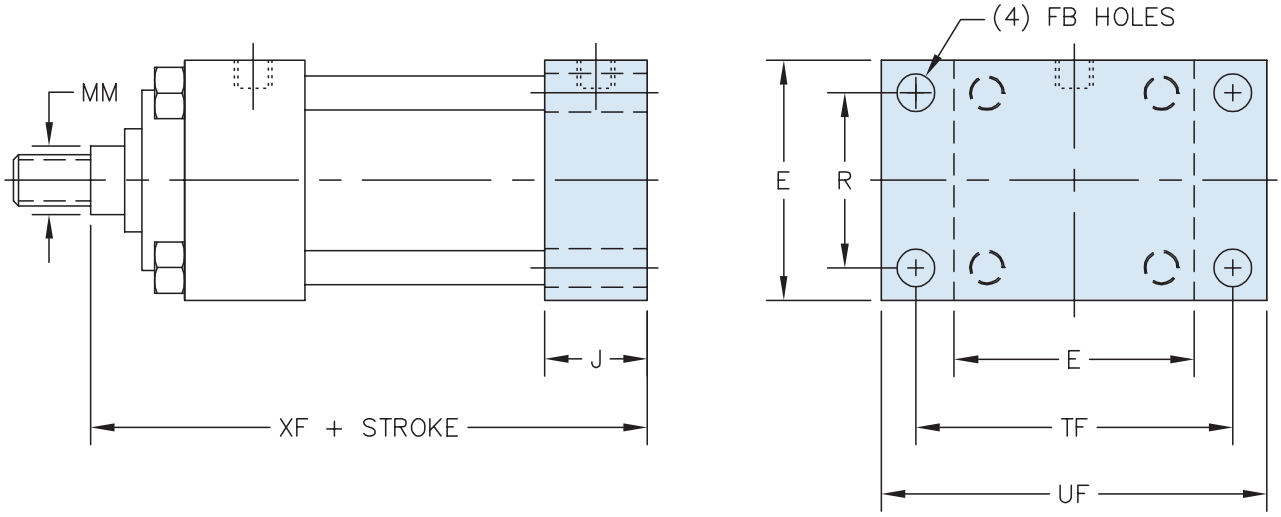
② 'B' dimension tolerance is +.000 / -.002

SERIES 'HH' DIMENSIONS: FLANGE MOUNTS

ME5: HEAD RECTANGULAR MOUNTING HOLES



ME6: CAP RECTANGULAR MOUNTING HOLES



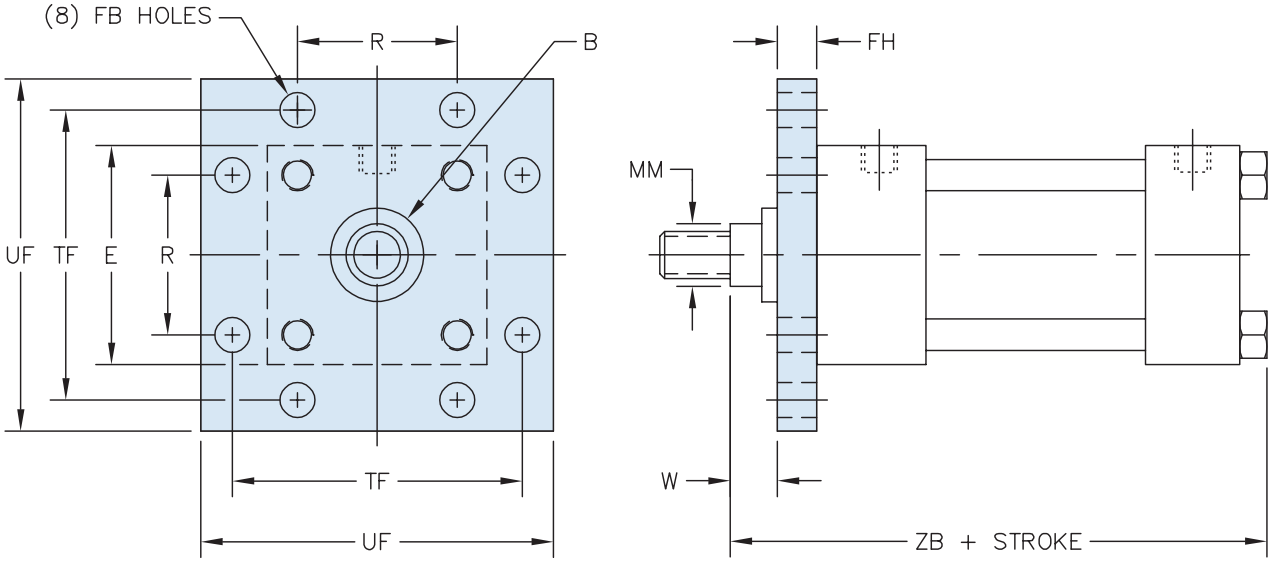
SERIES 'HH' DIMENSIONS: FLANGE MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	F	FB	G	J	R	RD	RS	TF	UF	WF	ADD TO STROKE XF	ADD TO STROKE ZB
1.50	0.625	3000	2.500	0.375	0.438	1.750	1.500	1.625	2.375	—	3.438	4.250	1.000	5.625	6.000
	1.000								2.563	2.438			1.375	6.000	6.375
2.00	1.000	3000	3.000	0.625	0.563	1.750	1.500	2.047	2.625	—	4.125	5.125	1.375	6.000	6.500
	1.375								3.250	2.943			1.625	6.250	6.750
2.50	1.000	3000	3.500	0.625	0.563	1.750	1.500	2.546	2.625	—	4.625	5.625	1.375	6.125	6.625
	1.375								3.250	—			1.625	6.375	6.875
	1.750								3.875	3.438			1.875	6.625	7.125
3.25	1.375	3000	4.500	0.750	0.688	2.000	1.750	3.250	3.250	—	5.875	7.125	1.625	7.125	7.750
	1.750			0.875					3.875				1.875	7.375	8.000
	2.000			0.875					4.250				2.000	7.500	8.125
4.00	1.750	3000	5.000	0.875	0.688	2.000	1.750	3.820	3.875	—	6.375	7.625	1.875	7.625	8.250
	2.000								4.250				2.000	7.750	8.375
	2.500								4.625				2.250	8.000	8.625
5.00	2.000	3000	6.500	0.875	0.938	2.000	1.750	4.953	4.250	—	8.188	9.750	2.000	8.250	9.125
	2.500								4.625				2.250	8.500	9.375
	3.000								5.250				2.250	8.500	9.375
	3.500								5.625				2.250	8.500	9.375
6.00	2.500	3000	7.500	0.875	1.063	2.250	2.250	5.734	4.625	—	9.438	11.250	2.250	9.625	10.625
	3.000			0.875					5.250						
	3.500			0.875					5.625						
	4.000			1.000					6.438						
7.00	3.000	3000	8.50	0.875	1.188	2.750	2.750	6.580	5.250	—	10.625	12.625	2.250	10.750	11.875
	3.500			0.875					5.625						
	4.000			1.000					6.438						
	4.500			1.000					7.125						
	5.000			1.000					7.250						
8.00	3.500	3000	9.500	0.875	1.313	3.000	3.000	7.500	5.625	—	11.813	14.000	2.250	11.750	13.000
	4.000			1.000					6.438						
	4.500			1.000					7.125						
	5.000			1.000					7.625						
	5.500			1.000					8.375						

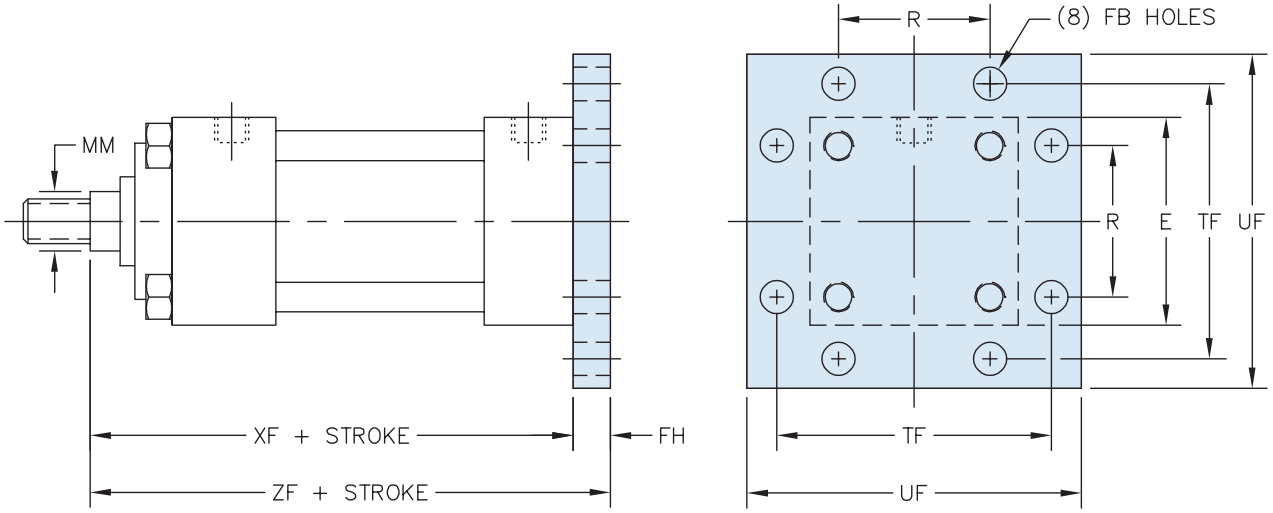
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: SQUARE FLANGE MOUNTS

MF5: HEAD SQUARE FLANGE



MF6: CAP SQUARE FLANGE



SERIES 'HH' DIMENSIONS: SQUARE FLANGE MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	② B	E	FB	FH	R	③ RD	TF	UF	W	ADD TO STROKE XF	ZB	ZF
1.50	0.625	3000	1.124	2.500	0.438	0.375	1.625	—	3.438	4.250	0.625	5.625	6.000	6.000
	1.000		1.499					—			1.000	6.000	6.375	6.375
2.00	1.000	3000	1.499	3.000	0.563	0.625	2.047	—	4.125	5.125	0.750	6.000	6.500	6.625
	1.375		1.999					—			1.000	6.250	6.750	6.875
2.50	1.000	3000	1.499	3.500	0.563	0.625	2.547	2.625	4.625	5.625	0.750	6.125	6.625	6.750
	1.375		1.999					—			1.000	6.375	6.875	7.000
	1.750		2.374					—			1.250	6.625	7.125	7.250
3.25	1.375	3000	1.999	4.500	0.688	0.750	3.250	3.250	5.875	7.125	0.875	7.125	7.750	7.875
	1.750		2.374					—			1.125	7.375	8.000	8.125
	2.000		2.624					—			1.250	7.500	8.125	8.250
4.00	1.750	3000	2.374	5.000	0.688	0.875	3.820	3.875	6.375	7.625	1.000	7.625	8.250	8.500
	2.000		2.624					4.250			1.125	7.750	8.375	8.625
	2.500		3.124					—			1.375	8.000	8.625	8.875
5.00	2.000	3000	2.624	6.500	0.938	0.875	4.953	4.250	8.188	9.750	1.125	8.250	9.125	9.125
	2.500		3.124					4.625			1.375	8.500	9.375	9.375
	3.000		3.749					5.250			1.375	8.500	9.375	9.375
	3.500		4.249					—			1.375	8.500	9.375	9.375
6.00	2.500	3000	3.124	7.500	1.063	1.000	5.734	4.625	9.438	11.250	1.250	9.625	10.625	10.625
	3.000		3.749					5.250						
	3.500		4.249					5.625						
	4.000		4.749					6.438						
7.00	3.000	3000	3.749	8.500	1.188	1.000	6.580	5.250	10.625	12.625	1.250	10.750	11.875	11.750
	3.500		4.249					5.625						
	4.000		4.749					6.438						
	4.500		5.249					7.125						
	5.000		5.749					7.250						
8.00	3.500	3000	4.249	9.500	1.313	1.000	7.500	5.625	11.813	14.000	1.250	11.750	13.000	12.750
	4.000		4.749					6.438						
	4.500		5.249					7.125						
	5.000		5.749					7.625						
	5.500		6.249					8.375						

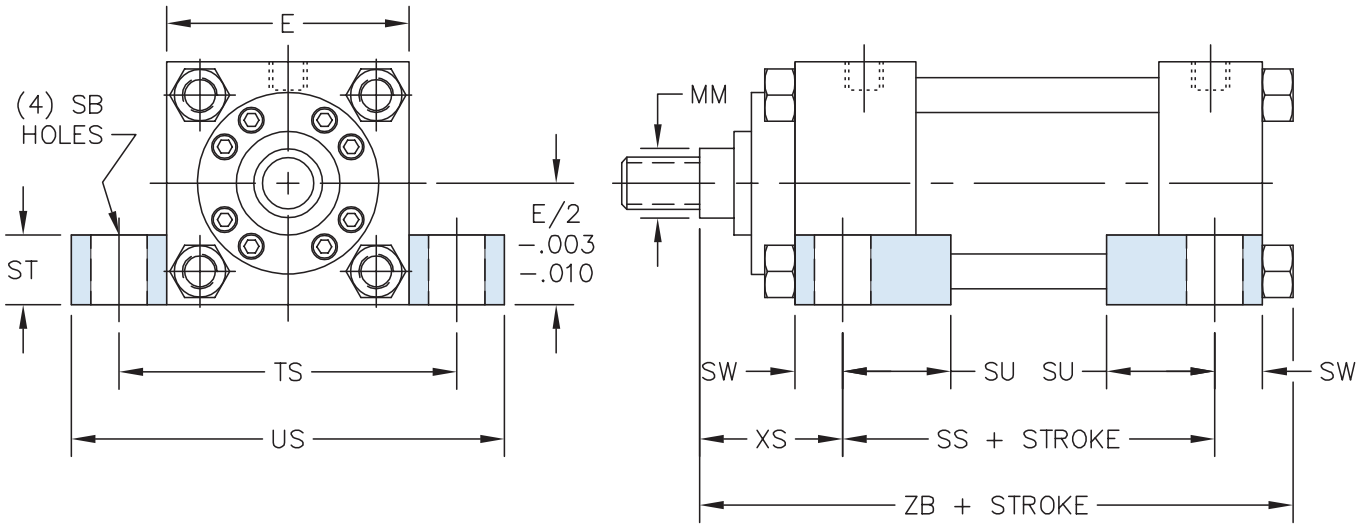
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

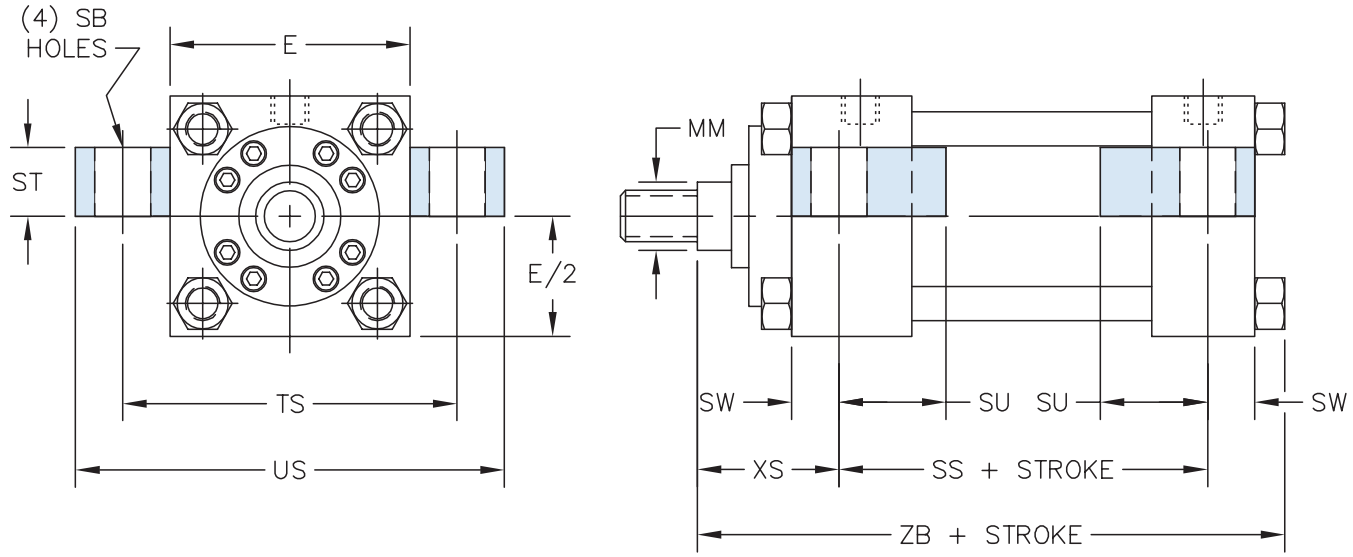
③ Where no dimension is shown, cylinder utilizes a full square retainer.

SERIES 'HH' DIMENSIONS: LUG MOUNTS

MS2: SIDE LUGS



MS3: CENTER LINE LUGS



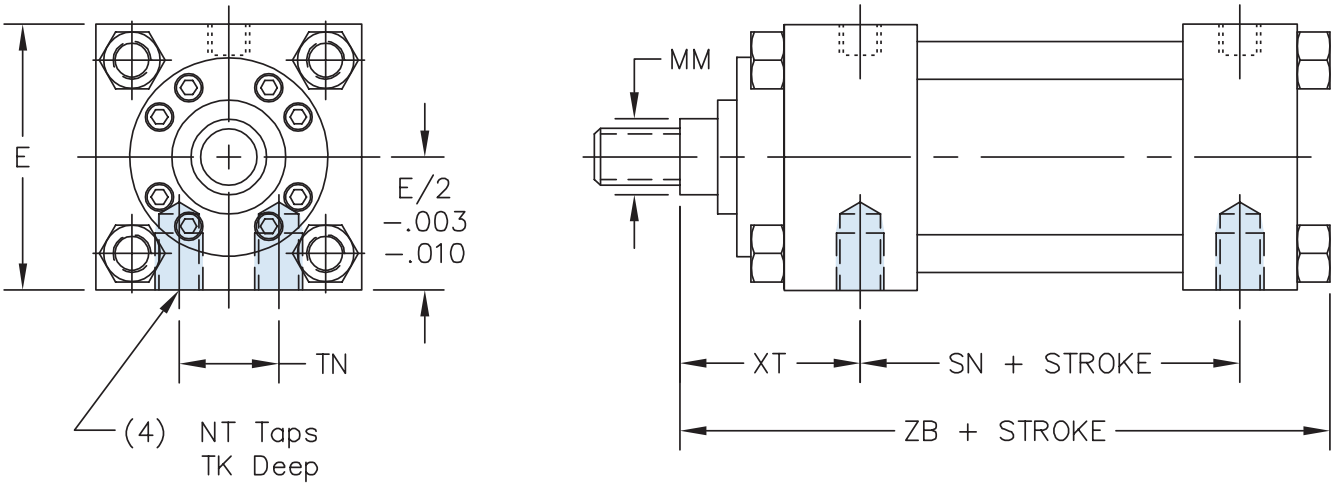
SERIES 'HH' DIMENSIONS: LUG MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	E / 2	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE	
												SS	ZB
1.50	0.625	3000	2.500	1.250	0.438	0.500	0.938	0.375	3.250	4.000	1.375	3.875	6.000
	1.000										1.750		6.375
2.00	1.000	3000	3.000	1.500	0.563	0.750	1.250	0.500	4.000	5.000	1.875	3.625	6.500
	1.375										2.125		6.750
2.50	1.000	3000	3.500	1.750	0.813	1.000	1.563	0.688	4.875	6.250	2.063	3.375	6.625
	1.375										2.313		6.875
	1.750										2.563		7.125
3.25	1.375	3000	4.500	2.250	0.813	1.000	1.563	0.688	5.875	7.250	2.313	4.125	7.750
	1.750										2.563		8.000
	2.000										2.688		8.125
4.00	1.750	3000	5.000	2.500	1.063	1.250	2.000	0.875	6.750	8.500	2.750	4.000	8.250
	2.000										2.875		8.375
	2.500										3.125		8.625
5.00	2.000	3000	6.500	3.250	1.063	1.250	2.000	0.875	8.250	10.000	2.875	4.500	9.125
	2.500										3.125		9.375
	3.000										3.125		9.375
	3.500										3.125		9.375
6.00	2.500	3000	7.500	3.750	1.313	1.500	2.500	1.125	9.750	12.000	3.375	5.125	10.625
	3.000												
	3.500												
	4.000												
7.00	3.000	3000	8.500	4.250	1.563	1.750	2.875	1.375	11.250	14.000	3.625	5.750	11.875
	3.500												
	4.000												
	4.500												
	5.000												
8.00	3.500	3000	9.500	4.750	1.563	1.750	2.875	1.375	12.250	15.000	3.625	6.750	13.000
	4.000												
	4.500												
	5.000												
	5.500												

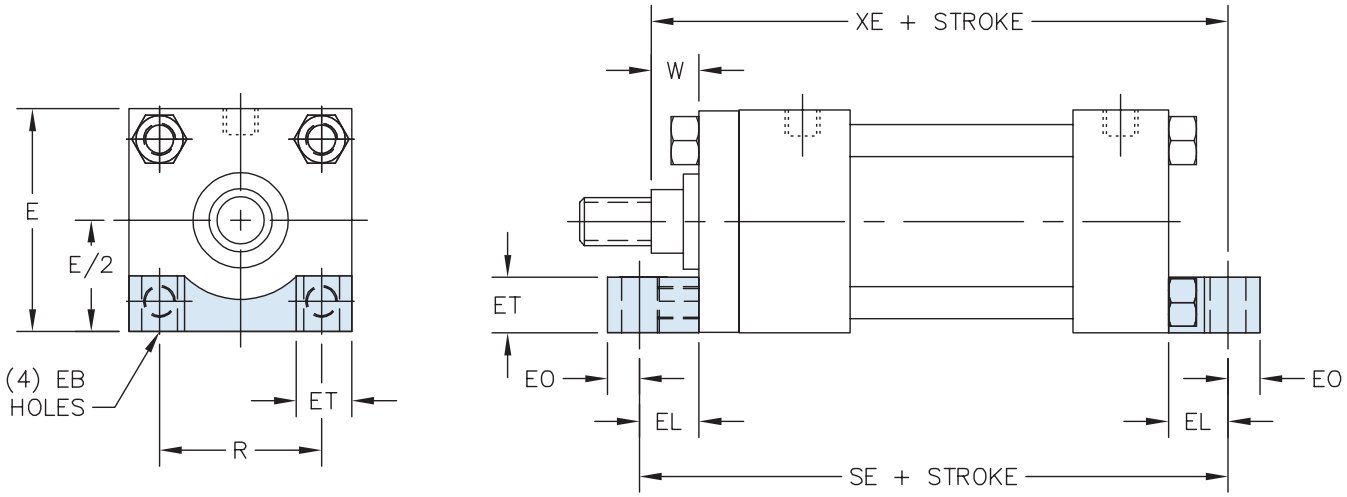
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: BOTTOM MOUNTS

MS4: BOTTOM TAPPED HOLES



MS7: END LUGS (1.50" - 6.00" BORES)



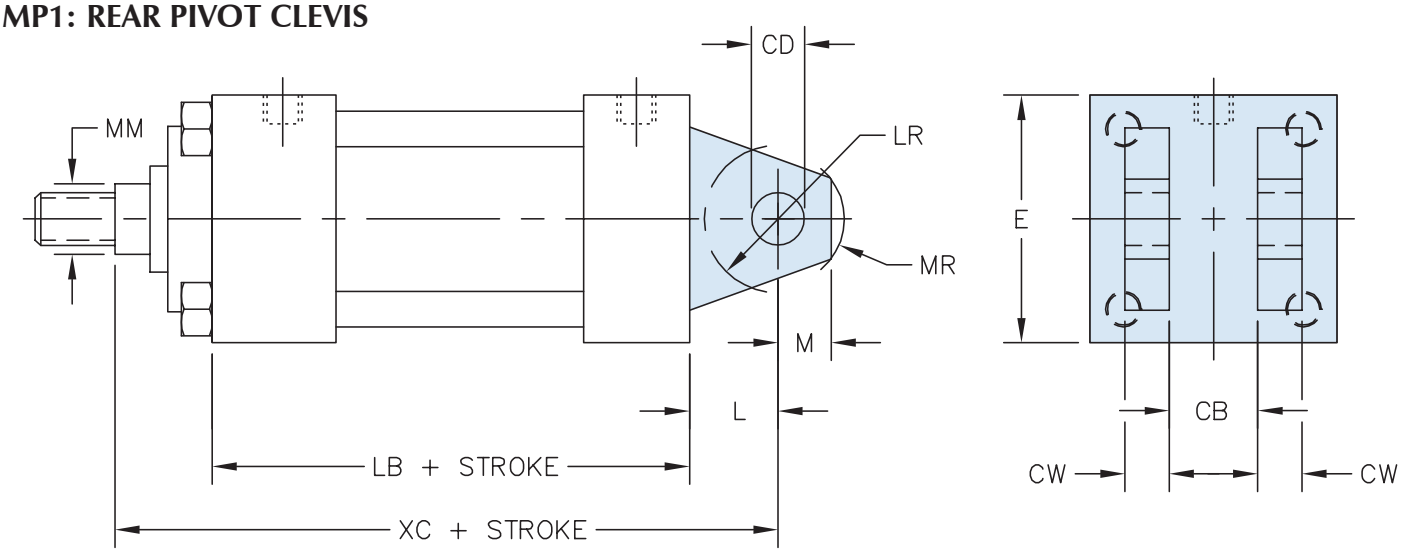
SERIES 'HH' DIMENSIONS: BOTTOM MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	E / 2	MS4 DIMENSIONS						MS7 DIMENSIONS							
					NT	TK	TN	XT	ADD TO STROKE SN	ADD TO STROKE ZB	EB	EL	EO	ET	R	W	ADD TO STROKE SE	ADD TO STROKE XE
1.50	0.625	3000	2.500	1.250	3/8-16	0.375	0.750	2.000	2.875	6.000	0.438	0.875	0.375	0.750	1.625	0.625	6.750	6.500
	1.000							2.375		6.375						1.000		6.875
2.00	1.000	3000	3.000	1.500	1/2-13	0.438	0.938	2.375	2.875	6.500	0.563	0.938	0.500	0.875	2.047	0.750	7.125	6.938
	1.375							2.625		6.750						1.000		7.188
2.50	1.000	3000	3.500	1.750	5/8-11	0.750	1.313	2.375	3.000	6.625	0.563	0.938	0.500	0.875	2.550	0.750	7.250	7.063
	1.375					0.625		2.625		6.875						1.000		7.313
	1.750					0.500		2.875		7.125						1.250		7.563
3.25	1.375	3000	4.500	2.250	3/4-10	1.000	1.500	2.750	3.500	7.750	0.688	1.125	0.625	1.188	3.250	0.875	8.500	8.250
	1.750					0.875		3.000		8.000						1.125		8.500
	2.000					0.750		3.125		8.125						1.250		8.625
4.00	1.750	3000	5.000	2.500	1 - 8	0.875	2.063	3.000	3.750	8.250	0.688	1.125	0.625	1.188	3.820	1.000	8.875	8.750
	2.000					0.750		3.125		8.375						1.125		8.875
	2.500					0.750		3.375		8.625						1.375		9.125
5.00	2.000	3000	6.500	3.250	1 - 8	1.000	2.938	3.125	4.250	9.125	0.938	1.500	0.750	1.500	4.953	1.125	10.125	9.750
	2.500							3.375		9.375						1.375		10.000
	3.000							3.375		9.375						1.375		10.000
	3.500							3.375		9.375						1.375		10.000
6.00	2.500	3000	7.500	3.750	1 1/4-7	1.250	3.313	3.500	5.125	10.625	1.063	1.688	0.875	1.750	5.734	1.250	11.750	11.313
	3.000					1.250												
	3.500					1.250												
	4.000					0.750												
7.00	3.000	3000	8.500	4.250	1 1/2-6	1.125	3.750	3.813	5.875	11.875	—	—	—	—	—	—	—	—
	3.500					1.125												
	4.000					1.125												
	4.500					1.125												
	5.000					0.875												
8.00	3.500	3000	9.500	4.750	1 1/2-6	1.500	4.250	3.938	6.625	13.000	—	—	—	—	—	—	—	—
	4.000					1.500												
	4.500					1.500												
	5.000					1.250												
	5.500					1.000												

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: PIVOT MOUNT

MP1: REAR PIVOT CLEVIS



NOTE: PIVOT PIN INCLUDED WITH CYLINDER

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	② CB	③ CD	CW	L	LR	M	MR	ADD TO STROKE	
											LB	XC
1.50	0.625	3000	2.500	0.750	0.500	0.500	0.750	0.563	0.500	0.625	4.625	6.375
	1.000											6.750
2.00	1.000	3000	3.000	1.250	0.750	0.625	1.250	1.000	0.750	0.938	4.625	7.250
	1.375											7.500
2.50	1.000	3000	3.500	1.250	0.750	0.625	1.250	1.000	0.750	0.938	4.750	7.375
	1.375											7.625
	1.750											7.875
3.25	1.375	3000	4.500	1.500	1.000	0.750	1.500	1.250	1.000	1.188	5.500	8.625
	1.750											8.875
	2.000											9.000
4.00	1.750	3000	5.000	2.000	1.375	1.000	2.125	1.875	1.375	1.625	5.750	9.750
	2.000											9.875
	2.500											10.125
5.00	2.000	3000	6.500	2.500	1.750	1.250	2.250	2.000	1.750	2.125	6.250	10.500
	2.500											10.750
	3.000											10.750
	3.500											10.750
6.00	2.500	3000	7.500	2.500	2.000	1.250	2.500	2.188	2.000	2.375	7.375	12.125
	3.000											
	3.500											
	4.000											
7.00	3.000	3000	8.500	3.000	2.500	1.500	3.000	2.688	2.500	2.875	8.500	13.750
	3.500											
	4.000											
	4.500											
	5.000											
8.00	3.500	3000	9.500	3.000	3.000	1.500	3.250	2.938	2.750	3.125	9.500	15.000
	4.000											
	4.500											
	5.000											
	5.500											

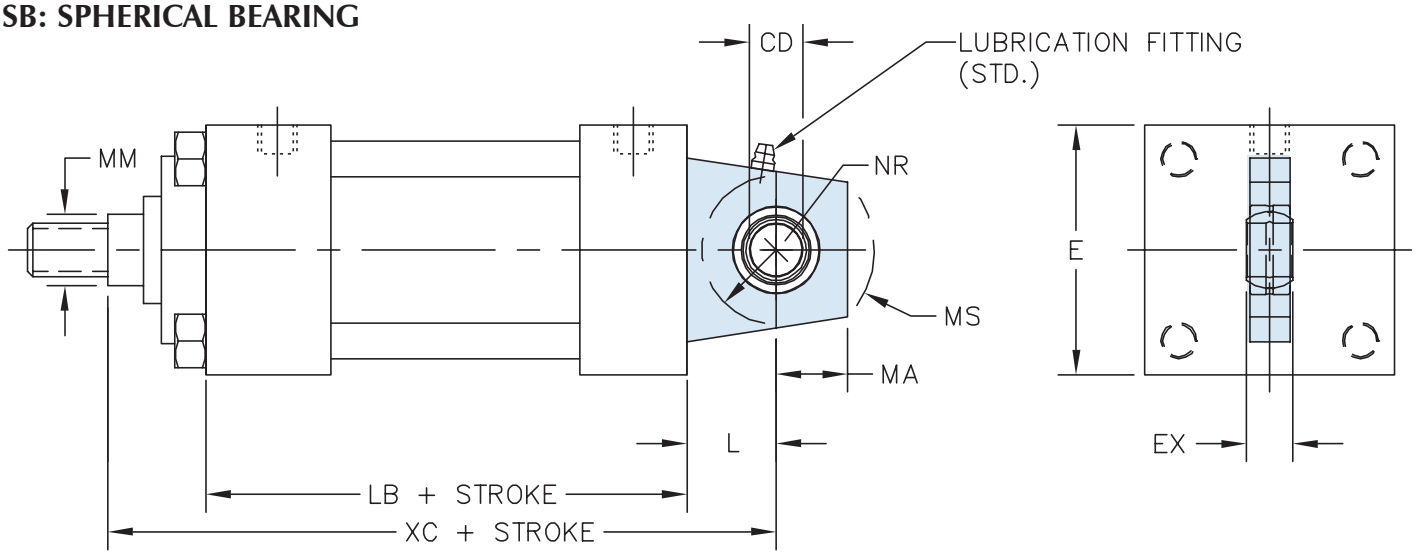
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'CB' dimension tolerance is +.010 to +.030 depending on bore size.

③ 'CD' dimension tolerance for pin is ±.001.

SERIES 'HH' DIMENSIONS: SB MOUNT

SB: SPHERICAL BEARING



NOTE: PIVOT PIN INCLUDED WITH CYLINDER CAP END ONLY

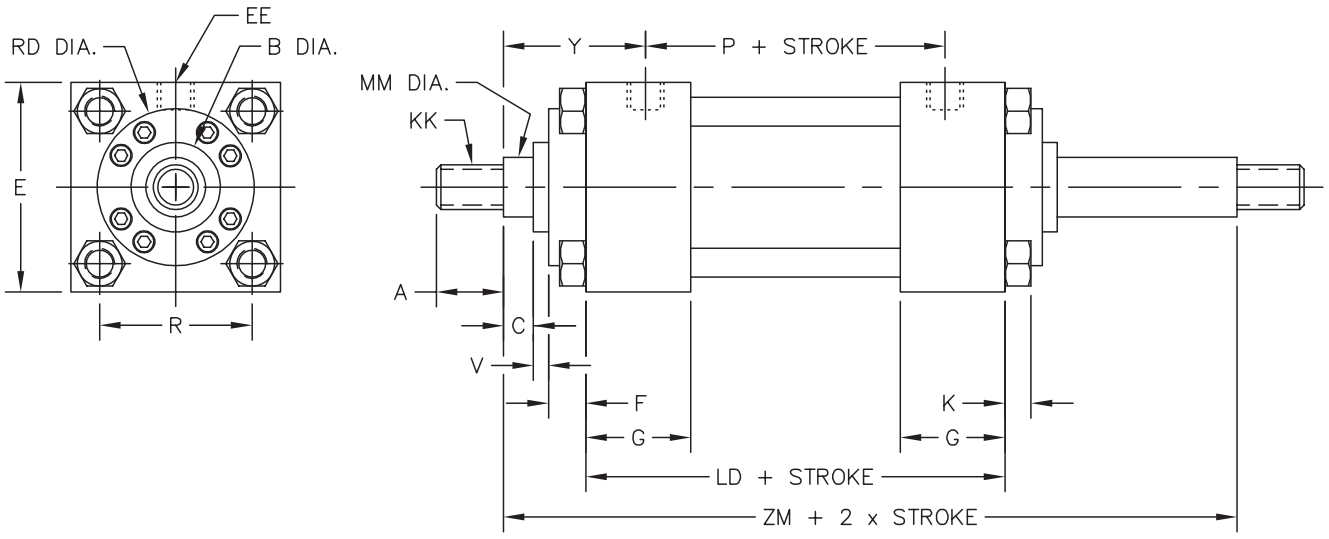
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	② CD	EX	L	NR	MA	MS	ADD TO STROKE	
										LB	XC
1.50	0.625	1650	2.500	0.500	0.437	0.750	0.625	0.750	0.938	4.625	6.375
	1.000	1650									6.750
2.00	1.000	2200	3.000	0.750	0.656	1.250	1.000	1.000	1.375	4.625	7.250
	1.375	2200									7.500
2.50	1.000	1400	3.500	0.750	0.656	1.250	1.000	1.000	1.375	4.750	7.375
	1.375	1400									7.625
	1.750	1400									7.875
3.25	1.375	1500	4.500	1.000	0.875	1.500	1.250	1.250	1.688	5.500	8.625
	1.750	1500									8.875
	2.000	1500									9.000
4.00	1.750	1750	5.000	1.375	1.188	2.125	1.625	1.875	2.438	5.750	9.750
	2.000	1750									9.875
	2.500	1750									10.125
5.00	2.000	1900	6.500	1.750	1.531	2.250	2.063	2.500	2.875	6.250	10.500
	2.500	1900									10.750
	3.000	1900									10.750
	3.500	1900									10.750
6.00	2.500	1700	7.500	2.000	1.750	2.500	2.375	2.500	3.313	7.375	12.125
	3.000	1700									12.125
	3.500	1700									12.125
	4.000	1700									12.125

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'CD' dimension tolerance for pin is -.0005 / -.001.

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MX0D: NO MOUNT



BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	EE NPTF	EE SAE	F	G	K	KK	R	③ RD	V	Y	ADD TO STROKE LD	ADD TO STROKE P	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	0.750	1.124	0.375	1/2	10	0.375	1.750	0.375	SEE ROD END DETAIL CHART ON PAGE 8	1.625	—	0.250	2.000	4.875	2.875	6.875
	1.000			1.125	1.499	0.500		8						—	0.500	2.375			7.625
2.00	1.000	3000	3.000	1.125	1.499	0.500	1/2	10	0.625	1.750	0.500		2.047	—	0.250	2.375	4.875	2.875	7.625
	1.375			1.625	1.999	0.625		8						—	0.375	2.625			8.125
2.50	1.000	3000	3.500	1.125	1.499	0.500	1/2	10	0.625	1.750	0.500		2.547	2.625	0.250	2.375	5.000	3.000	7.750
	1.375			1.625	1.999	0.625								—	0.375	2.625			8.250
	1.750			2.000	2.374	0.750								—	0.500	2.875			8.750
3.25	1.375	3000	4.500	1.625	1.999	0.625	3/4	12	0.750	2.000	0.625		3.250	3.250	0.250	2.750	5.750	3.500	9.000
	1.750			2.000	2.374	0.750								—	0.375	3.000			9.500
	2.000			2.250	2.624	0.875								—	0.375	3.125			9.750
4.00	1.750	3000	5.000	2.000	2.374	0.750	3/4	12	0.875	2.000	0.625		3.820	3.875	0.250	2.938	6.000	3.875	9.750
	2.000			2.250	2.624	0.875								4.250	0.250	3.063			10.000
	2.500			3.000	3.124	1.000								—	0.375	3.313			10.500
5.00	2.000	3000	6.500	2.250	2.624	0.875	3/4	12	0.875	2.000	0.875		4.953	4.250	0.250	3.125	6.500	4.250	10.500
	2.500			3.000	3.124	1.000								4.625	0.375	3.375			11.000
	3.000			3.500	3.749	1.000								5.250	0.375	3.375			11.000
	3.500			3.500	4.249	1.000								—	0.375	3.375			11.000
6.00	2.500	3000	7.500	3.000	3.124	1.000	1	16	0.875	2.250	1.000		5.734	4.625	0.375	3.500	7.375	4.875	11.875
	3.000			3.500	3.749				0.875					5.250	0.375				
	3.500			3.500	4.249				0.875					5.625	0.375				
	4.000			4.000	4.749				1.000					6.438	0.250				
7.00	3.000	3000	8.500	3.500	3.749	1.000	1	20	0.875	2.750	1.125		6.580	5.250	0.375	3.750	8.500	5.500	13.000
	3.500			3.500	4.249				0.875					5.625	0.375				
	4.000			4.000	4.749				1.000					6.438	0.250				
	4.500			4.500	5.249				1.000					7.125	0.250				
	5.000			5.000	5.749				1.000					7.250	0.250				
8.00	3.500	3000	9.500	3.500	4.249	1.000	1 1/2	24	0.875	3.000	1.250		7.500	5.625	0.375	3.938	9.500	6.125	14.000
	4.000			4.000	4.749				1.000					6.438	0.250				
	4.500			4.500	5.249				1.000					7.125	0.250				
	5.000			5.000	5.749				1.000					7.625	0.250				
	5.500			5.500	6.249				1.000					8.375	0.250				

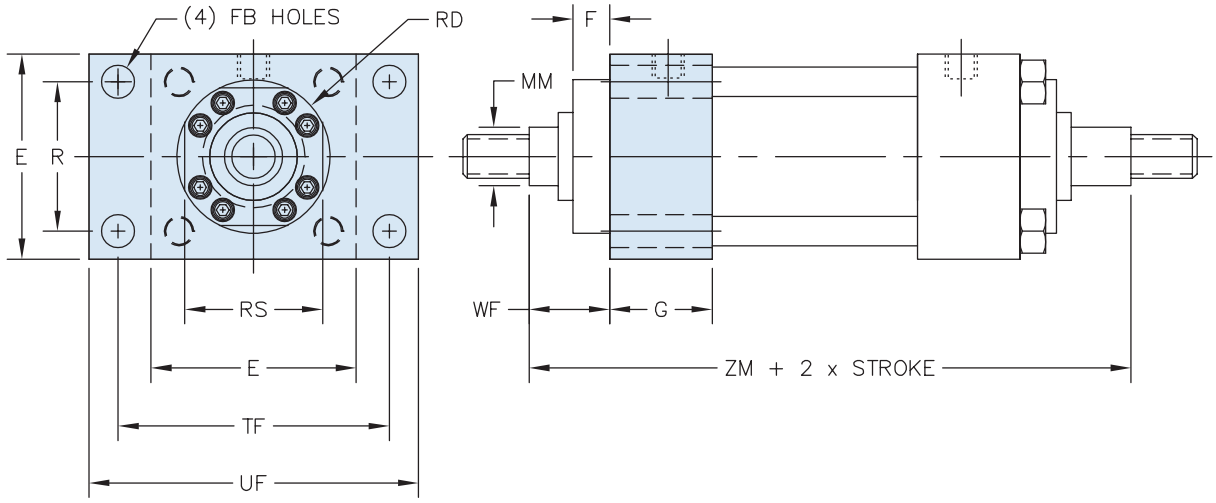
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

③ Where no dimension is shown, cylinder utilizes a full square retainer.

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

ME5D: HEAD RECTANGULAR MOUNTING HOLES

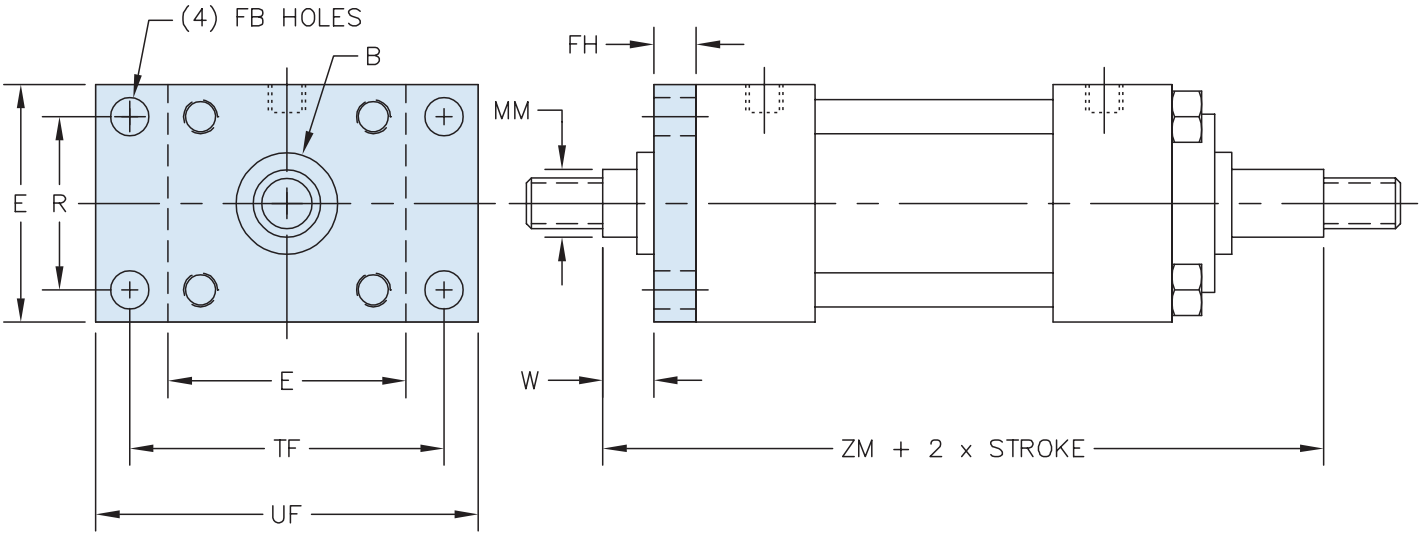


BORE	ROD DIA. (MM)	① MAX PSI RATING	E	F	FB	G	R	RD	RS	TF	UF	WF	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	0.375	0.438	1.750	1.625	2.375	—	3.438	4.250	1.000	6.875
	1.000							2.563	2.438			1.375	7.625
2.00	1.000	3000	3.000	0.625	0.563	1.750	2.047	2.625	—	4.125	5.125	1.375	7.625
	1.375							3.250	2.938			1.625	8.125
2.50	1.000	3000	3.500	0.625	0.563	1.750	2.547	2.625	—	4.625	5.625	1.375	7.750
	1.375							3.250	—			1.625	8.250
	1.750							3.875	3.438			1.875	8.750
3.25	1.375	3000	4.500	0.750	0.688	2.000	3.250	3.250	—	5.875	7.125	1.625	9.000
	1.750			0.875				3.875				1.875	9.500
	2.000			0.875				4.250				2.000	9.750
4.00	1.750	3000	5.000	0.875	0.688	2.000	3.820	3.875	—	6.375	7.625	1.875	9.750
	2.000							4.250				2.000	10.000
	2.500							4.625				2.250	10.500
5.00	2.000	3000	6.500	0.875	0.938	2.000	4.953	4.250	—	8.188	9.750	2.000	10.500
	2.500							4.625				2.250	11.000
	3.000							5.250				2.250	11.000
	3.500							5.625				2.250	11.000
6.00	2.500	3000	7.500	0.875	1.063	2.250	5.725	4.625	—	9.438	11.250	2.250	11.875
	3.000			0.875				5.250					
	3.500			0.875				5.625					
	4.000			1.000				6.438					
7.00	3.000	3000	8.500	0.875	1.188	2.750	6.580	5.250	—	10.625	12.625	2.250	13.000
	3.500			0.875				5.625					
	4.000			1.000				6.438					
	4.500			1.000				7.125					
	5.000			1.000				7.250					
8.00	3.500	3000	9.500	0.875	1.313	3.000	7.500	5.625	—	11.813	14.000	2.250	14.000
	4.000			1.000				6.438					
	4.500			1.000				7.125					
	5.000			1.000				7.625					
	5.500			1.000				8.375					

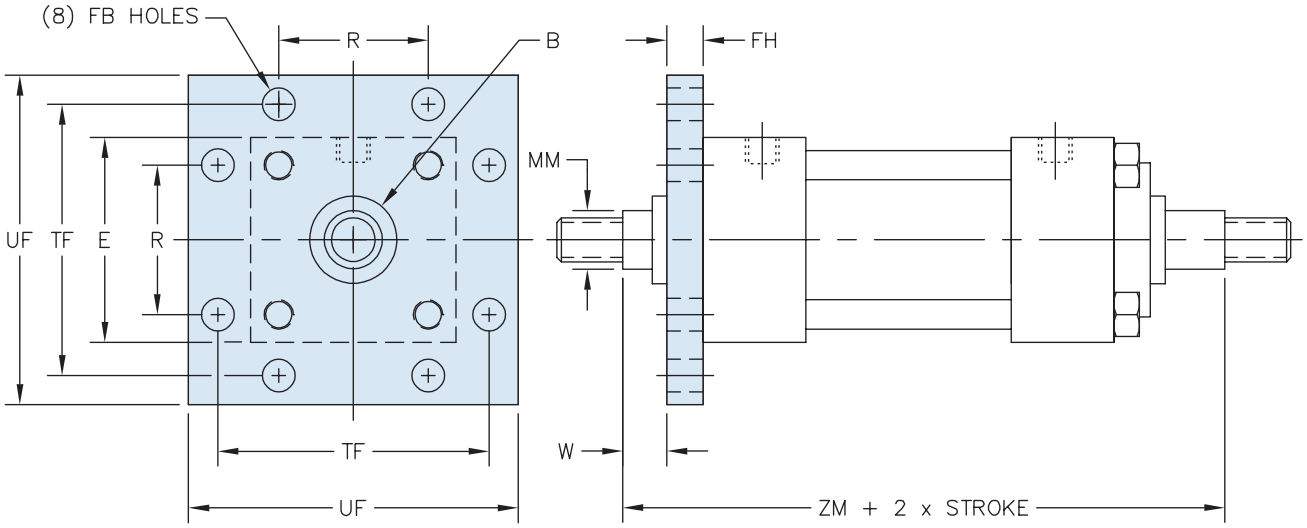
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MF1D: HEAD FLANGE



MF5D: HEAD SQUARE FLANGE



SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

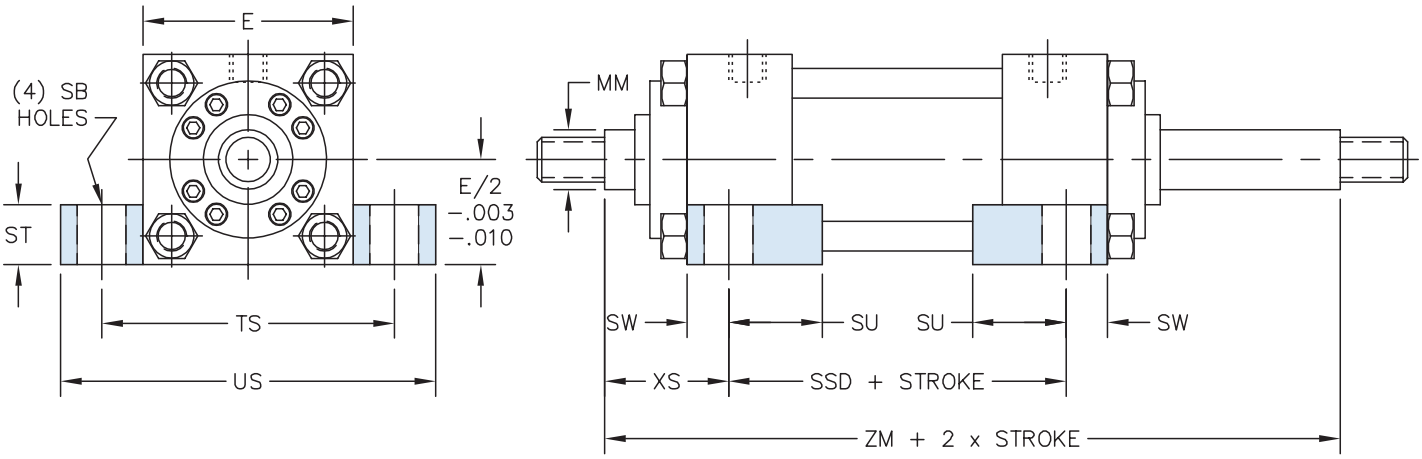
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	② B	FH	FB	R	TF	UF	W	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	1.124	0.375	0.438	1.625	3.438	4.250	0.625	6.875
	1.000			1.499						1.000	7.625
2.00	1.000	3000	3.000	1.499	0.625	0.563	2.047	4.125	5.125	0.750	7.625
	1.375			1.999						1.000	8.125
2.50	1.000	3000	3.500	1.499	0.625	0.563	2.547	4.625	5.625	0.750	7.750
	1.375			1.999						1.000	8.250
	1.750			2.374						1.250	8.750
3.25	1.375	3000	4.500	1.999	0.750	0.688	3.250	5.875	7.125	0.875	9.000
	1.750			2.374						1.125	9.500
	2.000			2.624						1.250	9.750
4.00	1.750	3000	5.000	2.374	0.875	0.688	3.820	6.375	7.625	1.000	9.750
	2.000			2.624						1.125	10.000
	2.500			3.124						1.375	10.500
5.00	2.000	3000	6.500	2.624	0.875	0.938	4.953	8.188	9.750	1.125	10.500
	2.500			3.124						1.375	11.000
	3.000			3.749						1.375	11.000
	3.500			4.249						1.375	11.000
6.00	2.500	3000	7.500	3.124	1.000	1.063	5.725	9.438	11.250	1.250	11.875
	3.000			3.749							
	3.500			4.249							
	4.000			4.749							
7.00	3.000	3000	8.500	3.749	1.000	1.188	6.580	10.625	12.625	1.250	13.000
	3.500			4.249							
	4.000			4.749							
	4.500			5.249							
	5.000			5.749							
8.00	3.500	3000	9.500	4.249	1.000	1.313	7.500	11.813	14.000	1.250	14.000
	4.000			4.749							
	4.500			5.249							
	5.000			5.749							
	5.500			6.249							

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

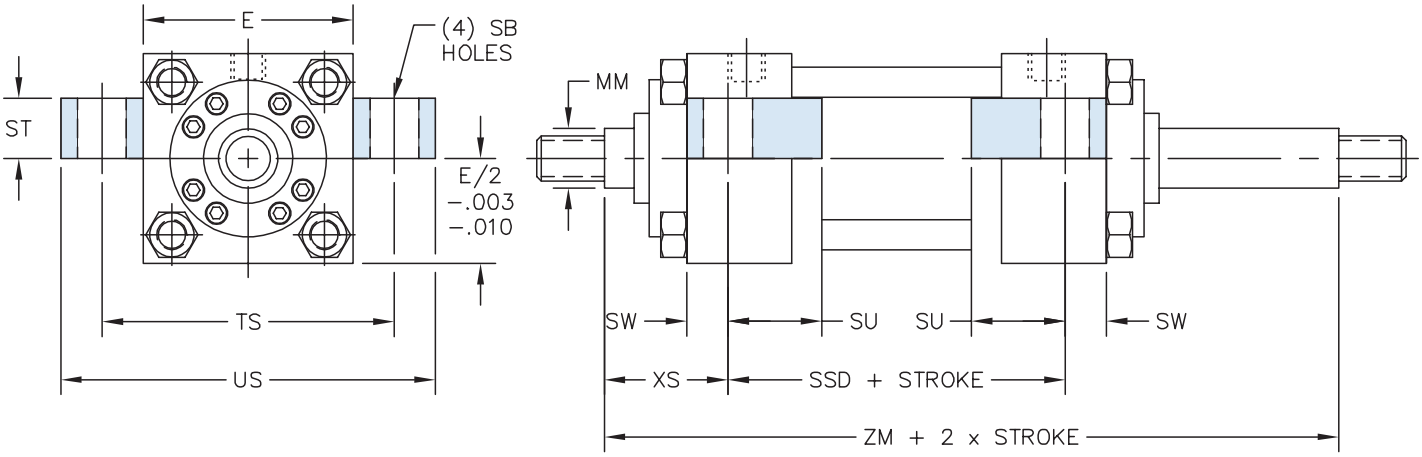
② 'B' dimension tolerance is +.000 / -.002

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MS2D: SIDE LUGS



MS3D: CENTER LINE LUGS



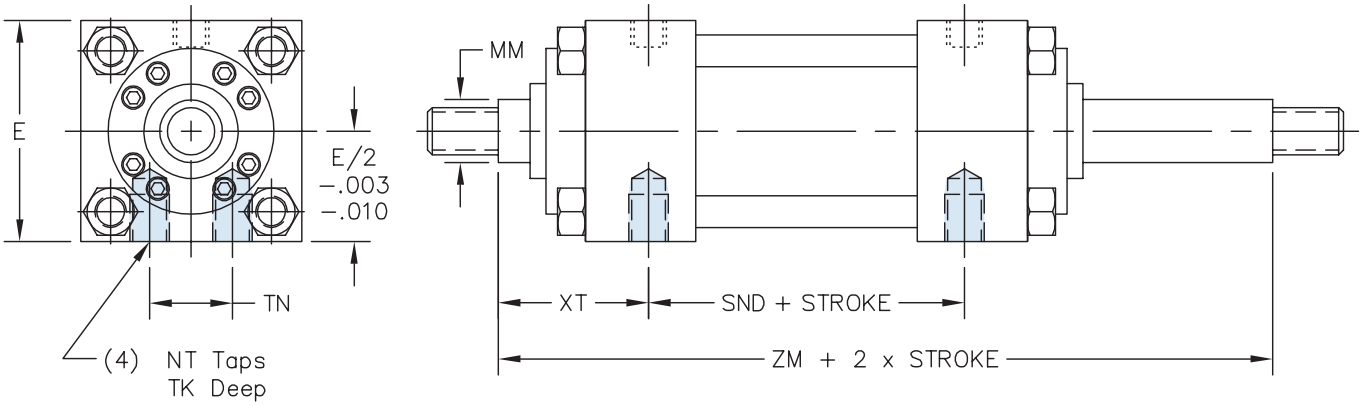
SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	E / 2	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE SSD	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	1.250	0.438	0.500	0.938	0.375	3.250	4.000	1.375	4.125	6.875
	1.000										1.750		7.625
2.00	1.000	3000	3.000	1.500	0.563	0.750	1.250	0.500	4.000	5.000	1.875	3.875	7.625
	1.375										2.125		8.125
2.50	1.000	3000	3.500	1.750	0.813	1.000	1.563	0.688	4.875	6.250	2.063	3.625	7.750
	1.375										2.313		8.250
	1.750										2.563		8.750
3.25	1.375	3000	4.500	2.250	0.813	1.000	1.563	0.688	5.875	7.250	2.313	4.375	9.000
	1.750										2.563		9.500
	2.000										2.688		9.750
4.00	1.750	3000	5.000	2.500	1.063	1.250	2.000	0.875	6.750	8.500	2.750	4.250	9.750
	2.000										2.875		10.000
	2.500										3.125		10.500
5.00	2.000	3000	6.500	3.250	1.063	1.250	2.000	0.875	8.250	10.000	2.875	4.750	10.500
	2.500										3.125		11.000
	3.000										3.125		11.000
	3.500										3.125		11.000
6.00	2.500	3000	7.500	3.750	1.313	1.500	2.500	1.125	9.750	12.000	3.375	5.125	11.875
	3.000												
	3.500												
	4.000												
7.00	3.000	3000	8.500	4.250	1.563	1.750	2.875	1.375	11.250	14.000	3.625	5.750	13.000
	3.500												
	4.000												
	4.500												
	5.000												
8.00	3.500	3000	9.500	4.750	1.563	1.750	2.875	1.375	12.250	15.000	3.625	6.750	14.000
	4.000												
	4.500												
	5.000												
	5.500												

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MS4D: BOTTOM TAPPED HOLES

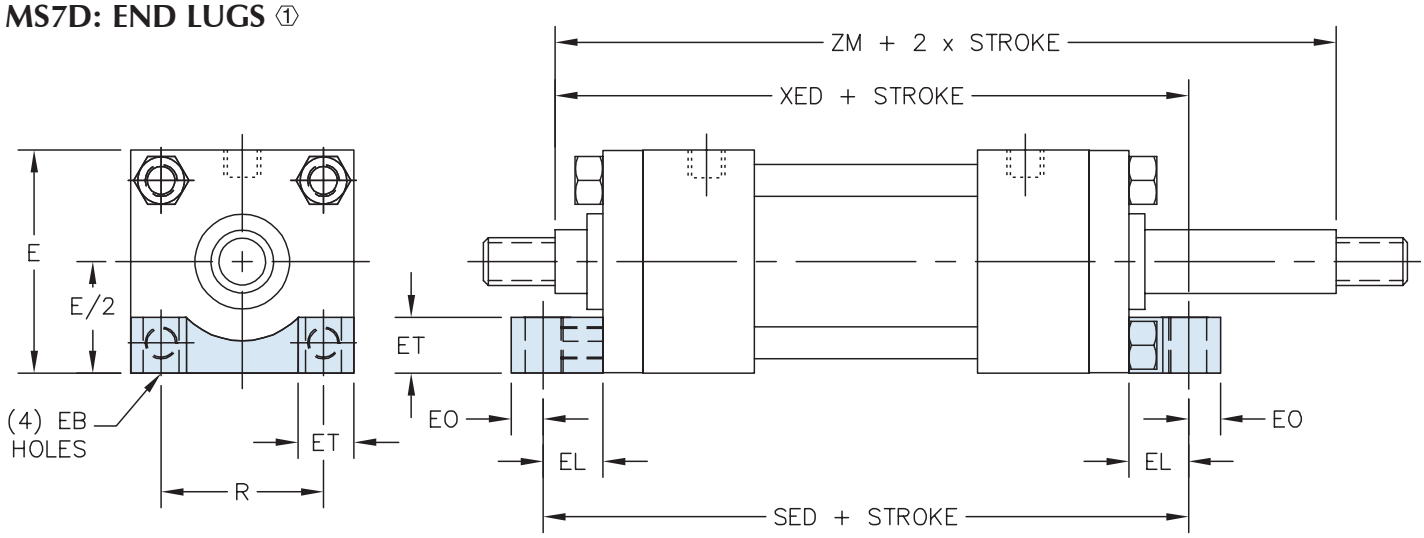


BORE	ROD DIA. (MM)	① MAX PSI RATING	E	E / 2	NT	TK	TN	XT	ADD TO STROKE SND	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	1.250	3/8 - 16	0.375	0.750	2.000	2.875	6.875
	1.000					0.375		2.375		7.625
2.00	1.000	3000	3.000	1.500	1/2 - 13	0.438	0.938	2.375	2.875	7.625
	1.375					0.438		2.625		8.125
2.50	1.000	3000	3.500	1.750	5/8 - 11	0.750	1.313	2.375	3.000	7.750
	1.375					0.625		2.625		8.250
	1.750					0.500		2.875		8.750
3.25	1.375	3000	4.500	2.250	3/4 - 10	1.000	1.500	2.750	3.500	9.000
	1.750					0.875		3.000		9.500
	2.000					0.750		3.125		9.750
4.00	1.750	3000	5.000	2.500	1 - 8	0.875	2.063	3.000	3.750	9.750
	2.000					0.750		3.125		10.000
	2.500					0.750		3.375		10.500
5.00	2.000	3000	6.500	3.250	1 - 8	1.000	2.938	3.125	4.250	10.500
	2.500									11.000
	3.000									11.000
	3.500									11.000
6.00	2.500	3000	7.500	3.750	1 1/4 - 7	1.250	3.313	3.500	4.875	11.875
	3.000					1.250				
	3.500					1.250				
	4.000					0.750				
7.00	3.000	3000	8.500	4.250	1 1/2 - 6	1.125	3.750	3.813	5.375	13.000
	3.500									
	4.000									
	4.500									
	5.000									
8.00	3.500	3000	9.500	4.750	1 1/2 - 6	1.500	4.250	3.938	6.125	14.000
	4.000					1.500				
	4.500					1.500				
	5.000					1.250				
	5.500					1.000				

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MS7D: END LUGS ①



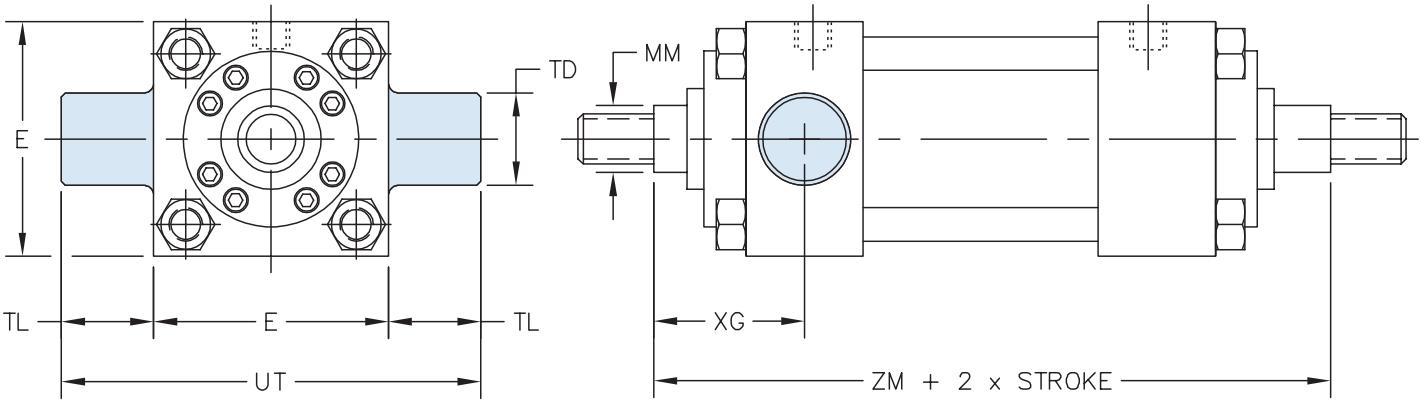
BORE	ROD DIA. (MM)	② MAX PSI RATING	E	E / 2	EB	EL	EO	ET	R	ADD TO STROKE		ADD 2X STROKE
										SED	XED	ZM
1.50	0.625	3000	2.500	1.250	0.438	0.875	0.375	0.750	1.625	7.375	7.125	6.875
	1.000	NOT AVAILABLE										
2.00	1.000	3000	3.000	1.500	0.563	0.938	0.500	0.875	2.047	8.000	7.687	7.625
	1.375	NOT AVAILABLE										
2.50	1.000	3000	3.500	1.750	0.563	0.938	0.500	0.875	2.547	8.125	7.938	7.750
	1.375										8.188	8.250
	2.000	NOT AVAILABLE										
3.25	1.375	3000	4.500	2.250	0.688	1.125	0.625	1.188	3.250	9.500	9.250	9.000
	1.750	NOT AVAILABLE										
	2.000											
4.00	1.750	3000	5.000	2.500	0.688	1.125	0.625	1.188	3.820	10.000	9.875	9.750
	2.000	NOT AVAILABLE										
	2.500											
5.00	2.000	3000	6.500	3.250	0.938	1.500	0.750	1.500	4.953	11.250	10.875	10.500
	2.500										11.125	11.000
	3.000										11.125	11.000
	3.500	NOT AVAILABLE										
6.00	2.500	3000	7.500	3.750	1.063	1.688	0.875	1.750	5.734	12.750	12.313	11.875
	3.000											
	3.500											
	4.000	NOT AVAILABLE										

① When using this mount, the cylinder feet, head & cap are to be firmly supported.

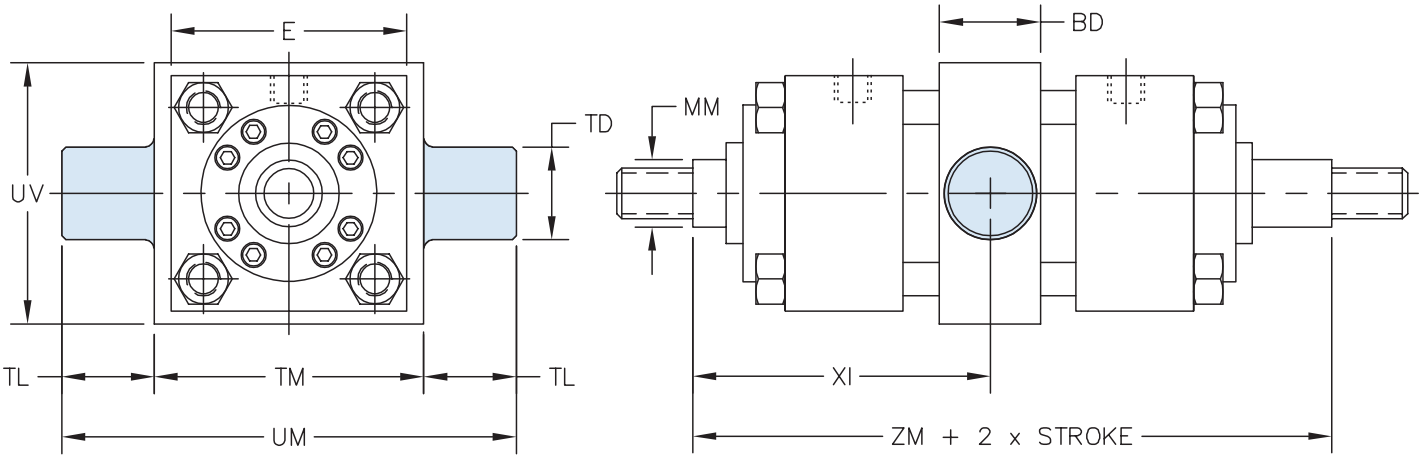
② Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MT1D: HEAD TRUNNION



MT4D: INTERMEDIATE TRUNNION



SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	BD	② TD	TL	TM	UM	UT	UV	XG	③ MT4 XI MIN	MT4 MIN STROKE	ADD TO STROKE MT4 XI MAX	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.875	3.625	0.375	3.250	6.875
	1.000										2.250	4.000		3.625	7.625
2.00	1.000	3000	3.000	1.500	1.375	1.375	3.500	6.250	5.750	3.500	2.250	4.000	0.375	3.625	7.625
	1.375										2.500	4.250		3.875	8.125
2.50	1.000	3000	3.500	1.500	1.375	1.375	4.000	6.750	6.250	4.000	2.250	4.000	0.250	3.750	7.750
	1.375										2.500	4.250		4.000	8.250
	1.750										2.750	4.500		4.250	8.750
3.25	1.375	3000	4.500	2.000	1.750	1.750	5.000	8.500	8.000	5.000	2.625	4.750	0.500	4.250	9.000
	1.750										2.875	5.000		4.500	9.500
	2.000										3.000	5.125		4.625	9.750
4.00	1.750	3000	5.000	2.000	1.750	1.750	5.500	9.000	8.500	5.500	2.875	5.000	0.250	4.750	9.750
	2.000										3.000	5.125		4.875	10.000
	2.500										3.250	5.375		5.125	10.500
5.00	2.000	3000	6.500	2.500	1.750	1.750	7.000	10.500	10.000	7.250	3.000	5.375	0.250	5.125	10.500
	2.500										3.250	5.625		5.375	11.000
	3.000										3.250	5.625		5.375	11.000
	3.500										3.250	5.625		5.375	11.000
6.00	2.500	3000	7.500	3.000	2.000	2.000	8.500	12.500	11.500	8.750	3.375	6.125	0.375	5.750	11.875
	3.000														
	3.500														
	4.000														
7.00	3.000	3000	8.500	3.000	2.500	2.500	9.750	14.750	13.500	10.000	3.625	6.625	0.250	6.375	13.000
	3.500														
	4.000														
	4.500														
	5.000														
8.00	3.500	3000	9.500	3.500	3.000	3.000	11.000	17.000	15.500	11.750	3.750	7.125	0.250	6.875	14.000
	4.000														
	4.500														
	5.000														
	5.500														

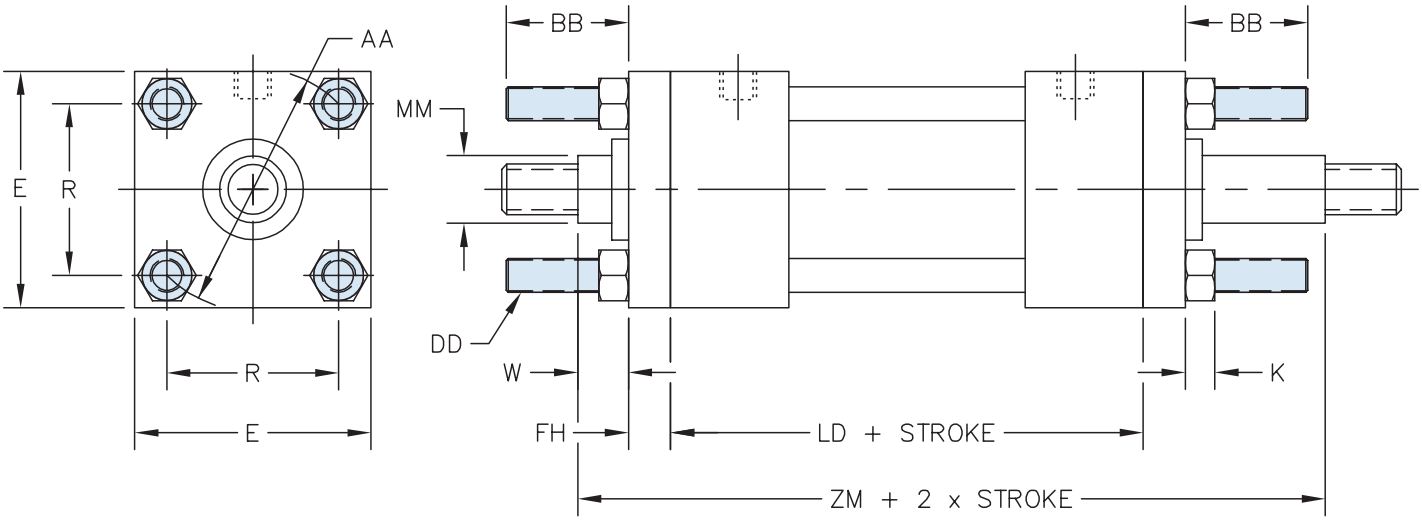
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'TD' dimension tolerance is + .000 / - .001

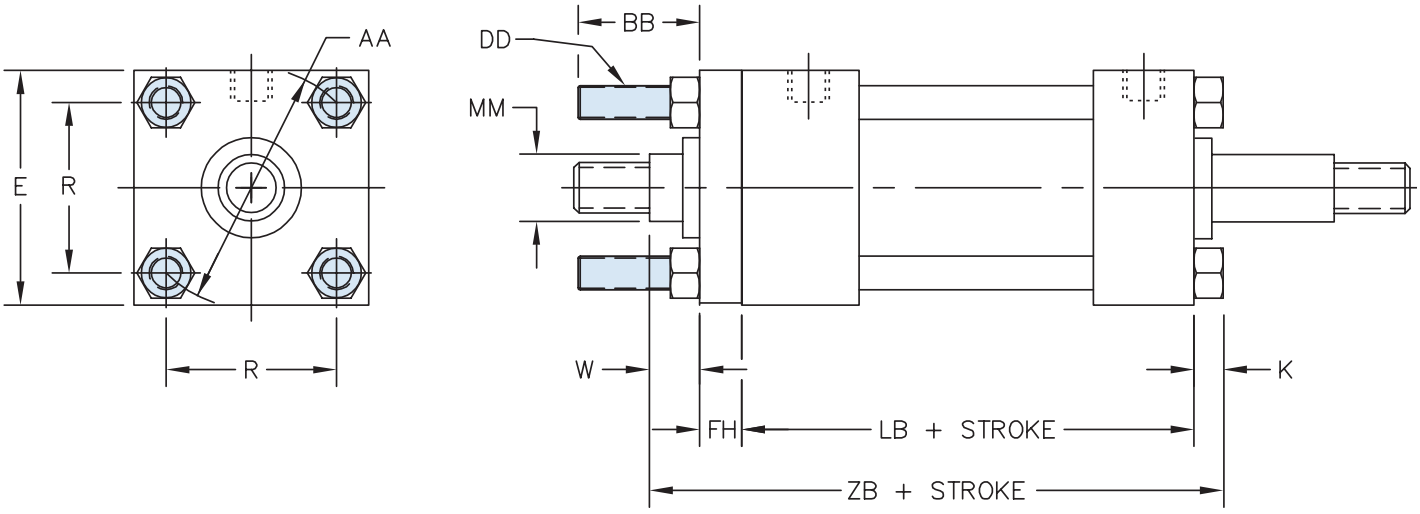
③ 'XI' dimension is the minimum that can be supplied (customer to specify 'XI' dimension).

SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

MX1D: EXTENDED TIE-RODS - HEAD & CAP



MX3D: EXTENDED TIE-RODS - HEAD END



SERIES 'HH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	AA	BB	DD	FH	K	R	W	ADD TO STROKE LD	ADD 2X STROKE ZM
1.50	0.625	3000	2.500	2.300	1.375	3/8 - 24	0.375	0.375	1.625	0.625	4.875	6.875
	1.000									1.000		7.625
2.00	1.000	3000	3.000	2.900	1.813	1/2 - 20	0.625	0.500	2.047	0.750	4.875	7.625
	1.375									1.000		8.125
2.50	1.000	3000	3.500	3.600	1.813	1/2 - 20	0.625	0.500	2.547	0.750	5.000	7.750
	1.375									1.000		8.250
	1.750									1.250		8.750
3.25	1.375	3000	4.500	4.600	2.313	5/8 - 18	0.750	0.625	3.250	0.875	5.750	9.000
	1.750									1.125		9.500
	2.000									1.250		9.750
4.00	1.750	3000	5.000	5.400	2.313	5/8 - 18	0.875	0.625	3.820	1.000	6.000	9.750
	2.000									1.125		10.000
	2.500									1.375		10.500
5.00	2.000	3000	6.500	7.000	3.188	7/8 - 14	0.875	0.875	4.953	1.125	6.500	10.500
	2.500									1.375		11.000
	3.000									1.375		11.000
	3.500									1.375		11.000
6.00	2.500	3000	7.500	8.100	3.625	1 - 14	1.000	1.000	5.734	1.250	7.375	11.875
	3.000											
	3.500											
	4.000											
7.00	3.000	3000	8.500	9.300	4.125	1 1/8 - 12	1.000	1.125	6.580	1.250	8.500	13.000
	3.500											
	4.000											
	4.500											
	5.000											
8.00	3.500	3000	9.500	10.600	4.500	1 1/4 - 12	1.000	1.250	7.500	1.250	9.500	14.000
	4.000											
	4.500											
	5.000											
	5.500											

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

Design Tips - 'HH' Series Rod Locks & Rod Boots

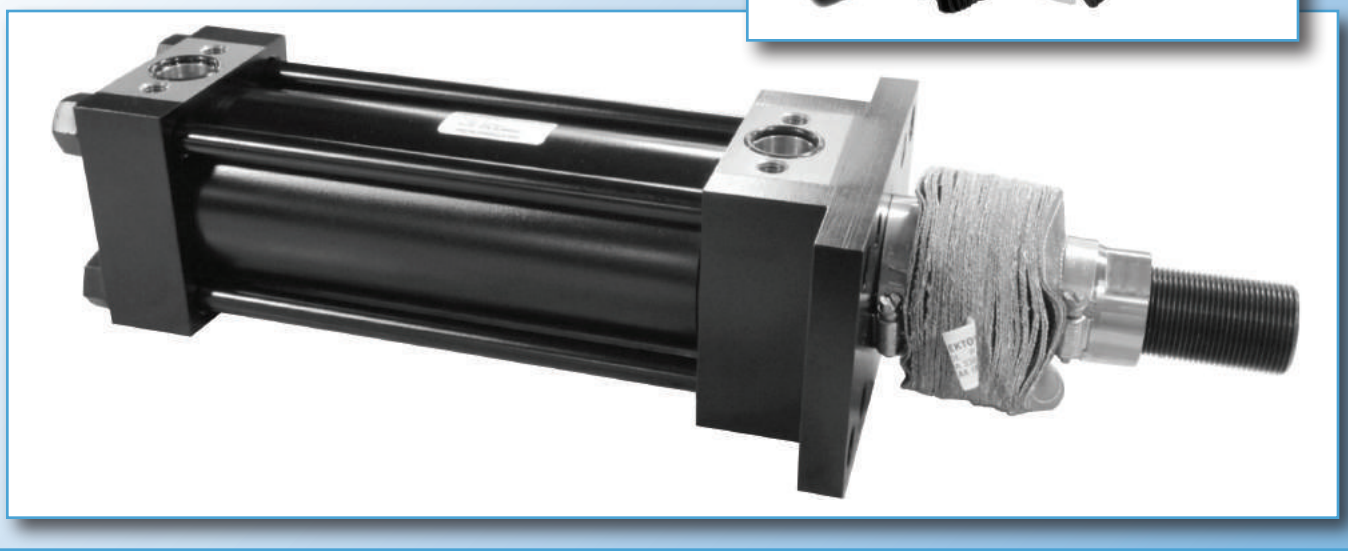
'HH' Series Rod Locks

'HH' Series rod locks provide high holding force and are available in several hydraulic release pressures. The higher the release pressure, the higher the spring force available and thus the higher holding force rating.

Design Tip: By locating the rod lock on the cap of a double rod end cylinder, the rod end of the cylinder can fit in tighter spaces.

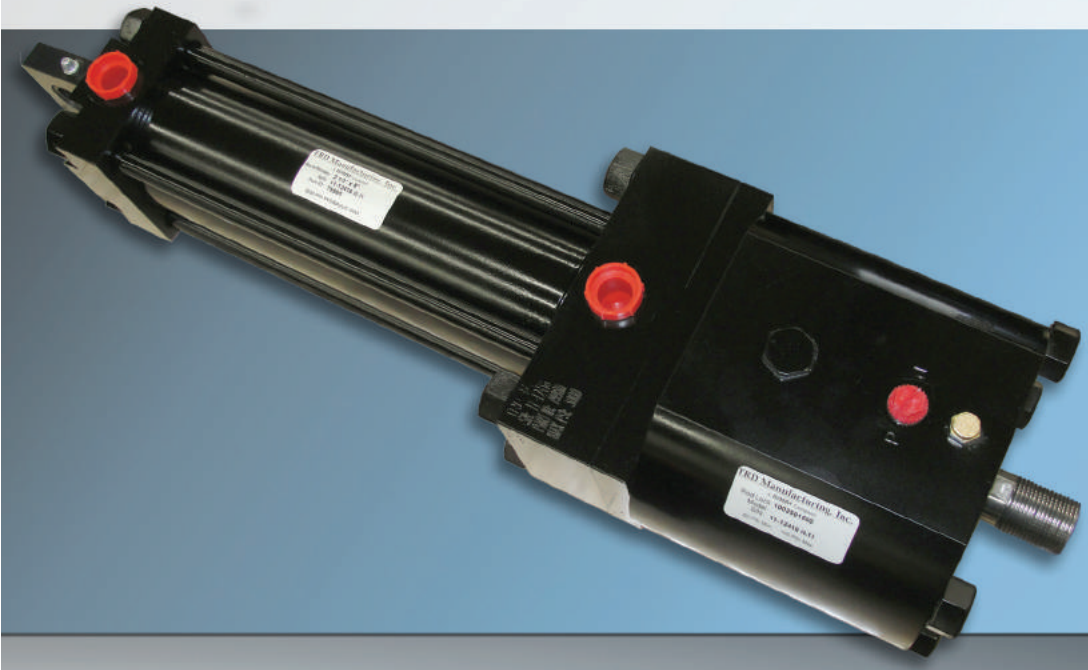
Rod Boots

Many times, a rod boot can provide additional protection to the cylinder rod. Boots are made-to-order and are available in many different materials.
Contact TRD for more information.



HH Series with Hydraulic Rod Lock

1.50″ to 8.00″ Bore



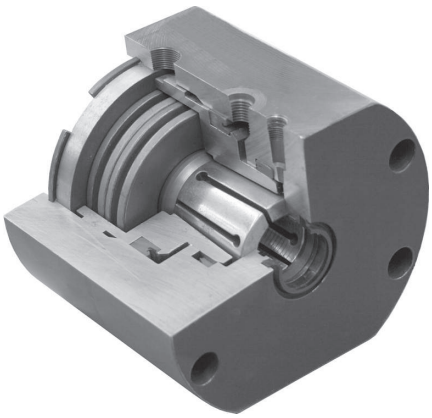
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'HH' WITH HYDRAULIC ROD LOCK

The TRD difference...

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

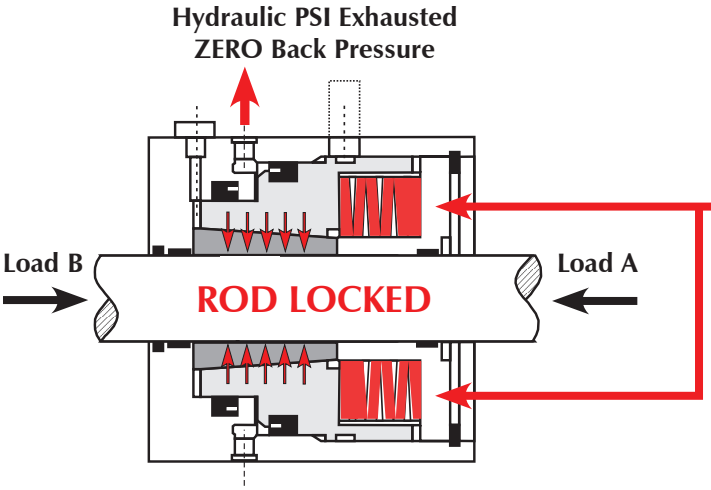
For rod locks to achieve the rated holding force and maximize cycle life, good alignment must be maintained between the locking mechanism and cylinder rod. Superior performance and trouble-free operation are assured with TRD's floating rod bushing design and accurate rod lock alignment.



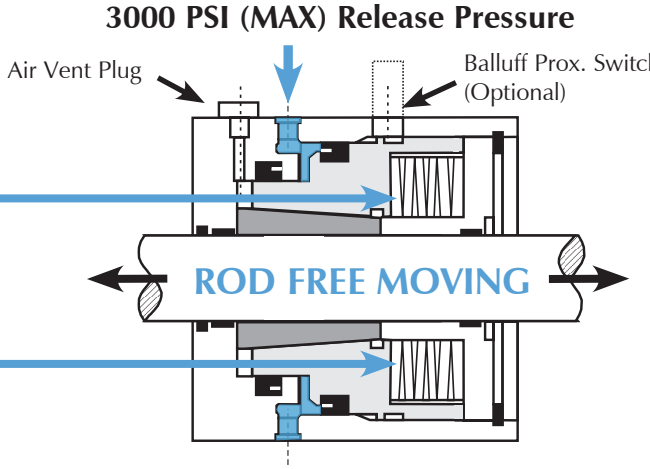
Rod locks are used to hold linear cylinder loads stationary in any mounting orientation during power off condition. Units will lock in both directions to rated holding force. They are not designed to withstand rotational loads or to brake the load in dynamic applications. TRD offers each rod lock model in three different holding forces, depending on available release pressure.

Refer to page 42 for minimum release pressure and corresponding holding force.

OPERATING PRINCIPAL



CLAMPING (LOCKED) CONDITION:
When hydraulic pressure is exhausted from rod lock, extreme spring force is applied to the piston/outer lock housing. This utilizes an ultra-fine tapered wedge, transferring the spring force directly to the rod. Clamping action does not move or disturb the rod, maintaining rod position during actuation.



UN-CLAMPED CONDITION:
When hydraulic pressure is applied to rod lock, the hydraulic pressure overcomes the spring force, moving piston outer locking housing. This movement provides clearance between the rod lock and piston rod, which allows free rod movement.

OPERATING PRESSURE	
Cylinder	Refer to Cylinder Mount Rating
Rod Lock (Low PSI)	750 to 3000 PSI HYD.
Rod Lock (Med PSI)	1000 to 3000 PSI HYD.
Rod Lock (High PSI)	1500 to 3000 PSI HYD.

AXIAL MOVEMENT (CLAMPED)*	
Load Direction A	.000"
Load Direction B	.012" Max

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

OPERATING TEMPERATURE	
Standard Seals	-20°F to 200°F (-29°C to 93°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
Finish	6 to 10 micro-inch

CLAMP SPECIFICATIONS	
Response Time	100 ms (clamp); 100 ms (un-clamp)
Average Life	1,000,000 Clamp Cycles

HOW TO ORDER: SERIES 'HH' WITH ROD LOCK

HH - ___ - 250 x 10 - H2C6 - 100 - KK1 - P15 = N375 - S S S S - _____

NFPA MOUNT (TO MOUNT CYLINDER)	
ME6	CAP RECTANGULAR MOUNTING HOLES (1.50" to 8.00" Bore)*
MF2	CAP RECTANGULAR FLANGE (1.50" to 6.00" Bore)*
MF6	SQUARE FLANGE, CAP END (1.50" to 8.00" Bore)*
MP1	FIXED CAP PIVOT CLEVIS (1.50" to 8.00" Bore)*
MS4	BOTTOM TAPPED HOLES (1.50" to 8.00" Bore)
MT2	CAP TRUNNION (1.50" to 8.00" Bore)
MT4	INTERMEDIATE (CENTER) TRUNNION (1.50" to 8.00" Bore)*
MX2	EXTENDED TIE RODS - CAP (1.50" to 8.00" Bore)

* HEAD END SPACER THICKNESS CAN VARY AND WILL ADD LENGTH TO CYLINDER

OPTIONS	
RLH	ROD LOCK READY CYLINDER NO ROD LOCK INSTALLED
RLH-MODEL NUMBER	CYLINDER WITH INSTALLED ROD LOCK EXAMPLE: RLH-100250750

Rod Lock Model Numbers

RLH- 100 250 750 _____

ROD SIZE	BORE
062	150
100	150
	200
	250
137	200
	250
	325
175	250
	325
	400
200	325
	500
250	600
300	600
300	700
350	800
400	800

RELEASE PSI
750
1000
1500

OPTIONS	
P	Proximity Switch
V	Fluorocarbon Seals
X	Special (Specify)

Replacement rod locks can be ordered using the same methodology.

Examples:
RLH-1374001500
RLH-100250750P

See page 7 for additional cylinder how-to-order information.

Consult factory for additional mounts.

TECHNICAL DATA: ROD LOCKS

ROD DIA.	BORE	MODEL NUMBER	① MIN RELEASE PSI	② MAX HOLDING FORCE	VOLUME OF OIL CM³	VOLUME OF OIL IN³	WEIGHT (LBS)
0.625	1.50	RLH-625150750	750	1,100	6	0.4	11.5
		RLH-6251501000	1000	1,800			
		RLH-6251501500	1500	2,250			
1.000	1.50	RLH-100150750	750	1,200	6	0.4	10.5
		RLH-1001501000	1000	2,000			
		RLH-1001501500	1500	2,300			
1.000	2.00	RLH-100200750	750	2,900	16	1.0	20.8
		RLH-1002001000	1000	5,200			
		RLH-1002001500	1500	5,600			
1.000	2.50	RLH-100250750	750	2,900	16	1.0	31.0
		RLH-1002501000	1000	5,200			
		RLH-1002501500	1500	6,000			
1.375	2.00	RLH-137200750	750	2,700	10	0.6	20.0
		RLH-1372001000	1000	2,700			
		RLH-1372001500	1500	5,200			
1.375	2.50	RLH-137250750	750	2,700	16	1.0	30.2
		RLH-1372501000	1000	5,200			
		RLH-1372501500	1500	6,000			
1.375	3.25	RLH-137325750	750	8,200	30	1.8	66.0
		RLH-1373251000	1000	11,500			
		RLH-1373251500	1500	16,000			
1.750	2.50	RLH-175250750	750	3,500	16	1.0	29.5
		RLH-1752501200	1200	5,200			
		RLH-1752502000	2000	7,500			
1.750	3.25	RLH-175325750	750	8,200	30	1.8	65.1
		RLH-1753251000	1000	11,500			
		RLH-1753251500	1500	16,000			

ROD DIA.	BORE	MODEL NUMBER	① MIN RELEASE PSI	② MAX HOLDING FORCE	VOLUME OF OIL CM³	VOLUME OF OIL IN³	WEIGHT (LBS)
1.750	4.00	RLH-175400750	750	8,200	39	2.4	75.5
		RLH-1754001000	1000	12,000			
		RLH-1754001500	1500	17,000			
2.000	3.25	RLH-200325750	750	8,200	39	2.4	64.0
		RLH-2003251000	1000	11,500			
		RLH-2003251500	1500	16,000			
2.000	5.00	RLH-200500750	750	8,200	39	2.4	114.0
		RLH-2005001000	1000	12,000			
		RLH-2005001500	1500	17,000			
2.500	6.00	RLH-250600750	750	30,000	129	7.9	270.0
		RLH-2506001000	1000	36,000			
		RLH-2506001500	1500	50,000			
3.000	6.00	RLH-300600750	750	17,000	129	7.9	260.0
		RLH-3006001000	1000	22,500			
3.000	7.00	RLH-300700750	750	30,000	144	8.8	380.0
		RLH-3007001000	1000	36,000			
		RLH-3007001500	1500	50,000			
3.500	8.00	RLH-350800750	750	40,000	181	11.0	550.0
		RLH-3508001000	1000	55,000			
		RLH-3508001500	1500	80,000			
4.000	8.00	RLH-400800750	750	40,000	230	14.0	530.0
		RLH-4008001000	1000	55,000			
		RLH-4008001500	1500	80,000			

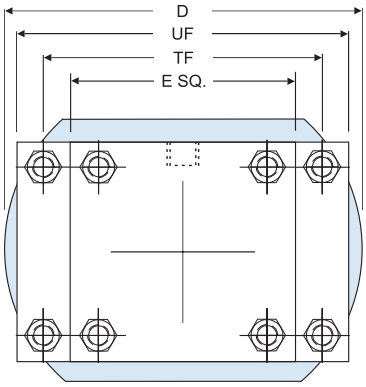
① Maximum hydraulic release pressure: 3000 PSI.
② Holding forces are based on dry or mineral-oil lubricated shafts.

SERIES 'HH' WITH ROD LOCK: BASIC CYLINDER (No Mount)

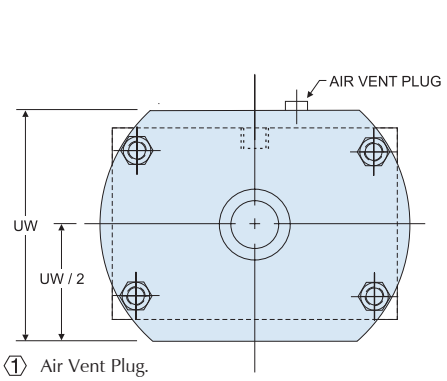
To be able to handle the high holding forces, the rod lock cylinder uses a full rectangle cylinder head and full rectangle bushing retainer plate to attach the rod lock unit to the cylinder.

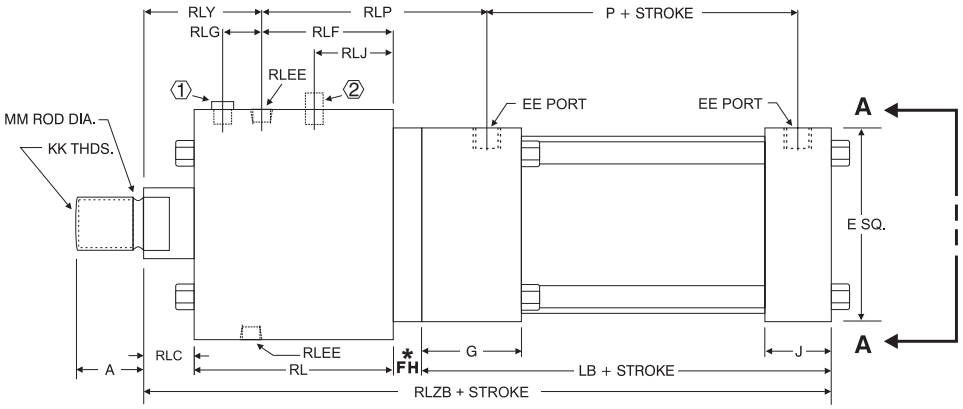
Customers need to specify an additional NFPA mount to use the cylinder in any application.

Refer to pages 8 through 26 for basic cylinder dimensions not shown.



VIEW AA



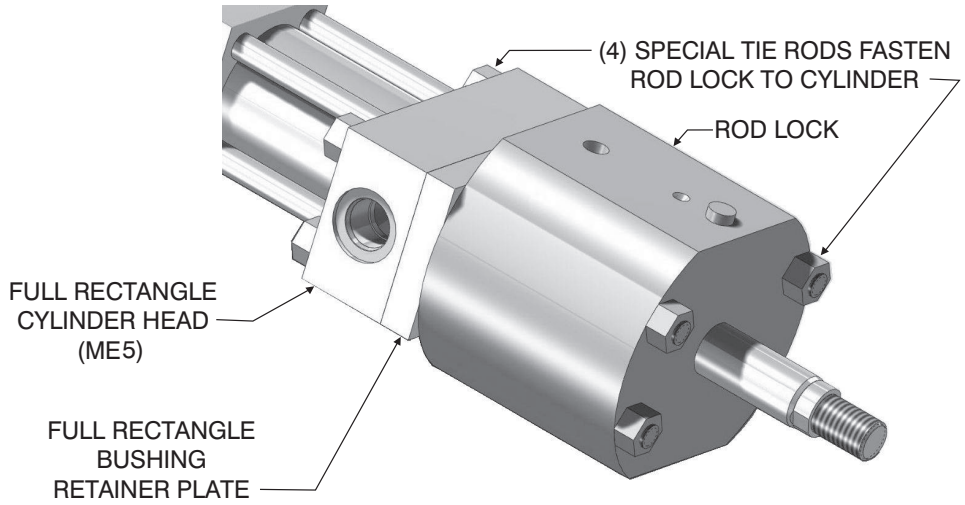


① Air Vent Plug.
② M12x1 port for optional proximity switch (indicates un-clamped condition).

ROD DIA. (MM)	BORE	D	E	FH*	TF	UF	UW	RL	RLC	RLEE	RLF	RLG	RLJ	RLP	RLY	ADD TO STROKE RLZB
0.625	1.50	4.370	2.500	0.375	3.438	4.250	3.250	3.547	0.375	SAE 4	2.125	0.750	0.790	3.500	1.740	8.930
1.000	1.50	4.370	2.500	0.375	3.438	4.250	3.500	3.453	0.500	SAE 4	1.875	0.870	0.790	3.250	2.010	8.947
1.000	2.00	5.375	3.000	0.625	4.125	5.125	4.500	4.375	0.500	SAE 4	2.900	0.850	1.000	4.531	1.910	10.120
1.000	2.50	5.984	3.500	0.625	4.625	5.625	5.000	5.125	0.500	SAE 4	3.480	1.000	1.500	5.031	2.160	11.000
1.375	2.00	5.370	3.000	0.625	4.125	5.125	4.500	4.650	0.625	SAE 4	3.000	1.000	1.500	4.625	2.210	10.531
1.375	2.50	5.984	3.500	0.625	4.625	5.625	5.000	5.125	0.625	SAE 4	3.500	0.900	1.500	5.031	2.280	11.120
1.375	3.25	7.750	4.500	0.750	5.875	7.125	6.500	6.500	0.625	SAE 4	4.500	1.100	2.600	6.375	2.625	13.375
1.750	2.50	5.984	3.500	0.625	4.625	5.625	5.000	5.900	0.750	SAE 4	3.900	0.960	2.438	5.531	2.700	12.040
1.750	3.25	7.750	4.500	0.750	5.875	7.125	6.500	6.500	0.750	SAE 4	4.672	0.930	2.600	6.547	2.580	13.500
1.750	4.00	8.375	5.000	0.875	6.375	7.625	7.000	6.500	0.750	SAE 4	4.375	1.230	2.200	6.313	2.810	13.875
2.000	3.25	7.750	4.500	0.750	5.875	7.125	6.500	6.500	0.875	SAE 4	4.438	1.160	2.600	6.313	2.938	13.625
2.000	5.00	11.250	6.500	0.875	8.188	9.750	7.000	6.500	0.875	SAE 4	4.375	1.230	2.200	6.375	3.000	14.500
2.500	6.00	12.750	7.500	1.000	9.438	11.250	10.000	9.000	1.000	SAE 8	6.625	1.125	3.000	8.750	3.375	18.375
3.000	6.00	12.750	7.500	1.000	9.438	11.250	10.000	9.000	1.000	SAE 8	4.875	1.100	3.110	7.000	5.125	18.375
3.000	7.00	14.750	8.500	1.000	10.625	12.625	13.000	10.000	1.000	SAE 8	7.325	1.375	4.730	9.825	3.675	20.500
3.500	8.00	16.140	9.500	1.000	11.813	14.000	14.000	11.500	1.000	SAE 10	8.938	1.320	5.350	11.625	3.563	23.000
4.000	8.00	16.140	9.500	1.000	11.813	14.000	14.000	11.500	1.000	SAE 10	8.875	1.370	5.350	11.563	3.625	23.000

***May vary per mount, consult factory for details.**

SERIES 'HH' WITH ROD LOCK: BASIC CYLINDER (No Mount)



General Construction

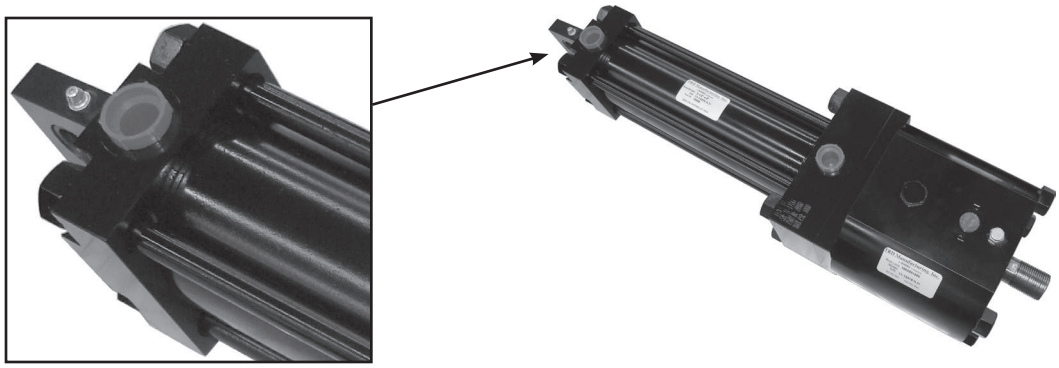
TRD 'HH' Series hydraulic cylinders are designed to be stand alone units so they can be fully serviced without the rod lock installed. Hydraulic rod locks are aligned and bolted to the cylinders using (4) special tie rods and hex nuts. This design allows for both the cylinder and the rod lock to maintain full serviceability once in use.

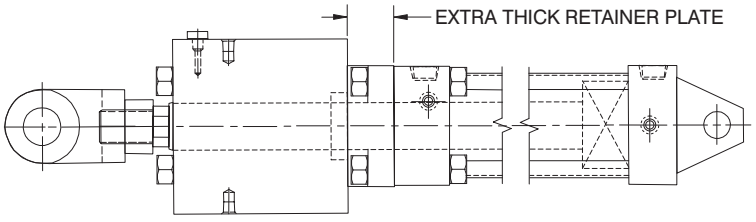
CYLINDER DESIGN AND AVAILABLE MOUNTS

A full rectangle cylinder head mount is used exclusively to attach the rod lock to the cylinder. An additional mount must be specified to be able to use the cylinder.

The cylinder design can vary depending on the bore size, tie rod hex nut location and desired mount. **Note: some designs will increase cylinder overall length.**

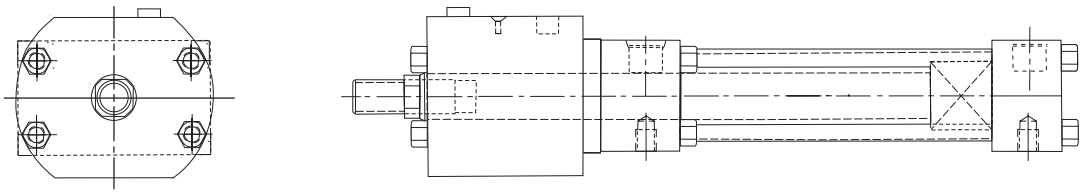
SB mount with special recessed hex nuts at cap





MP1 mount with special, extra thick bushing retainer plate and recessed tie rod hex nuts at head.

MS4 mount with standard hex nuts at cap.



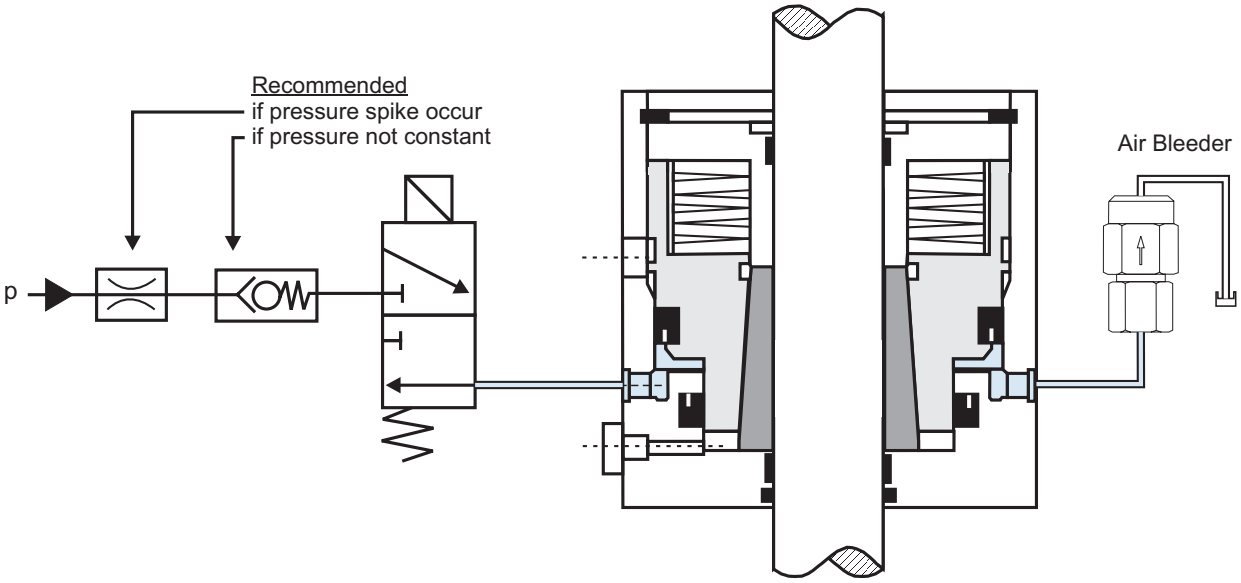
Contact your local distributor with the basic cylinder bore, stroke and desired NFPA mount information and TRD will configure a cylinder with rod lock to meet your specifications!

ROD LOCK HYDRAULIC CIRCUIT AND AUTOMATIC AIR BLEED VALVE

In most applications, the sample circuit in Figure 1 is used to actuate the rod lock. To release (un-clamp) the rod lock, the three-way valve is energized, supplying pressure to the rod lock. In power failure modes, E-Stop, loss of hydraulic pressure, etc., pressure is removed from the rod lock; spring energized rod lock clamps the rod holding it in place.

Avoid designs where the piston rod is moved while rod lock is actuated (clamped condition); piston rod and rod lock damage may occur. Do not exceed the maximum holding force of the rod lock unit.

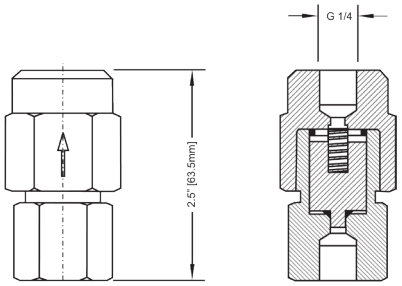
Figure 1



AUTOMATIC AIR BLEED VALVE ABV-1

All rod lock units have a very short activation stroke and quick (100ms) response. It is highly recommended that all air be removed from the rod lock unit. Trapped air at high pressure and frequent cycling can cause ignition of the air-oil mixture, causing mini explosions (dieseling) to occur, which will lead to seal failure.

To avoid trapped air, an automatic air bleed valve (or similar component) should be installed between the rod lock and the oil reservoir. Locate the ABV-1 as near as possible to the rod lock, in the port with the highest elevation (see Figures 2 and 3).



Part Number: ABV-1
(Order separately)

ABV-1 OPERATION

The automatic air bleed valve (ABV-1) opens slightly each time pressure is removed from the rod lock, allowing air to escape back to the oil reservoir.

For proper operation, back pressure exceeding 30 PSI (2 bar) should be avoided between the ABV-1 and oil reservoir.

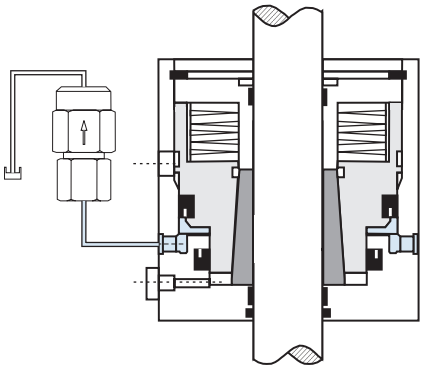


Figure 2: Vertical Mount

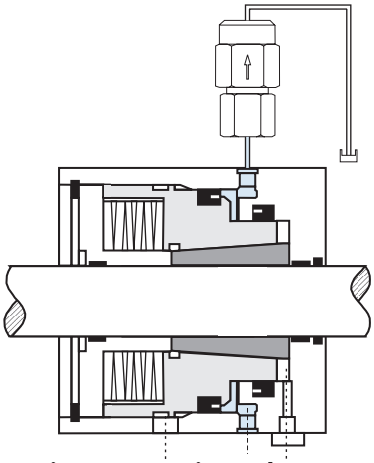


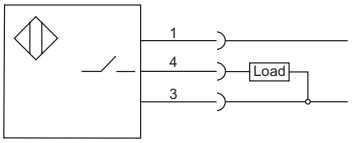
Figure 3: Horizontal Mount

ROD LOCK SENSORS (For Un-Clamped Condition)

An inductive proximity switch (with M12 x 1 thread) can be used to sense the rod lock un-clamped (free moving rod) condition.
(**BALLUFF Model: BES 516325S4**)

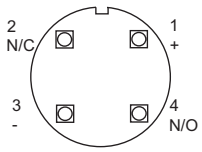
ELECTRICAL DATA	
SA Operational distance with steel	1.6 mm
Maximum switching frequency	800 Hz
Operating voltage	10 - 30 V DC
Supply voltage ripple	≤ 15% (Peak to Peak)
Load current capacity	≤ 200 mA
Protection against polarity reversal	yes
Short circuit protected	yes
Function display	LED
Output resistance	2.2 K + Diode + LED
Ambient temperature range	-25°C to 70°C (-13°F to 158°F)
Temperature of switch point	≤ 4 mm / °C
Parallel cap to load permitted	1 mF at 24 V DC
Residual voltage (un-clamped)	≤ 0.8 V
Voltage drop (clamped)	≤ 2.5 V
Voltage rise on switching	
Switching hysteresis	≤ 15% Sensing distance
Repeatability	≤ 5% Sensing distance
Current Consumption	≤ 25 mA clamped / ≤ 12 mA un-clamped

SCHEMATIC



Wiring Connections:
PNP Normally Open

View of Male Connector Pins



PROXIMITY SENSOR INSTALLATION INSTRUCTIONS

1) Apply hydraulic pressure to rod lock (un-clamped condition).
2) Assemble the proximity sensor jam nut and lock tooth washer to the proximity sensor. Thread the proximity sensor (by hand) into the M12 x 1 rod lock threaded port until it contacts the internal steel piston.
3) Back the proximity sensor out one full turn. While holding the proximity sensor's position, tighten the jam nut to 15 ft-lbs (do not over torque).
4) With electrical power off, connect the proximity sensor electric wiring per the diagram included with the sensor. When the electrical power is on, the proximity sensor LED should be "on" to indicate an un-clamped condition. Slight adjustments may be necessary to set proximity sensor for proper operation.
5) Remove the hydraulic pressure to the rod lock, the proximity sensor LED should go "off" to indicate the clamped conditions.

ROD LOCK INSTALLATION INSTRUCTIONS

1) Using a flexible hydraulic rated hose, apply hydraulic pressure to the rod lock unit *(refer to model number for specific rod lock hydraulic release pressure)*.
2) With the rod lock counter-bored end facing the cylinder rod end, align rod lock to rod. Using care not to damage rod lock seals or bearings, slide the rod lock onto the piston rod until it contacts the cylinder mounting surface. Rod lock should fully contact the cylinder.
3) Remove the hydraulic pressure to the rod lock. Torque cylinder tie rod nuts a little at a time, in a clockwise rotation, finishing with the proper cylinder tie rod torque *(refer to torque charts on page 150)*.
4) Cycle the rod lock unit on and off several times. With pressure applied, the cylinder rod should move freely by hand.
5) If the cylinder rod does not move freely, remove the rod lock and repeat installation instructions. If the piston rod still drags, check the squareness of the rod lock to the cylinder and make adjustments as needed.

WARNING! DO NOT DISASSEMBLE ROD LOCK — UNIT CONTAINS HIGH SPRING FORCE THAT COULD CAUSE PERSONAL INJURY. Return to TRD for service.

SERIES 'HH' BASIC OPTIONS

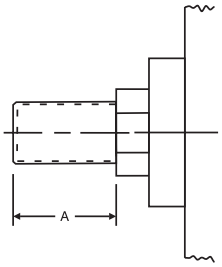
Index To Standard Options:

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!*

Note: Maximum thread length is double the standard "A" length.

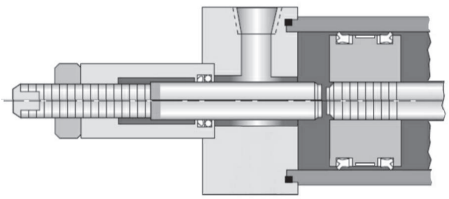


AS Adjustable Stroke (Retract)

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

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

ADJUSTABLE STROKE	
BORE	MAX "AS"
1.50	Up to 8 inch
2.00-3.25	Up to 6 inch
4.00-6.00	Up to 5 inch
7.00 & 8.00	Up to 4 inch



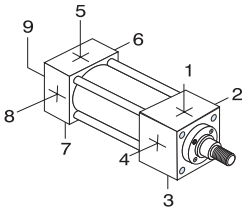
Consult factory for additional adjustable strokes offerings.

ABP= Air Bleed Ports

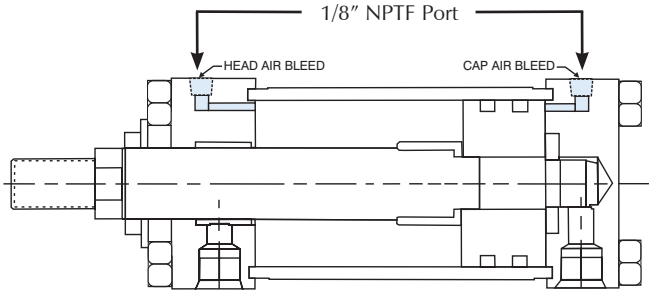
Air bleeds can be provided at either or both ends of the cylinder. Air bleeds should be located at the highest point in the cylinder for maximum effectiveness. The location needs to be specified, similar to port locations.

Example: ABP=15
(Air Bleed ports at position 1 & 5)

Plugged from factory.

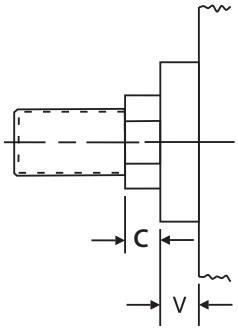


Location 9 is center of cap face.



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.



Example: If C=0.50", then 1" rod extension is C=1.50"

Be sure to check piston rod column strength charts to properly size the rod and prevent buckling.

Extended piston rods do not delay delivery.

SERIES 'HH' BASIC OPTIONS

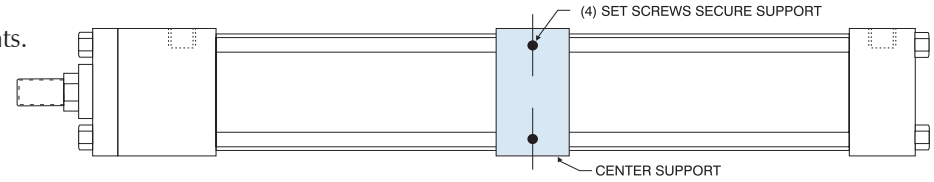
CS Center Supports

Center supports are recommended for long stroke cylinders to support tube and prevent the tie rods from sagging. Properly supported cylinders will eliminate premature cylinder wear and eliminate tie rod vibration.

Center supports can include MS2 mounts.

Contact TRD for more information.

CENTER SUPPORT RECOMMENDATIONS		
BORE	ONE SUPPORT	TWO SUPPORTS
1.50"	STROKES OVER 44 INCHES	STROKES OVER 89 INCHES
2.00"	STROKES OVER 74 INCHES	STROKES OVER 99 INCHES
2.50"	STROKES OVER 84 INCHES	NOT REQUIRED
3.25" - 8.00"	STROKES OVER 99 INCHES	



H C Cushions

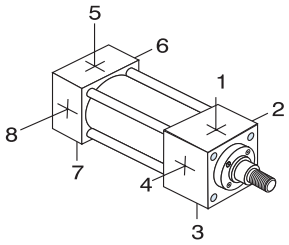
TRD's cushion design features industry proven technology and ultra fine adjustment needles for perfect deceleration and long life. Cushion adjustment needle positions need to be specified.

Example: H2C6

CUSHION LOCATIONS	
HEAD CUSHION	CAP CUSHION
H1	C5
H2	C6
H3	C7
H4	C8

STANDARD CUSHION LOCATIONS	
MOST MOUNTS	H2 C6
MS3 MOUNT	H3 C7
MT1 MOUNT	H3 C6
MT2 MOUNT	H2 C7

UNAVAILABLE CUSHION LOCATIONS BY MOUNT		
MOUNT	HEAD CUSHION	CAP CUSHION
ME5	H2, H4	
ME6		C6, C8
MS3	H2, H4	C6, C8
MT1	H2, H4	
MT2		C6, C8

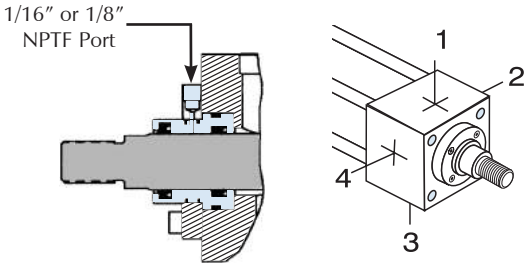


Note: Cylinders with a short stroke (value varies with bore/rod diameter and cushion combinations) may result in improper cylinder operation. Consult factory for availability.

DBB= Drain Back Bushing

When oil leakage cannot be tolerated, a rod bushing drain port can be provided. Since there isn't any pressure in the drain line, clear tubing can offer a visual inspection of any leakage. A constant leak indicates that the rod seal is worn and needs to be replaced.

Example: DBB=1 (drain port at position 1)



EK Extended Key Plate

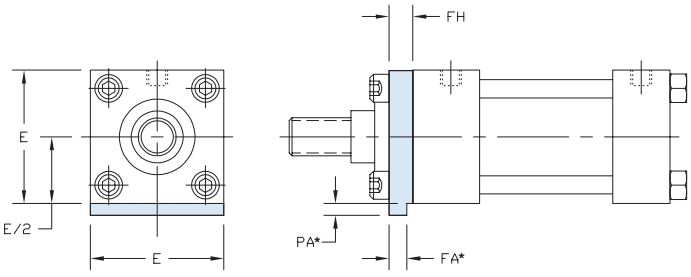
Extended key plate or thrust key is made from a full square bushing retainer plate. The key is designed to fit in a milled slot on the equipment to prevent the cylinder from shifting.

An additional mount needs to be specified to secure cylinder.

Available bore sizes: HH - 1.50" to 8.00" Bore

'HH' DIMENSIONS FOR EXTENDED KEY PLATE				
BORE	E	FA*	FH	PA*
1.50	2.500	0.312 / 0.314	0.375	0.188
2.00	3.000	0.562 / 0.564	0.625	0.313
2.50	3.500	0.562 / 0.564	0.625	0.313
3.25	4.500	0.687 / 0.689	0.750	0.375
4.00	5.000	0.812 / 0.814	0.875	0.438
5.00	6.500	0.812 / 0.814	0.875	0.438
6.00	7.500	0.937 / 0.939	1.000	0.500
7.00	8.500	0.937 / 0.939	1.000	0.500
8.00	9.500	0.937 / 0.939	1.000	0.500

*FA & PA dimensions will have a black oxide finish and will not be painted.



SERIES 'HH' BASIC OPTIONS

Option T (PTFE) Piston Seal - Recommended for High Load & Low Friction Applications

Long stroke cylinders and pivot type mounting can create severe cylinder piston-to-tube side loads. The PTFE piston seal provides increased side load capacity and low friction without increasing the cylinder base dimensions.

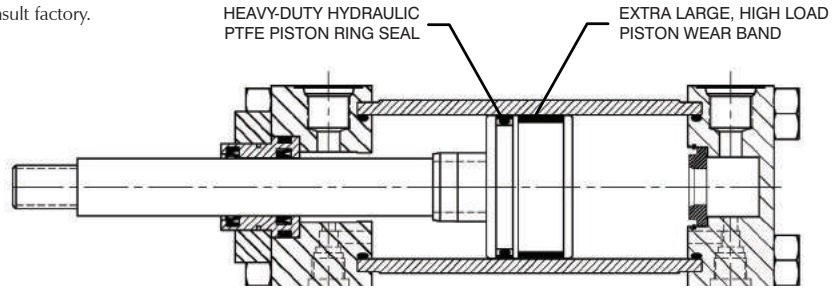
Design Benefits

- Bi-direction piston seal offers low leakage rating.
- Piston seal design offers lower friction than cast iron rings or lip seals, which eliminate stick/slip breakaway issues.
- Glass filled PTFE piston seal is 20% stronger than bronze filled seals.
- High contamination tolerant; offers the longest life of any seal type.
- Temperature Rating (PTFE): -100°F to 400°F (-73°C to 204°C)
- Temperature Rating (Nitrile): -20°F to 200°F (-29°C to 93°C)
- Temperature Rating (Viton): 0°F to 400°F (-18°C to 204°C)

High Load Piston Wear Band - Our superior design is 35% to 80% wider than competitive models and we locate the wear band at the furthest point from the rod bearing to increase overall effectiveness.

Piston Ring Seal - Glass filled PTFE with Nitrile* expander.

*Other materials are available, consult factory.

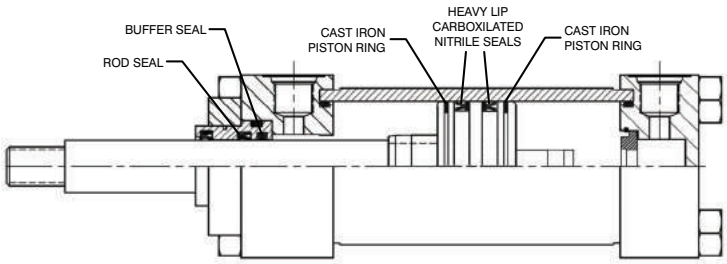


HSS *High Shock Seals*

High shock seal option provides shock protection to the rod and piston seal.

Piston Seal - Consists of two (2) bidirectional sealing, step-cut, cast iron piston rings to buffer the shock and two (2) heavy-lip design Carboxilated Nitrile seals (with back-up rings), to provide near leak-free operation.

Rod Seals - Consists of a buffer seal to handle the shock and a double lip polyurethane block vee seal for leak free operation.



KKX *Non-Standard Rod Threads*

Cylinders piston rods can be furnished with non-standard rod threads.

Ordering Example: HH - MF1 - 150 X 24 - 100 - KKX = 3/4-10 - P15 = N375 - SSSS

Add special thread to part number

KK3M *Female Metric Rod Threads*

Equipment that is imported to the United States will typically contain metric tie-rod cylinders. In general, ISO tie rod cylinders are not as robust as NFPA cylinder designs and some customers prefer to replace the metric cylinders with NFPA designs to provide longer life.

TRD can provide cylinders with metric piston rod end threads to assist customers in mating replacement cylinders to existing equipment.

Ordering Example: HH - MF1 - 150 X 24 - 100 - KK3M = M8 X 1 - P15 = N375 - SSSS

KK3X *Female Special Rod Threads*

TRD can machine a wide range of female rod threads. Standard NFPA rod threads are UNF (fine), class 2 threads. Common alternative choices are UNC (coarse) threads. Note: unless otherwise specified, the rod thread will be standard catalog "A" dimension lengths.

Ordering Example: HH - MF1 - 150 X 24 - 100 - KK3X = 3/4-10 - P15 = N375 - SSSS

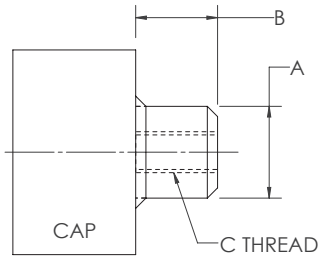
SERIES 'HH' BASIC OPTIONS

LRB Lift Ring Boss

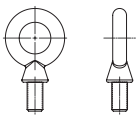
A steel, tapped lug is welded to the center of the cylinder cap.

UNC coarse threads are provided to accept high load type lifting eyes (lift eyes are available with the below options).

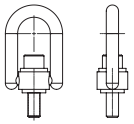
Also available in additional locations and styles.



LRE
Lift Ring Eye



LRS
Swivel Lift Ring



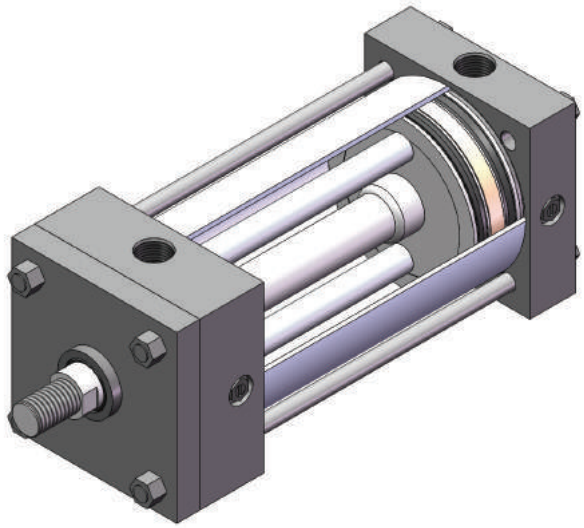
LIFT LUG DIMENSIONS				
BORE	A	B	C	STRAIGHT PULL LIFTING CAPACITY*
1.50	1.120	1.000	1/2-13	2500
2.00	1.500	1.250	5/8-11	4000
2.50	1.500	1.250	5/8-11	4000
3.25	2.000	1.500	3/4-10	6000
4.00	2.000	1.500	3/4-10	6000
5.00	2.000	1.500	3/4-10	6000
6.00	2.500	2.000	1-8	9000
7.00	2.500	2.000	1-8	9000
8.00	2.500	2.000	1-8	9000

*Lifting capacity is the maximum capacity for intermittent lifting and placement of cylinder only. It is NOT intended to be used as the primary cylinder mount.
Note: Not available on MF2, MF6, ME6, MP1 and SB mounts.

NR Non-Rotating (NFPA) Cylinders

Benefits

- Two integral guide rods throughout stroke torqued with hex nuts on cap end
- 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
- Steel, hard chrome plated guide rods offer an abrasive resistant surface



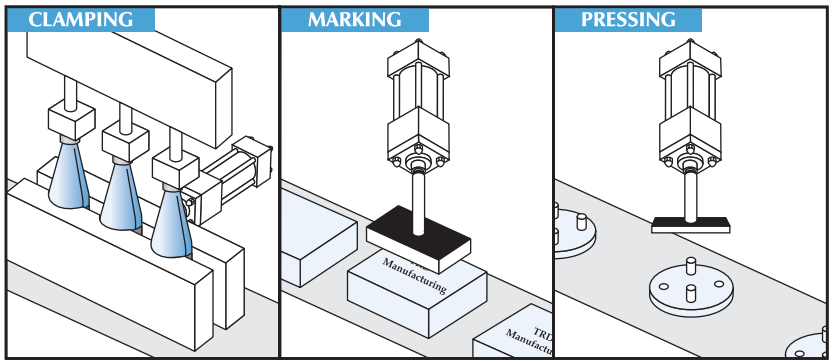
Advantages

- Eliminates the need for external guide shafts in many positioning applications
- Guide rods are self-cleaning and not subjected to harsh cleaners
- Compact design saves space; no larger than standard NFPA cylinders!
- Durable
- Great when rod end rotation is not wanted

AVAILABLE BORE SIZES WITH 'NR' GUIDE ROD SIZES AND MAX. STROKE				
GUIDE ROD	BORE	ROD DIA. (MM)	CUSHIONS	MAX. STROKE
.375	3.25	1.375	CAP ONLY	18″
.625	5.00	2.000	AVAILABLE	30″
.625	6.00	2.500	AVAILABLE	30″
		3.000		
1.000	8.00	3.500	AVAILABLE	40″

Note: External guide rod models are available with rectangular head and cap. Contact factory for additional information.

Application Possibilities:



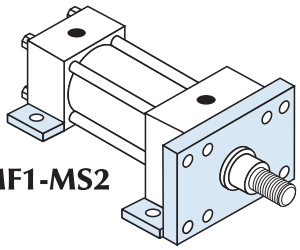
SERIES 'HH' BASIC OPTIONS

MULTIPLE MOUNTS

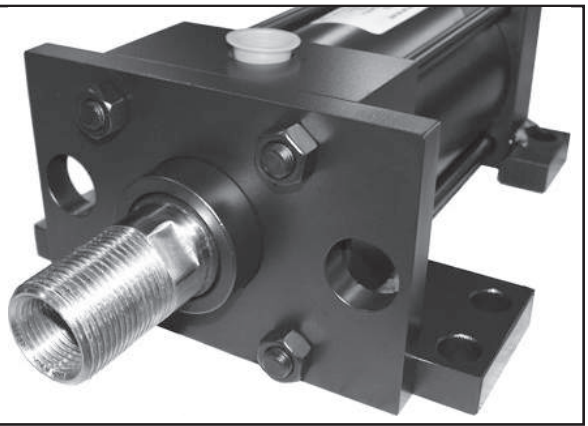
Cylinders can be furnished with a wide selection of multiple mounts.

Ordering Example: HH - MF1 - MS2 - 250 X 12 - 100 - KK1 - P15 - SSSS

Add additional mount to part number



MF1-MS2



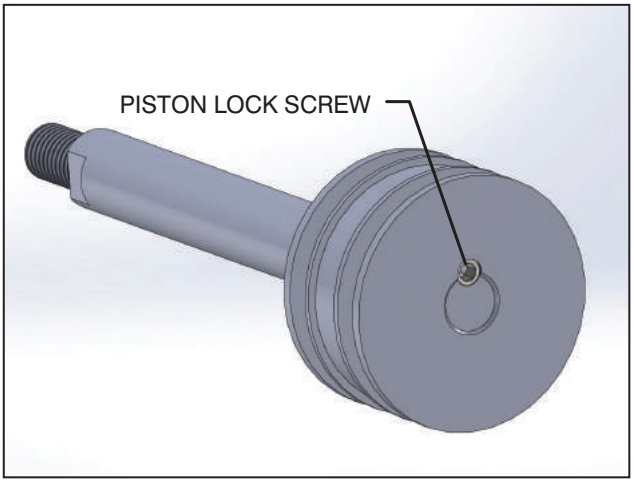
PLS *Piston Lock Screw* (For higher shock load applications)

Now standard on all hydraulic series!

Hydraulic cylinders develop high forces and can also be subjected to severe shock loads in demanding applications due to piston-to-end cap impact. The Piston Lock Screw acts as a shear pin between the piston and rod threads, eliminating any chance of a piston coming loose from the rod.

All TRD hydraulic cylinders use a specified torque with a permanent anaerobic thread lock/sealant to secure pistons to the piston rod; threads are then staked. This standard connection method has proven to be very effective in almost all applications. However, in severe shock load applications, the piston lock screw option provides a 100% positive connection that cannot come apart.

Note: Also referred to as Dutch Key or Skotch Key.



PORT OPTIONS

Cylinders can be furnished with NPTF or SAE O-Ring Boss (SAEJ514) ports at no-charge.

Cylinders can be furnished with BSPP, BSPT or SAE Flange Ports for additional cost.

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)

RBB *Solid Bronze Rod Bushing*

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 uses are in water hydraulic applications.

Note: Since the mechanical properties of bronze is much lower than cast iron, bronze rod bushings typically do not provide the same long life that our standard PTFE coated cast iron rod bushings provide.

Specials: TRD can provide special length rod bushings; contact your local distributor for details

SERIES 'HH' BASIC OPTIONS

RLH Rod Lock

Cylinders can be furnished with Hydraulic Rod Locks. ***Refer to pages 41-46 for complete specifications.***

SSR 17-4 Stainless Steel Hard Chrome Plated Piston Rod

Cylinders can be furnished with hard chrome plated stainless steel piston rods.

100,000 min. yield (rods up to 5.00)
75,000 min. yield (5.500 rod)

SEALS

The 'HH' Series allows for the use of different types of seal design and material compounds in every area, for maximum flexibility and performance.

How to Order Seals

S S S S

PISTON SEAL	
S	STANDARD (CARBOXILATED)
C	CAST-RING
E	EP
T	PTFE
V	FLUOROCARBON

ROD SEAL	
S	STANDARD (POLYURETHANE)
E	EP
V	FLUOROCARBON

TUBE SEAL	
S	STANDARD (BUNA)
E	EP
V	FLUOROCARBON

ROD WIPER	
S	STANDARD (FLOCKED NITRILE)
M	METALLIC SCRAPER
T	PTFE
V	FLUOROCARBON

S Standard Seals

Piston: Carboxilated Nitrile
Rod Seal: Polyurethane
Tube Seals: Buna
Rod Wiper: Flocked Nitrile

Temperature Rating: -20°F to 200°F (-29°C to 93°C)

Compatible with: Mineral based hydraulic fluids

E Ethylene Propylene

Temperature Rating: -50°F to 300°F (-45°C to 149°C)

Compatible with: Most Phosphate Ester (Skydrol 500 and 7000, type 2) fluids

C Cast Iron Piston Rings

Temperature Range: -20°F to 400°F* (-29°C to 204°C)
Compatible with: Virtually all fluids
Uses: Hydraulic shock protection

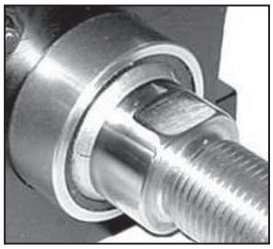
*When cylinder is equipped with Viton seals.

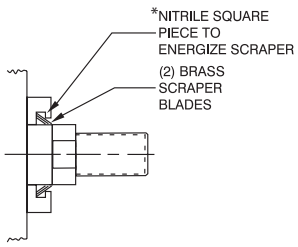
T Glass Filled PTFE

Temperature Rating (PTFE): -100°F to 400°F (-73°C to 204°C)
Temperature Rating (Nitrile): -20°F to 200°F (-29°C to 93°C)
Temperature Rating (Viton): 0°F to 400°F (-18°C to 204°C)
Compatible with: All hydraulic fluids and almost any fluid
Use: Low friction and high side load

M Metallic Rod Scraper

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





*Standard energizer will match cylinder seals.

V Fluorocarbon

Temperature Rating: 0°F to 400°F (-18°C to 204°C)
(Up to 400°F with reduced service life)

Compatible with: Some Phosphate Ester (Houghto-Safe 1000, 1120; Pyrogard 42, 43, 53, 55) fluids; mineral based petroleum, halogenated hydrocarbons, silicate ester and diester fluids

XX Special

Non-standard seals can be furnished.

Contact TRD for more information.

SERIES 'HH' BASIC OPTIONS

ST *Stop Tube and Rod Size Selection*

Stop tubes are designed to reduce the piston rod bushing stress to within the designed range of the bearing material. This will ensure proper cylinder performance in any given application. Stop tubes lower the cylinder bearing stress by adding length to the piston, which increases the overall length of the cylinder (Note: TRD uses a double piston design when possible).

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 has 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:

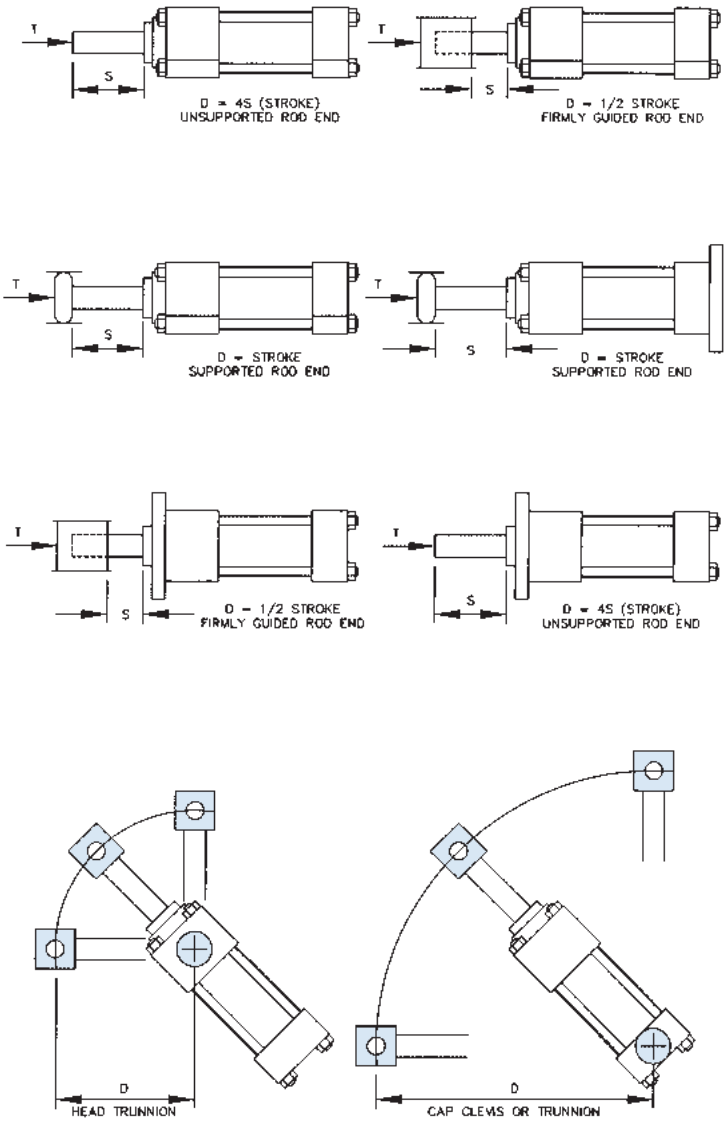
- **Add the stop tube prefix "ST=" and the stop tube length to the cylinder model number.**
- **Add "ES" after the cylinder stroke to indicate that the stroke is the effective stroke.**

Example:
HH-MS2-2.50 X 42ES-100-KK2-P15=N375-SSSS-ST=2

Chart 1

Find the value of "D" for your application

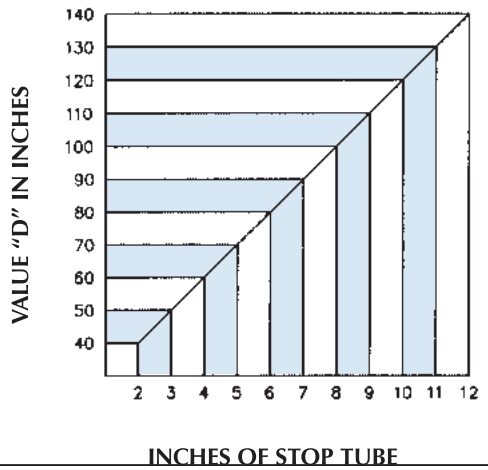
"D" = Stroke, adjusted for mounting condition
"S" = Actual cylinder stroke
"T" = Axial thrust (refer to Chart 3)



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

Chart 2

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



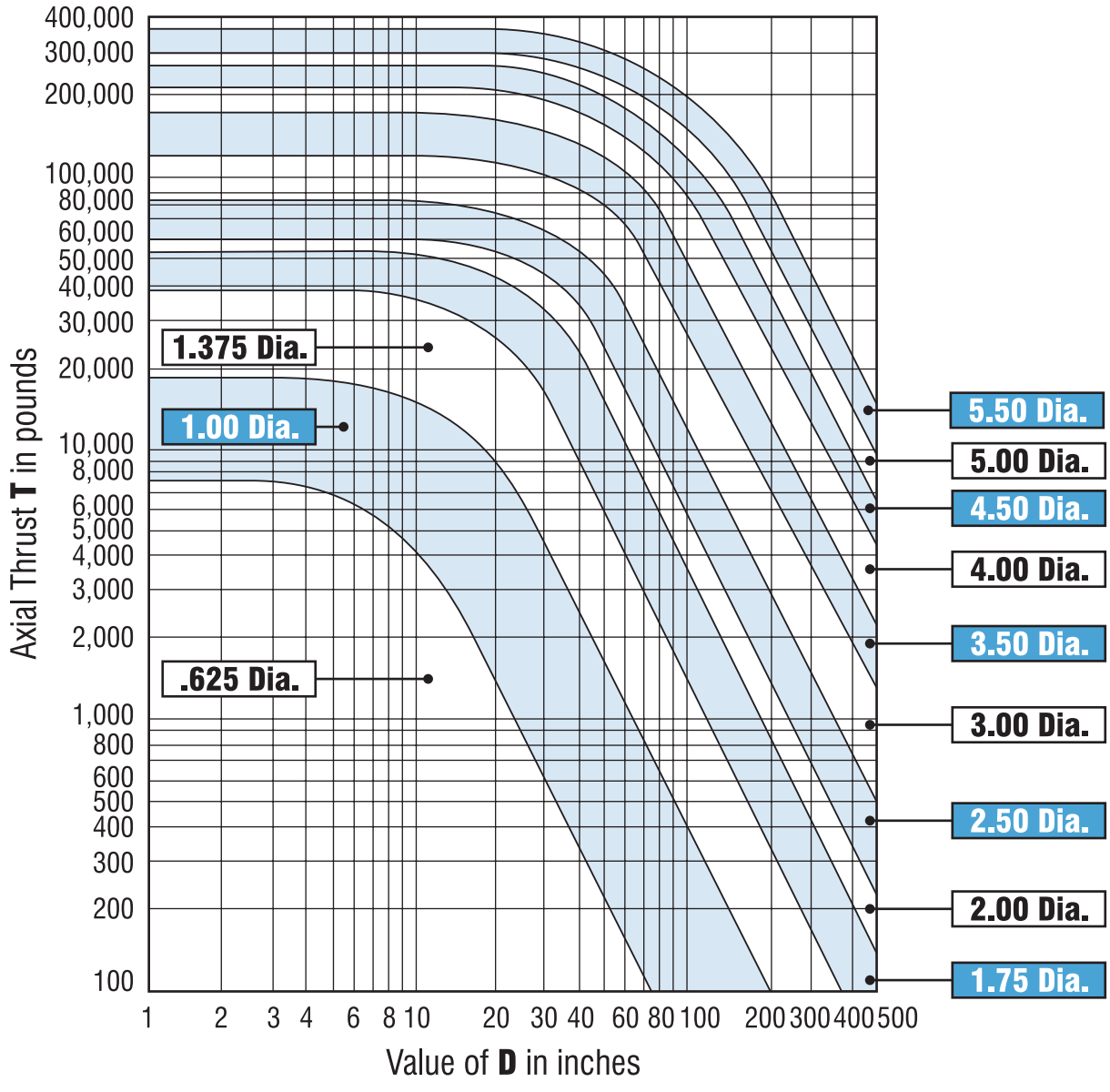
Refer to page 54 for Rod Size Selection Chart

Piston Rod Size Selection

Standard rod sizes are usually suitable for shorter stroke applications at lower hydraulic pressures. With high thrust force or long stroke applications, you must check the column strength of the rod in the mounting style to determine the proper rod diameter size.

1. Determine the total axial thrust by multiplying the bore area size (in inches) by the operating pressure (in PSI).
2. From page 53, determine the value of "D" for the application.
3. Find the value of "D" in the chart below. Follow the value of "D" vertically on the graph until it intersects with the axial thrust value of the cylinder. The intersection of these two values will fall within one of the shaded areas representing the piston rod diameter size required for the application.

Chart 3 (Piston Rod Diameter Selection)



SERIES 'HH' UNCOMMON OPTIONS

3P *Three-Position Cylinder*

You can create a 3-Position cylinder from two of the same bore size cylinders.

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

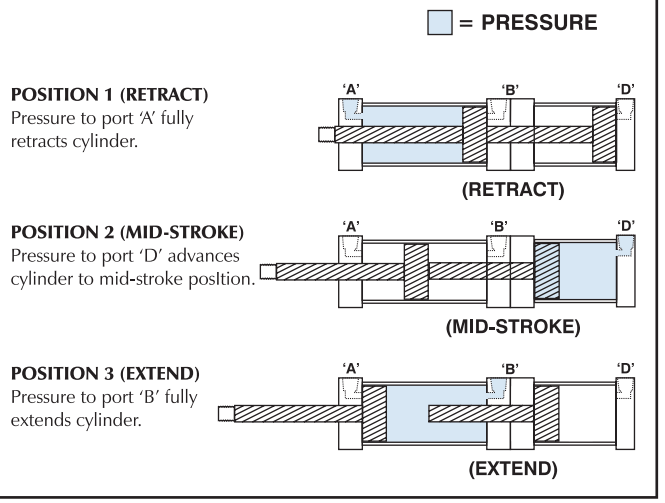
3-POSITION BENEFITS:

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

Note: Piston rods are not connected.

Contact TRD for more information.

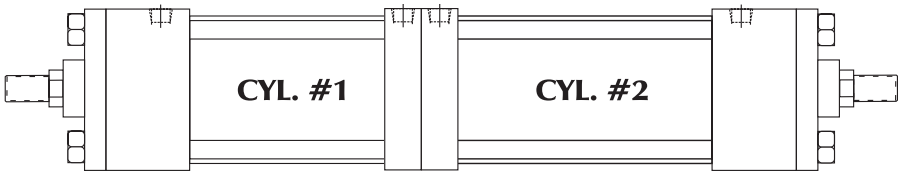
3-POSITION CYLINDERS
HOW THEY WORK



BTB *Back-To-Back Cylinders*

Back-to-Back cylinders consist of two individual cylinders built as one unit. These cylinders can act as a four position cylinder.

Contact TRD for more information.

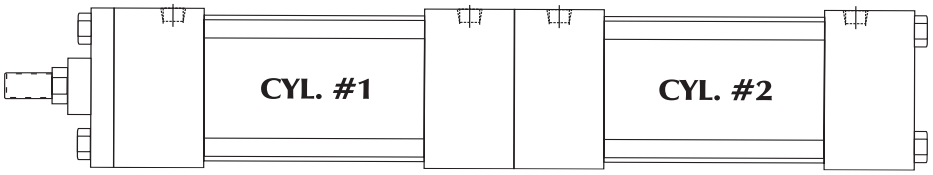


TM *Tandem Cylinders*

You can tandem different cylinders together to create unlimited design possibilities.

Note: Piston rods are connected.

Contact TRD for more information.



SPECIAL FINISHES

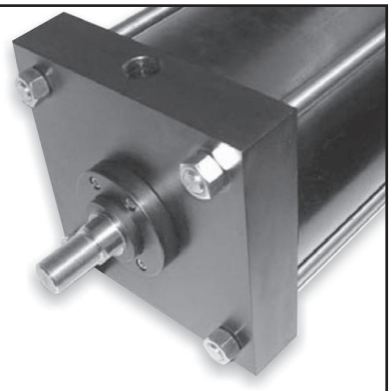
Standard Finish: Black Urethane Paint (suitable for indoor or outdoor use).

Optional Paint: Black Epoxy Paint (suitable for indoor use only).

Additional Paint Choices: TRD can provide paint in any color or type.

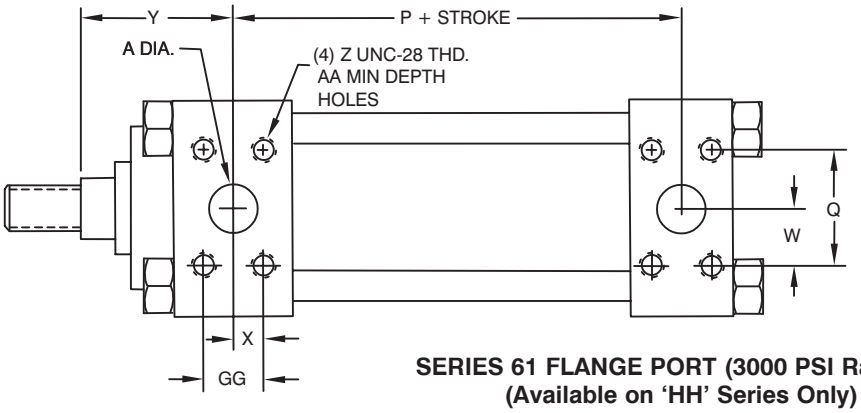
Additional Finishes: TRD can provide special finishes, i.e. Nutride Plate Heavy Chrome Plated Piston Rods.

Contact TRD with your specifications — we would be pleased to provide a quote!



SERIES 'HH' UNCOMMON OPTIONS

FLANGE PORTS



Ref Port Call Out Information

P15 = FL24

PORT POSITION	FLANGE PORT	SAE DASH NO.

Note:
Flanges overhang caps on 2.50" through 5.00" Bore

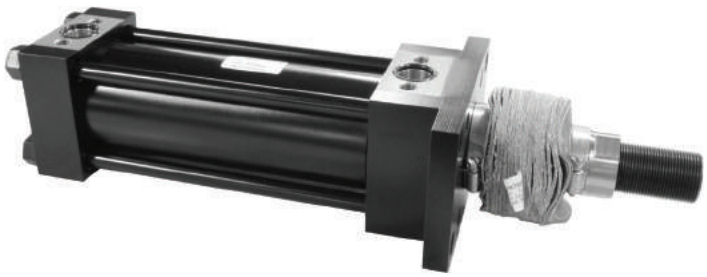
Affected Mounts:
ME5 and MF6 Mounts are not available
MF2 Mount is not available with ports at positions 6 and/or 8

SERIES 61 FLANGE PORT (3000 PSI Rating)
(Available on 'HH' Series Only)

BORE	ROD DIA. (MM)	MAX PSI RATING	SAE DASH NO.	Y	P	A	Q	W	X	Z	AA	GG	REF. MAIN FLANGE SIZE
2.50	1.000	3000	8	2.250	3.125	0.500	1.500	0.750	0.340	5/16 -18	0.810	0.690	1/2
3.25	1.375	3000	12	2.625	3.750	0.750	1.870	0.938	0.438	3/8 -16	0.750	0.870	3/4
	1.750			2.875									
	2.000			3.000									
4.00	1.750	3000	12	2.875	4.000	0.750	1.870	0.938	0.438	3/8 -16	0.750	0.870	3/4
	2.000			3.000									
	2.500			3.250									
5.00	2.000	3000	12	3.000	4.500	0.750	1.870	0.938	0.438	3/8 -16	0.750	0.870	3/4
	2.500			3.250									
	3.000			3.250									
	3.500			3.250									
6.00	2.500	3000	16	3.375	5.125	1.000	2.060	1.030	0.520	3/8 -16	0.870	1.030	1
	3.000												
	3.500												
	4.000												
7.00	3.000	3000	20	3.688	5.625	1.25	2.31	1.16	0.590	7/16 - 14	1.000	1.190	1 1/4
	3.500												
	4.000												
	4.500												
	5.000												
8.00	3.500	3000	24	3.750	6.500	1.500	2.750	1.370	0.700	1/2 -13	1.060	1.410	1 1/2
	4.000												
	4.500												
	5.000												
	5.500												

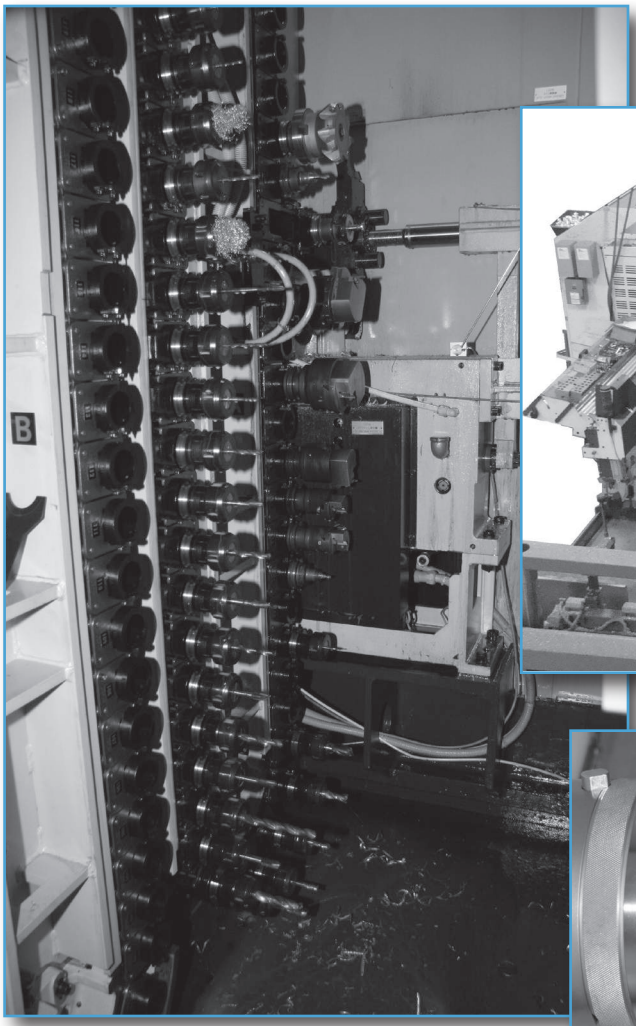
ROD BOOTS

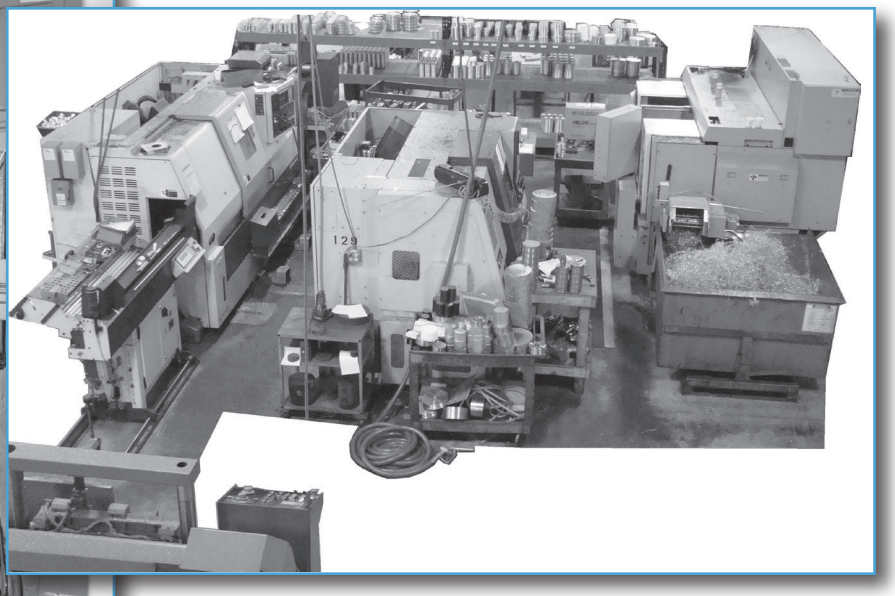
Rod boots are common in dirty environments; a standard spec for many applications.
(Note: Rod boots add length to cylinder rod extension)

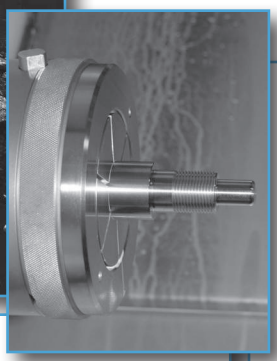


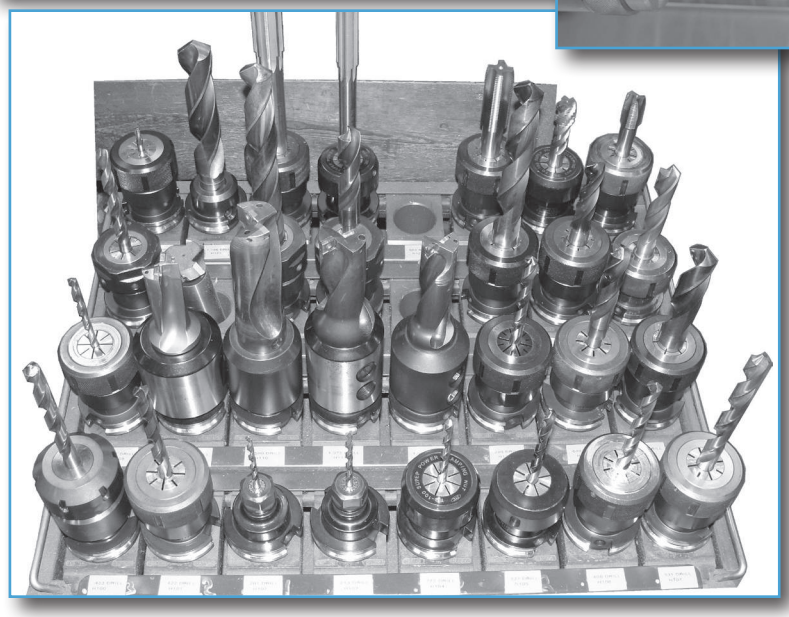
WHY TRD CYLINDERS CAN COST LESS THAN OTHER CYLINDERS...

Quick-change preset tooling, CNC programming and Flexible Manufacturing Systems (FMS) eliminate virtually all set-up costs. TRD doesn't have to charge for set-up or lot charges, which saves customers money.







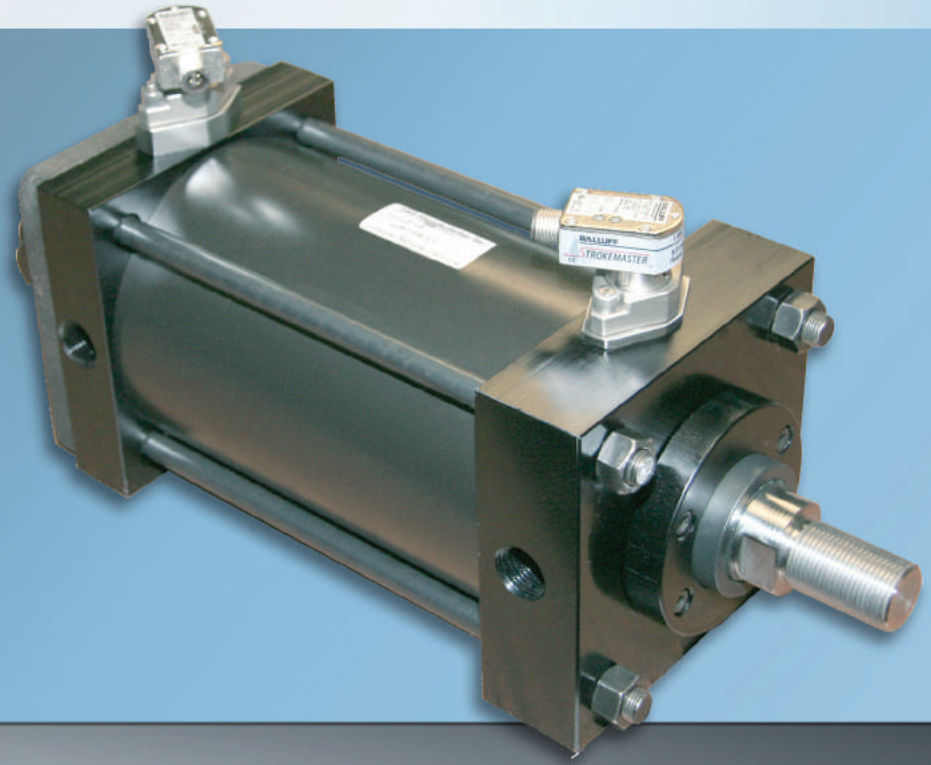


MH Series Medium Duty Industrial Hydraulic

1.50″ to 8.00″ Bore

Single Rod End Page 59

Double Rod End Page 80



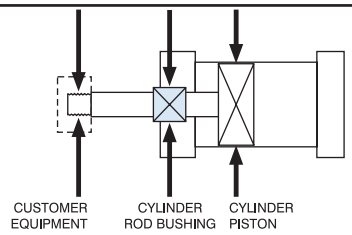
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'MH' (NFPA) CYLINDER

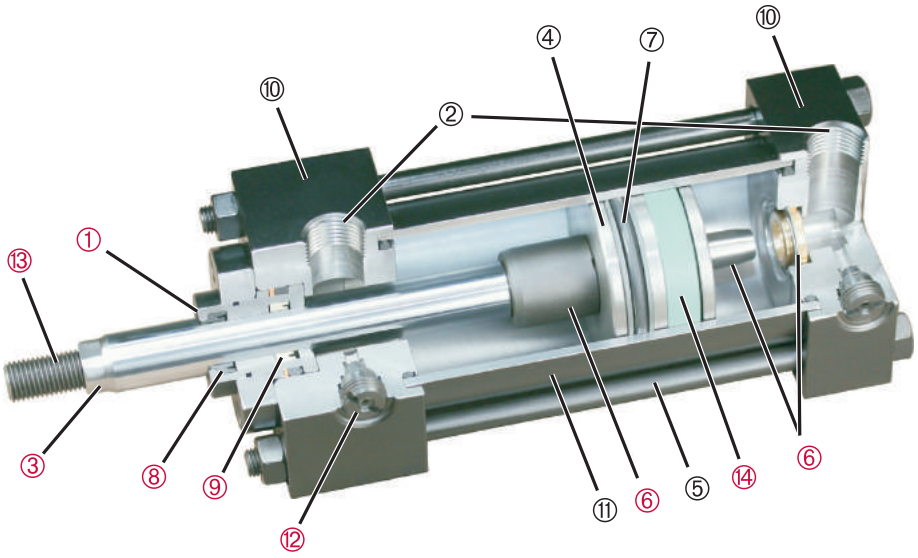
Floating Rod Bushing

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 ductile iron and PTFE coated to reduce friction and extend cycle life. Bushing design traps lubrication in effective bearing area. Bronze bushings also available.

② ***PORTS*** – NPTF and SAE ports available standard. Non-standard locations, sizes and other port styles can be made-to-order to fit any application needs.

③ ***PISTON ROD*** – Steel piston rod provides high strength and damage resistance. Induction hardened and chrome plated for maximum wear resistance and long life (100K min. yield up to 5" rod; 75K min. yield for 5 1/2" rod).

④ ***PISTON*** – Precision machined ductile iron provides high strength and an excellent bearing surface for extended cylinder life.

⑤ ***TIE RODS*** – Pre-stressed high carbon steel tie rod construction eliminates axial loading of cylinder tube and maintains compression on tube (100K min. yield).

⑥ ***CUSHION*** – Precision machined cushions are available at either end and provide smooth deceleration which helps reduce end of stroke shock.

⑦ ***PISTON SEAL*** – Heavy-duty, bi-directional Carboxilated Nitrile T-Seal with double back-up. Rated for shock loads and incorporates anti-extrusion technology. EP, PTFE and fluorocarbon designs available.

⑧ ***ROD WIPER*** – Flocked nitrile wiper removes contaminants on retract stroke, helping ensure long life for all internal components.

⑨ ***ROD SEALS*** – Polyurethane seals offer high abrasion resistance and strength. Pressure activated double lip and wear compensating for extended life.

⑩ ***HEAD & CAP*** – Precision machined steel head and cap are held to tight tolerances and ensure accurate alignment for a truly square cylinder.

⑪ ***TUBE*** – Precision machined steel tube with hard chrome I.D. is honed and micro finished for extended seal life and improved cycle rates.

⑫ ***CUSHION ADJUSTMENT NEEDLE*** – Adjustable steel needle design has fine thread metering and is positively captured to prevent needle ejection during adjustment.

⑬ ***PISTON ROD STUD*** – Standard on KK1 and KK2 threads for 5/8" - 2" rods (125K min. yield). Available up to two times standard "A" thread length.

⑭ ***WEAR BAND*** – Wear Guard Nylon (standard); reinforced PTFE for E and V seal option.

FINISH – Black urethane paint.

Note: Items in RED are the exact same heavy-duty components used in TRD's 3000 PSI (207 BAR) 'HH' Series.

OPERATING PRESSURE	1500 PSI HYD (103 BAR) *Refer to mount section for specific PSI rating by bore size and mount.*

OPERATING TEMPERATURE	Standard Seals: -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 98 for cylinder design guidance).
- ***CS*** – Center supports are recommended for cylinders with long strokes in horizontal applications to prevent buckling of the cylinder and extend cylinder life.
- ***SSR*** – 17-4 Chrome Plated Stainless Steel Piston Rod provide corrosion resistance in outdoor applications and wet environments (100K min. yield up to 5" rod; 75K min. yield 5 1/2" rod).
- ***HP*** – High-impact pistons use a high strength steel nut retained piston for fatigue resistance and additional strength in demanding applications.

HOW TO ORDER: SERIES 'MH' (MEDIUM DUTY HYDRAULIC CYLINDERS)

MH - MF1 ___ - 250 x 10 - H2C6 - 100 - KK1 - P15 = N375 - S S S S - _____

SERIES	
MH	MEDIUM DUTY HYDRAULIC

STYLE	
(BLANK)	SINGLE ROD
D	DOUBLE ROD

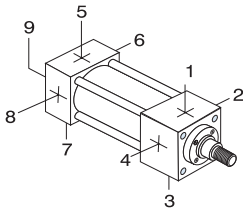
STROKE
0" to 120"
Made-to-Order.
(Use decimals for fractional strokes)

NFPA MOUNTS	
MX0	NO MOUNT (1.50" to 8.00" Bore)
MF1	HEAD RECTANGULAR FLANGE (1.50" to 6.00" Bore)
MF2	CAP RECTANGULAR FLANGE (1.50" to 6.00" Bore)
MF5	HEAD SQUARE FLANGE (1.50" to 6.00" Bore)
MF6	CAP SQUARE FLANGE (1.50" to 6.00" Bore)
ME3	HEAD MOUNTING HOLES (8.00" Bore)
ME4	CAP MOUNTING HOLES (8.00" Bore)
MP1	FIXED CAP PIVOT CLEVIS (1.50" to 8.00" Bore)
MP2	DETACHABLE CAP PIVOT CLEVIS (1.50" to 6.00" Bore)
MS2	SIDE LUGS (1.50" to 8.00" Bore)
MS3	CENTER LINE LUGS (1.50" to 8.00" Bore)
MS4	BOTTOM TAPPED HOLES (1.50" to 8.00" Bore)
MS7	END LUGS (1.50" to 8.00" Bore)
MT1	HEAD TRUNNION (1.50" to 8.00" Bore)
MT2	CAP TRUNNION (1.50" to 8.00" Bore)
MT4	INTERMEDIATE (CENTER) TRUNNION (1.50" to 8.00" Bore)
MX1	EXTENDED TIE RODS - HEAD & CAP (1.50" to 8.00" Bore)
MX2	EXTENDED TIE RODS - CAP (1.50" to 8.00" Bore)
MX3	EXTENDED TIE RODS - HEAD (1.50" to 8.00" Bore)
SB	SPHERICAL BEARING CAP PIVOT (1.50" to 8.00" Bore)

BORE	
150	1.50"
200	2.00"
250	2.50"
325	3.25"
400	4.00"
500	5.00"
600	6.00"
800	8.00"

CUSHIONS	
H	1
	2
	3
	4
C	5
	6
	7
	8

Call out 'H' for head cushion, 'C' for cap cushion, followed by the desired location(s).



Location 9 is center of cap face.

ROD SIZE	
062	0.625" ROD DIA.
100	1.000" ROD DIA.
137	1.375" ROD DIA.
175	1.750" ROD DIA.
200	2.000" ROD DIA.
250	2.500" ROD DIA.
300	3.000" ROD DIA.
350	3.500" ROD DIA.
400	4.000" ROD DIA.
450	4.500" ROD DIA.
500	5.000" ROD DIA.
550	5.500" ROD DIA.

ROD END	
KK1	SMALL MALE THREAD
KK2	LARGE MALE THREAD
KK3	FEMALE THREAD
KK3M	FEMALE METRIC ROD THREAD
KK3X	FEMALE SPECIAL THREAD
KK4	FULL DIA. MALE THREAD
KK5	PLAIN END
KK10	ROD COUPLER END
KKM	METRIC THREAD
KKX	MALE SPECIAL THREAD

When additional thread details are required, use format "Rod End" = "Modification"

Example: KKM=M12 x 1.75

PORT LOC	
P	1
	2
	3
	4
	5
	6
	7
	8
	9

Call out 'P' followed by all desired locations.

PORT SIZE	
N062	0.063" NPTF
N125	0.125" NPTF
N250	0.250" NPTF
N375	0.375" NPTF
N500	0.500" NPTF
N750	0.750" NPTF
S6	#6 SAE
S8	#8 SAE
S10	#10 SAE
S12	#12 SAE

SEALS
See Below for Seal Ordering Instructions

Port Note:
For complex port designs, multiple port locations & sizes can be ordered. Call out locations and sizes for all sets using the following format.

Example:-P15=N375 -P26=N500

(3/8" NPTF Ports at 1 & 5 and 1/2" NPTF Ports at 2 & 6)

BSPP & BSPT ports also available.

HOW TO ORDER SEALS

S S S S

PISTON SEAL	
S	STANDARD (Carboxilated)
C	Cast-Ring
E	EP
T	PTFE**
V	Fluorocarbon

ROD SEAL	
S	STANDARD (Polyurethane)
E	EP
V	Fluorocarbon

TUBE SEAL	
S	STANDARD (Buna)
E	EP
V	Fluorocarbon

ROD WIPER*	
S	STANDARD (Flocked Nitrile)
M	Metallic Scraper
T	PTFE
V	Fluorocarbon

*When cylinder design calls for all EP seals, use PTFE rod wiper.
**See page 97 for seal specifications.

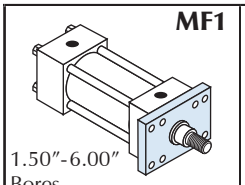
OPTIONS	
A=	EXTENDED PISTON ROD THREAD (EXAMPLE: A = 2") (MAX = 2 TIMES ST'D "A" DIM.)
ABP=	AIR BLEED PORTS (EXAMPLE: ABP=15)
AS=	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, EXAMPLE: AS = 4")
C=	EXTENDED PISTON ROD (EXAMPLE: IF C = 0.500", THEN 1" ROD EXTENSION IS C = 1.500")
CS	CENTER SUPPORT
DBB=	DRAIN BACK BUSHING (EXAMPLE: DBB=1)
EK	EXTENDED KEYPLATE
HLP	HIGH LOAD PISTON
HSS	HIGH SHOCK SEALS
LRB	LIFT RING BOSS
NR	NON-ROTATING
PLS	PISTON LOCK SCREW (STD.)
RBB	ROD BUSHING MATERIAL: BRONZE
SSR	STAINLESS STEEL PISTON ROD
ST=	STOP TUBE NOTE: SPECIFY STOP TUBE LENGTH (IN INCHES) SPECIFY STROKE AS ES (EFFECTIVE STROKE) EXAMPLE: MH-MS2-250X48ES-H2C6-ST=3*
4WF	FOUR WRENCH FLATS (ROD SIZES: 0.625"- 3.500")
XX=	SPECIAL VARIATION (SPECIFY)

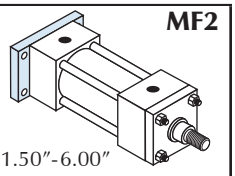
*The desired stop tube length adds directly to the overall cylinder length.

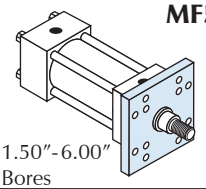
Note: Refer to MH Options for specifications.

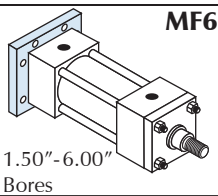
MAXIMUM STROKE RECOMMENDATIONS			
BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION)	
		ONE SUPPORT	TWO SUPPORTS
1.50", 2.00" & 2.50"	48 INCHES	OVER 48 INCHES	OVER 72 INCHES
3.25", 4.00" & 5.00"	65 INCHES	OVER 65 INCHES	OVER 92 INCHES
6.00"	72 INCHES	OVER 72 INCHES	NOT REQUIRED

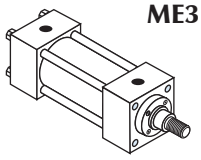
NFPA MOUNTS

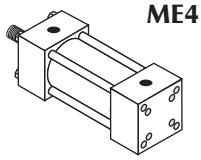

MF1
1.50"-6.00" Bores

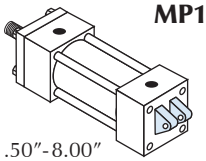

MF2
1.50"-6.00" Bores

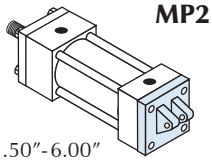

MF5
1.50"-6.00" Bores

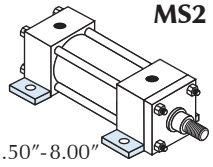

MF6
1.50"-6.00" Bores

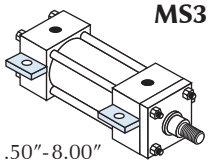

ME3
8.00" Bore

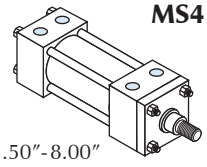

ME4
8.00" Bore

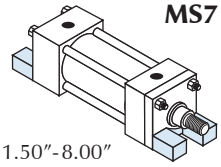

MP1
1.50"-8.00" Bores

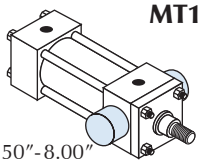

MP2
1.50"-6.00" Bores

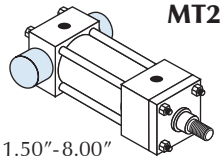

MS2
1.50"-8.00" Bores

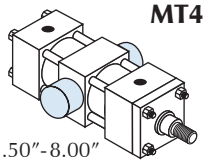

MS3
1.50"-8.00" Bores

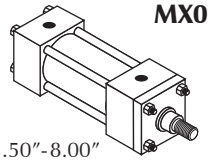

MS4
1.50"-8.00" Bores

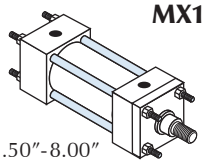

MS7
1.50"-8.00" Bores

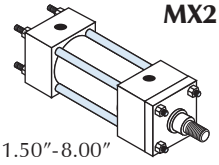

MT1
1.50"-8.00" Bores


MT2
1.50"-8.00" Bores


MT4
1.50"-8.00" Bores


MX0
1.50"-8.00" Bores


MX1
1.50"-8.00" Bores


MX2
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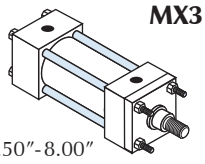
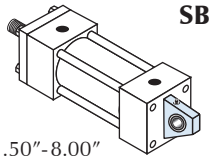
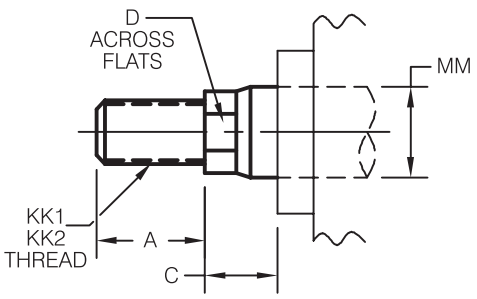

MX3
1.50"-8.00" Bores

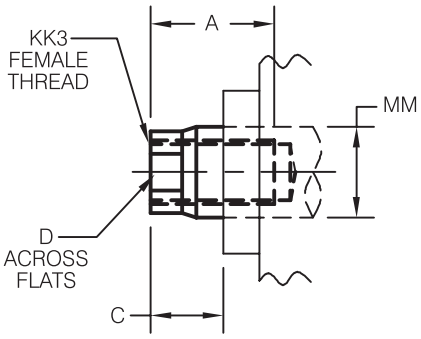

SB
1.50"-8.00" Bores

SERIES 'MH' DIMENSIONS: THREADS

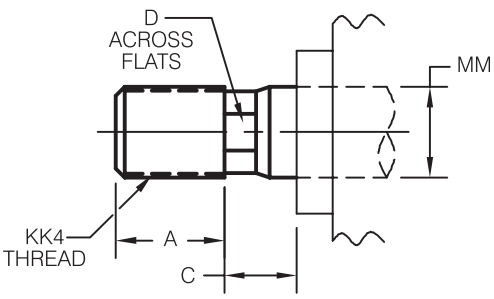
ROD END STYLE: KK1 KK2



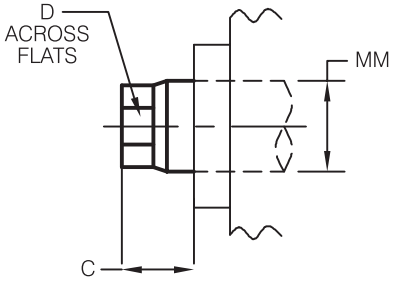
ROD END STYLE: KK3



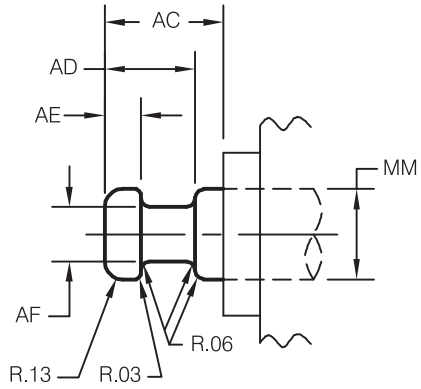
ROD END STYLE: KK4



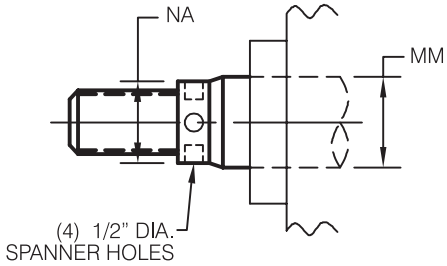
ROD END STYLE: KK5



ROD END STYLE: KK10



SPANNER HOLES (4.000-5.500 RODS) (SHOWN ON KK1-KK2)



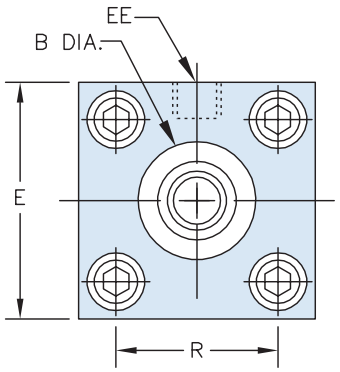
ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4	NA ±.002
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16 - 20*	1/2 - 20*	7/16 - 20	5/8 - 18	—
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 - 16*	7/8 - 14*	3/4 - 16	1 - 14	—
1.375	1.625	0.625	1.125	1.750	1.062	0.375	0.875	1 - 14*	1 1/4 - 12*	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	—
2.000	2.250	0.875	1.750	2.625	1.688	0.625	1.375	1 1/2 - 12*	1 3/4 - 12*	1 1/2 - 12	2 - 12	—
2.500	3.000	1.000	2.125	3.250	1.938	0.750	1.750	1 7/8 - 12	2 1/4 - 12	1 7/8 - 12	2 1/2 - 12	—
3.000	3.500	1.000	2.625	3.625	2.438	0.875	2.250	2 1/4 - 12	2 3/4 - 12	2 1/4 - 12	3 - 12	—
3.500	3.500	1.000	3.000	4.375	2.688	1.000	2.500	2 1/2 - 12	3 1/4 - 12	2 1/2 - 12	3 1/2 - 12	—
4.000	4.000	1.000	—	4.500	2.688	1.000	3.000	3 - 12	3 3/4 - 12	3 - 12	4 - 12	3.875
4.500	4.500	1.000	—	5.250	3.188	1.500	3.500	3 1/4 - 12	4 1/4 - 12	3 1/4 - 12	4 1/2 - 12	4.375
5.000	5.000	1.000	—	5.375	3.188	1.500	3.875	3 1/2 - 12	4 3/4 - 12	3 1/2 - 12	5 - 12	4.875
5.500	5.500	1.000	—	6.250	3.938	1.875	4.375	4 - 12	5 1/4 - 12	4 - 12	5 1/2 - 12	5.375

*Studded rod end.
(4) Wrench flats is an option.
Note: Rods larger than 3.50" dia. utilize (4) 0.50" dia. spanner holes 0.50" deep.

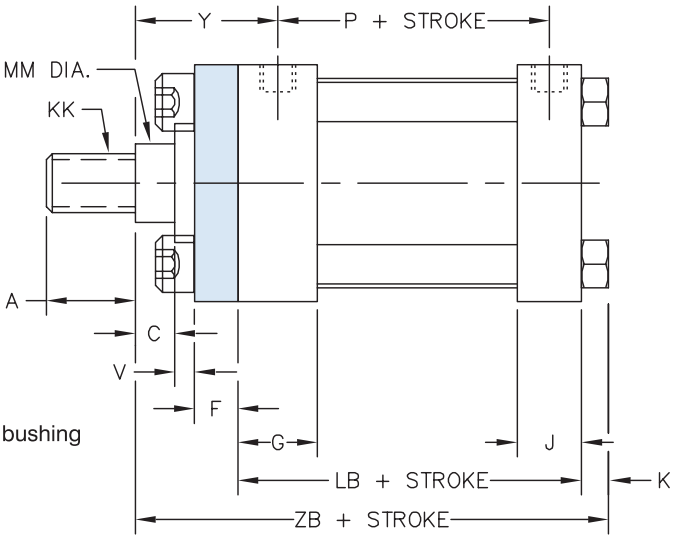
SERIES 'MH' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)

RETAINER CONSTRUCTION

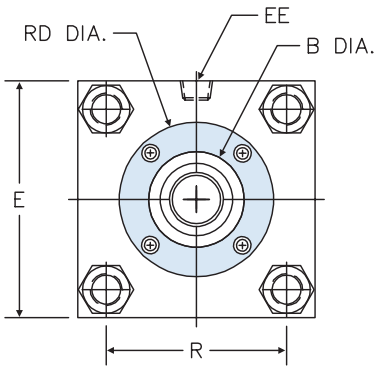
FULL SQUARE RETAINER USED ON:	
BORE	ROD DIA.
1.50	0.625
	1.000
2.00	1.000
	1.375
2.50	1.000
	1.375
	1.750
3.25	1.375
	1.750
	2.000
4.00	2.000
	2.500
5.00	2.500
	3.000
	3.500
6.00	4.000



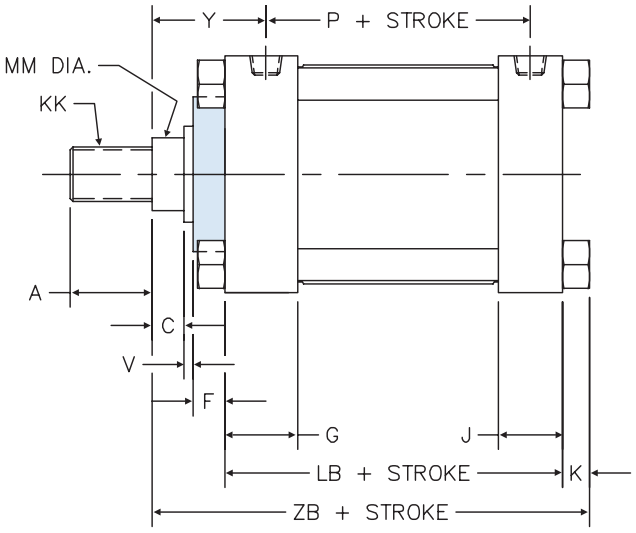
Note: Full square retainer is removable to service rod bushing



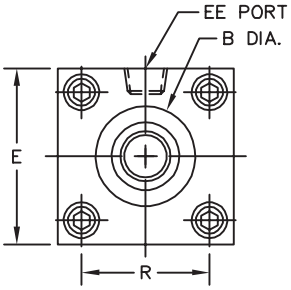
ROUND RETAINER USED ON:	
BORE	ROD DIA.
2.00	0.625
2.50	0.625
3.25	1.000
4.00	1.000
	1.375
	1.750
5.00	1.000
	1.375
	1.750
	2.000
6.00	1.375
	1.750
	2.000
	2.500
	3.000
	3.500
8.00	1.375
	1.750
	2.000
	2.500
	3.000
	3.500
	4.000
	4.500
	5.000
	5.500



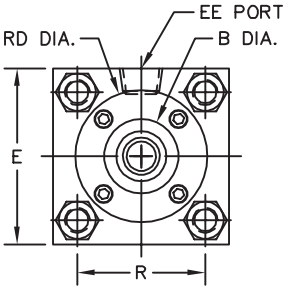
Note: Round retainer is removable to service rod bushing.



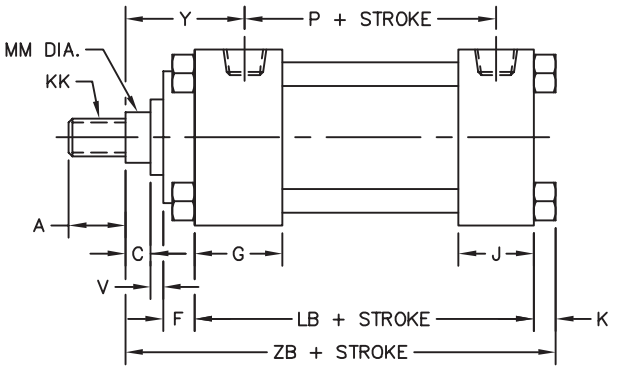
SERIES 'MH' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)



WITH SQUARE RETAINER



WITH ROUND RETAINER



BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	EE NPTF	EE SAE	F	G	J	K	KK	R	③ RD	V	Y	ADD TO STROKE LB	ADD TO STROKE P	ADD TO STROKE ZB
1.50	0.625	1500	2.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.250	SEE ROD END DETAIL CHART ON PAGE 61	1.430	SQ	0.250	1.875	3.625	2.375	4.875
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.250
2.00	0.625	1500	2.500	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.313		1.840	2.000	0.250	1.875	3.625	2.375	4.938
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.313
	1.375	1500		1.625	1.999	0.625									SQ	0.625	2.500			5.563
2.50	0.625	1000	3.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.313		2.190	2.000	0.250	1.875	3.750	2.500	5.063
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.438
	1.375	1500		1.625	1.999	0.625									SQ	0.625	2.500			5.688
	1.750	1500		2.000	2.374	0.750									SQ	0.750	2.750			5.938
3.25	1.000	1500	3.750	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.375		2.760	2.750	0.250	2.375	4.250	2.750	6.000
	1.375	1500		1.625	1.999	0.625									SQ	0.375	2.625			6.250
	1.750	1500		2.000	2.374	0.750									SQ	0.500	2.875			6.500
	2.000	1500		2.250	2.624	0.875									SQ	0.500	3.000			6.625
4.00	1.000	1000	4.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.375		3.320	2.750	0.250	2.375	4.250	2.750	6.000
	1.375	1000		1.625	1.999	0.625									3.500	0.375	2.625			6.250
	1.750	1000		2.000	2.374	0.750									3.500	0.500	2.875			6.500
	2.000	1000		2.250	2.624	0.875									SQ	0.500	3.000			6.625
	2.500	1000		3.000	3.124	1.000									SQ	0.625	3.250			6.875
5.00	1.000	750	5.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.438		4.100	2.750	0.250	2.375	4.500	3.000	6.313
	1.375	1000		1.625	1.999	0.625									3.500	0.375	2.625			6.563
	1.750	1000		2.000	2.374	0.750									3.500	0.500	2.875			6.813
	2.000	1000		2.250	2.624	0.875									4.250	0.500	3.000			6.983
	2.500	1000		3.000	3.124	1.000									SQ	0.625	3.250			7.188
	3.000	1000		3.500	3.749	1.000									SQ	0.625	3.250			7.188
	3.500	1000		3.500	4.249	1.000									SQ	0.625	3.250			7.188
6.00	1.375	750	6.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	1.500	0.438		4.880	3.500	0.250	2.750	5.000	3.250	7.063
	1.750	750		2.000	2.374	0.750									3.875	0.375	3.000			7.313
	2.000	750		2.250	2.624	0.875									4.250	0.375	3.125			7.438
	2.500	750		3.000	3.124	1.000									4.625	0.500	3.375			7.688
	3.000	750		3.500	3.749	1.000									5.250	0.500	3.375			7.688
	3.500	750		3.500	4.249	1.000									5.750	0.500	3.375			7.688
	4.000	750		4.000	4.749	1.000									SQ	0.500	3.375			7.688
8.00	1.375	500	8.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	1.500	0.563		6.440	3.500	0.250	2.750	5.125	3.375	7.313
	1.750	500		2.000	2.374	0.750									3.875	0.375	3.000			7.563
	2.000	675		2.250	2.624	0.875									4.250	0.375	3.125			7.688
	2.500	675		3.000	3.124	1.000									4.625	0.500	3.375			7.938
	3.000	675		3.500	3.749	1.000									5.250	0.500	3.375			7.938
	3.500	675		3.500	4.249	1.000									5.750	0.500	3.375			7.938
	4.000	675		4.000	4.749	1.000									6.500	0.500	3.375			7.938
	4.500	675		4.500	5.249	1.000									7.250	0.500	3.375			7.938
	5.000	675		5.000	5.749	1.000									7.500	0.500	3.375			7.938
	5.500	675		5.500	6.249	1.000									7.500	0.500	3.375			7.938

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

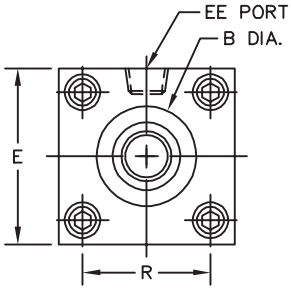
③ Where SQ is shown in chart, cylinder utilizes a full square retainer.

'MH' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 63)

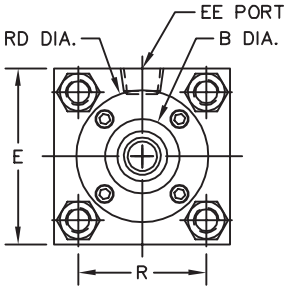
EASY FLIP OUT PAGE FOR REFERENCE

EASY FLIP OUT PAGE FOR REFERENCE

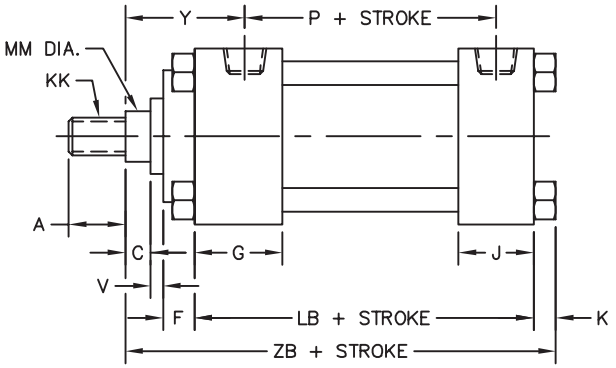
SERIES 'MH' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)



WITH SQUARE RETAINER



WITH ROUND RETAINER



BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	EE NPTF	EE SAE	F	G	J	K	KK	R	③ RD	V	Y	ADD TO STROKE LB	P	ZB
1.50	0.625	1500	2.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.250	SEE ROD END DETAIL CHART ON PAGE 61	1.430	SQ	0.250	1.875	3.625	2.375	4.875
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.250
2.00	0.625	1500	2.500	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.313		1.840	2.000	0.250	1.875	3.625	2.375	4.938
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.313
	1.375	1500		1.625	1.999	0.625									SQ	0.625	2.500			5.563
2.50	0.625	1000	3.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	1.000	0.313		2.190	2.000	0.250	1.875	3.750	2.500	5.063
	1.000	1500		1.125	1.499	0.500									SQ	0.500	2.250			5.438
	1.375	1500		1.625	1.999	0.625									SQ	0.625	2.500			5.688
	1.750	1500		2.000	2.374	0.750									SQ	0.750	2.750			5.938
3.25	1.000	1500	3.750	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.375		2.760	2.750	0.250	2.375	4.250	2.750	6.000
	1.375	1500		1.625	1.999	0.625									SQ	0.375	2.625			6.250
	1.750	1500		2.000	2.374	0.750									SQ	0.500	2.875			6.500
	2.000	1500		2.250	2.624	0.875									SQ	0.500	3.000			6.625
4.00	1.000	1000	4.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.375		3.320	2.750	0.250	2.375	4.250	2.750	6.000
	1.375	1000		1.625	1.999	0.625									3.500	0.375	2.625			6.250
	1.750	1000		2.000	2.374	0.750									3.500	0.500	2.875			6.500
	2.000	1000		2.250	2.624	0.875									SQ	0.500	3.000			6.625
	2.500	1000		3.000	3.124	1.000									SQ	0.625	3.250			6.875
5.00	1.000	750	5.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	1.250	0.438		4.100	2.750	0.250	2.375	4.500	3.000	6.313
	1.375	1000		1.625	1.999	0.625									3.500	0.375	2.625			6.563
	1.750	1000		2.000	2.374	0.750									3.500	0.500	2.875			6.813
	2.000	1000		2.250	2.624	0.875									4.250	0.500	3.000			6.983
	2.500	1000		3.000	3.124	1.000									SQ	0.625	3.250			7.188
	3.000	1000		3.500	3.749	1.000									SQ	0.625	3.250			7.188
	3.500	1000		3.500	4.249	1.000									SQ	0.625	3.250			7.188
6.00	1.375	750	6.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	1.500	0.438		4.880	3.500	0.250	2.750	5.000	3.250	7.063
	1.750	750		2.000	2.374	0.750									3.875	0.375	3.000			7.313
	2.000	750		2.250	2.624	0.875									4.250	0.375	3.125			7.438
	2.500	750		3.000	3.124	1.000									4.625	0.500	3.375			7.688
	3.000	750		3.500	3.749	1.000									5.250	0.500	3.375			7.688
	3.500	750		3.500	4.249	1.000									5.750	0.500	3.375			7.688
	4.000	750		4.000	4.749	1.000									SQ	0.500	3.375			7.688
8.00	1.375	500	8.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	1.500	0.563		6.440	3.500	0.250	2.750	5.125	3.375	7.313
	1.750	500		2.000	2.374	0.750									3.875	0.375	3.000			7.563
	2.000	675		2.250	2.624	0.875									4.250	0.375	3.125			7.688
	2.500	675		3.000	3.124	1.000									4.625	0.500	3.375			7.938
	3.000	675		3.500	3.749	1.000									5.250	0.500	3.375			7.938
	3.500	675		3.500	4.249	1.000									5.750	0.500	3.375			7.938
	4.000	675		4.000	4.749	1.000									6.500	0.500	3.375			7.938
	4.500	675		4.500	5.249	1.000									7.250	0.500	3.375			7.938
	5.000	675		5.000	5.749	1.000									7.500	0.500	3.375			7.938
	5.500	675		5.500	6.249	1.000									7.500	0.500	3.375			7.938

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

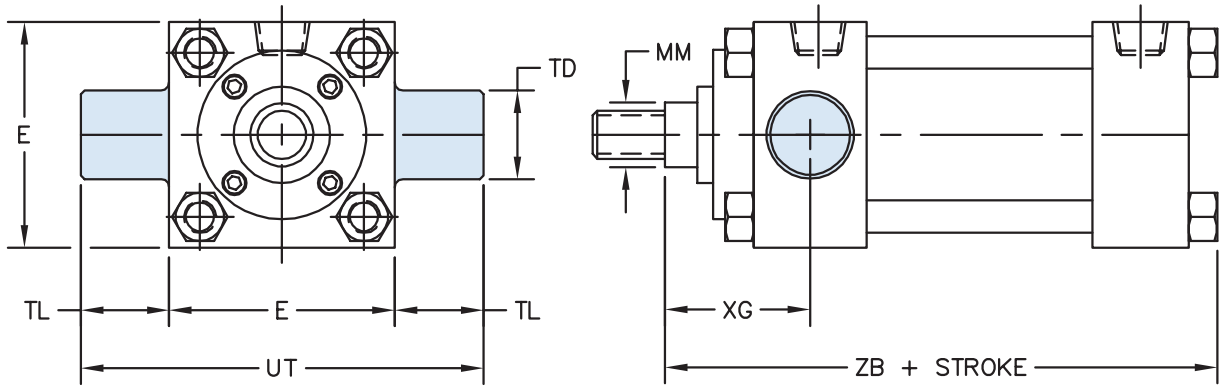
② 'B' dimension tolerance is +.000 / -.002

③ Where SQ is shown in chart, cylinder utilizes a full square retainer.

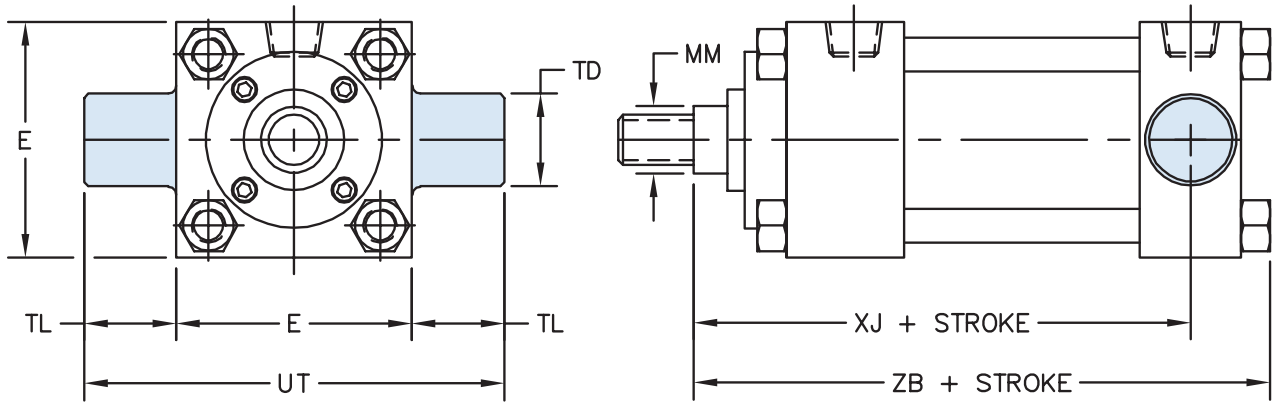
'MH' SERIES BASE DIMENSIONS FLIP-OUT (PAGE 63)

SERIES 'MH' DIMENSIONS: TRUNNION MOUNTS

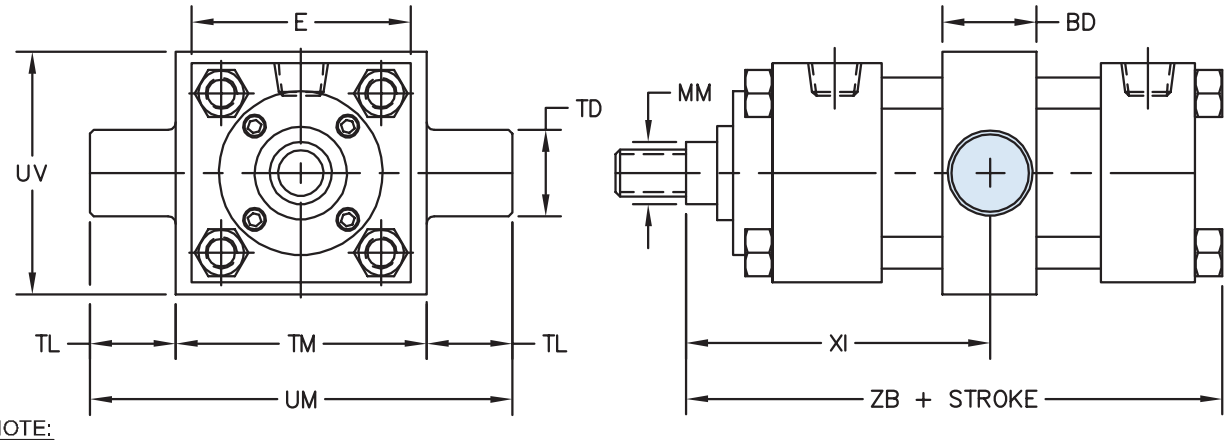
MT1: HEAD TRUNNION



MT2: CAP TRUNNION



MT4: INTERMEDIATE TRUNNION



NOTE:
'XI' DIMENSION TO BE SPECIFIED BY CUSTOMER

SERIES 'MH' DIMENSIONS: TRUNNION MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	BD	② TD	TL	TM	UM	UT	UV	XG	③ XI	MT4 MIN STROKE	ADD TO STROKE XJ	ADD TO STROKE ZB
1.50	0.625	1500	2.000	1.250	1.000	1.000	2.500	4.500	4.000	2.500	1.750	3.250	0.375	4.125	4.875
	1.000	1500									2.125	3.625		4.500	5.250
2.00	0.625	1500	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.750	3.375	0.625	4.125	4.938
	1.000	1500									2.125	3.750		4.500	5.313
	1.375	1500									2.375	4.000		4.750	5.563
2.50	0.625	1000	3.000	1.500	1.000	1.000	3.500	5.500	5.000	3.500	1.750	3.375	0.500	4.250	5.063
	1.000	1500									2.125	3.750		4.625	5.438
	1.375	1500									2.375	4.000		4.875	5.688
	1.750	1500									2.625	4.250		5.125	5.938
3.25	1.000	1500	3.750	2.000	1.000	1.000	4.500	6.500	5.750	4.250	2.250	4.250	1.000	5.000	6.000
	1.375	1500									2.500	4.500		5.250	6.250
	1.750	1500									2.750	4.750		5.500	6.500
	2.000	1500									2.875	4.875		5.625	6.625
4.00	1.000	1000	4.500	2.000	1.000	1.000	5.250	7.250	6.500	5.000	2.250	4.250	1.000	5.000	6.000
	1.375	1000									2.500	4.500		5.250	6.250
	1.750	1000									2.750	4.750		5.500	6.500
	2.000	1000									2.875	4.875		5.625	6.625
	2.500	1000									3.125	5.125		5.875	6.875
5.00	1.000	750	5.500	2.000	1.000	1.000	6.250	8.250	7.500	6.000	2.250	4.250	0.750	5.250	6.313
	1.375	1000									2.500	4.500		5.500	6.563
	1.750	1000									2.750	4.750		5.750	6.813
	2.000	1000									2.875	4.875		5.875	6.938
	2.500	1000									3.125	5.125		6.125	7.188
	3.000	1000									3.125	5.125		6.125	7.188
	3.500	1000									3.125	5.125		6.125	7.188
6.00	1.375	750	6.500	2.000	1.375	1.375	7.625	10.375	9.250	7.000	2.625	4.750	0.750	5.875	7.063
	1.750	750									2.875	5.000		6.125	7.313
	2.000	750									3.000	5.125		6.250	7.438
	2.500	750									3.250	5.375		6.500	7.688
	3.000	750									3.250	5.375		6.500	7.688
	3.500	750									3.250	5.375		6.500	7.688
	4.000	750									3.250	5.375		6.500	7.688
8.00	1.375	500	8.500	2.500	1.375	1.375	9.750	12.500	11.250	9.500	2.625	5.000	1.125	6.000	7.313
	1.750	500									2.875	5.250		6.250	7.563
	2.000	675									3.000	5.375		6.375	7.688
	2.500	675									3.250	5.625		6.625	7.938
	3.000	675									3.250	5.625		6.625	7.938
	3.500	675									3.250	5.625		6.625	7.938
	4.000	675									3.250	5.625		6.625	7.938
	4.500	675									3.250	5.625		6.625	7.938
	5.000	675									3.250	5.625		6.625	7.938
	5.500	675									3.250	5.625		6.625	7.938

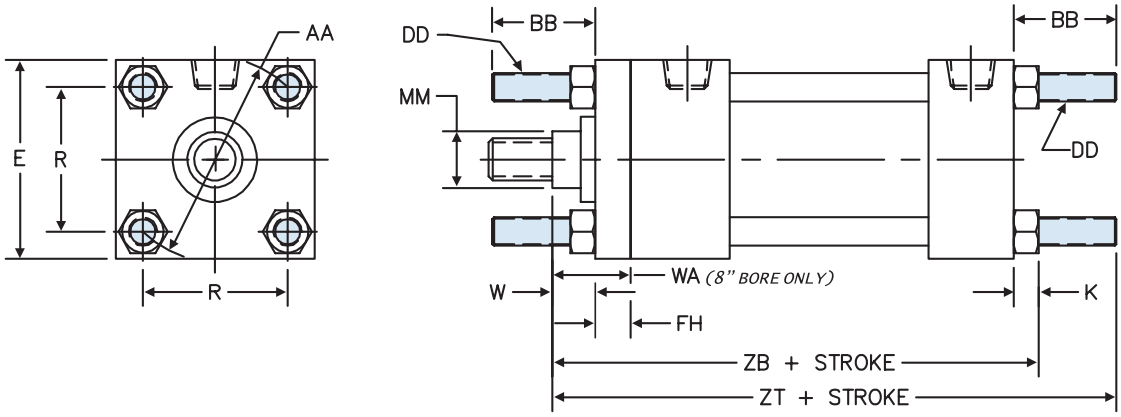
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'TD' dimension tolerance is + .000 / - .001

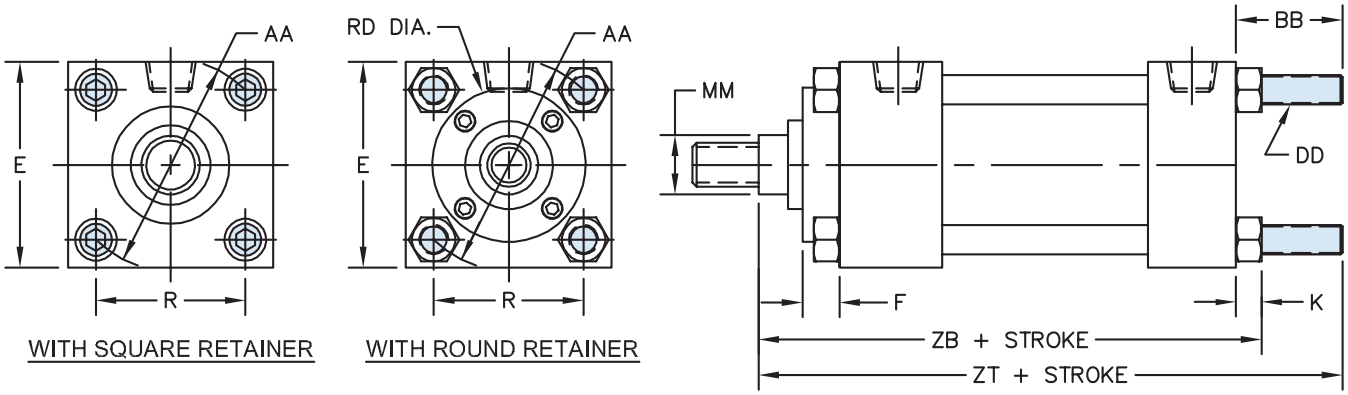
③ 'XI' dimension is the minimum that can be supplied and leaves 1/4" gap between head & trunnion block (customer to specify 'XI' dimension).

SERIES 'MH' DIMENSIONS: EXTENDED TIE ROD MOUNTS

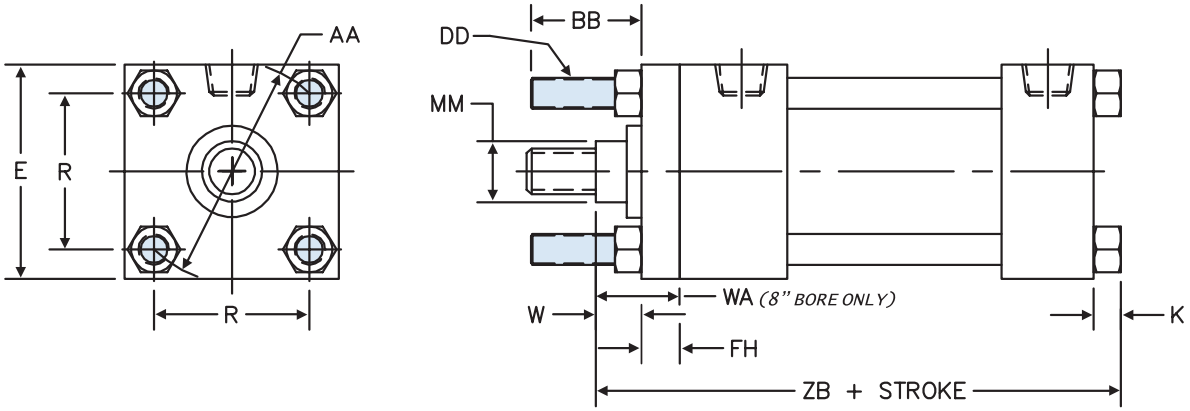
MX1: EXTENDED TIE-RODS - HEAD & CAP



MX2: EXTENDED TIE-RODS - CAP END



MX3: EXTENDED TIE-RODS - HEAD END



SERIES 'MH' DIMENSIONS: EXTENDED TIE ROD MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	FH	AA	BB	DD	F	K	R	② RD	W or WA (8")	ADD TO STROKE ZB	ADD TO STROKE ZT
1.50	0.625	1500	2.000	0.375	2.020	1.000	1/4 - 28	0.375	0.250	1.430	SQ	0.625	4.875	5.625
	1.000	1500									SQ	1.000	5.250	6.000
2.00	0.625	1500	2.500	0.375	2.600	1.125	5/16 - 24	0.375	0.313	1.840	2.000	0.625	4.938	5.750
	1.000	1500									SQ	1.000	5.313	6.125
	1.375	1500									SQ	1.250	5.563	6.375
2.50	0.625	1000	3.000	0.375	3.100	1.125	5/16 - 24	0.375	0.313	2.190	2.000	0.625	5.063	5.875
	1.000	1500									SQ	1.000	5.438	6.250
	1.375	1500									SQ	1.250	5.688	6.500
	1.750	1500									SQ	1.500	5.938	6.750
3.25	1.000	1500	3.750	0.625	3.900	1.375	3/8 - 24	0.625	0.375	2.760	2.750	0.750	6.000	7.000
	1.375	1500									SQ	1.000	6.250	7.250
	1.750	1500									SQ	1.250	6.500	7.500
	2.000	1500									SQ	1.375	6.625	7.625
4.00	1.000	1000	4.500	0.625	4.700	1.375	3/8 - 24	0.625	0.375	3.320	2.750	0.750	6.000	7.000
	1.375	1000									3.500	1.000	6.250	7.250
	1.750	1000									3.500	1.250	6.500	7.500
	2.000	1000									SQ	1.375	6.625	7.625
	2.500	1000									SQ	1.625	6.875	7.875
5.00	1.000	750	5.500	0.625	5.800	1.813	1/2 - 20	0.625	0.438	4.100	2.750	0.750	6.313	7.688
	1.375	1000									3.500	1.000	6.563	7.938
	1.750	1000									3.500	1.250	6.813	8.188
	2.000	1000									4.250	1.375	6.938	8.313
	2.500	1000									SQ	1.625	7.188	8.563
	3.000	1000									SQ	1.625	7.188	8.563
	3.500	1000									SQ	1.625	7.188	8.563
6.00	1.375	750	6.500	0.750	6.900	1.813	1/2 - 20	0.750	0.438	4.880	3.500	0.875	7.063	8.438
	1.750	750									3.875	1.125	7.313	8.688
	2.000	750									4.250	1.250	7.438	8.813
	2.500	750									4.625	1.500	7.688	9.063
	3.000	750									5.250	1.500	7.688	9.063
	3.500	750									5.750	1.500	7.688	9.063
	4.000	750									SQ	1.500	7.688	9.063
8.00	1.375	500	8.500	③ 0.625	9.100	③ 2.313	5/8 - 18	0.750	0.563	6.440	3.500	1.625	7.313	9.063
	1.750	500									3.875	1.875	7.563	9.313
	2.000	675									4.250	2.000	7.688	9.438
	2.500	675									4.625	2.250	7.938	9.688
	3.000	675									5.250	2.250	7.938	9.688
	3.500	675									5.750	2.250	7.938	9.688
	4.000	675									6.500	2.250	7.938	9.688
	4.500	675									7.250	2.250	7.938	9.688
	5.000	675									7.500	2.250	7.938	9.688
	5.500	675									7.500	2.250	7.938	9.688

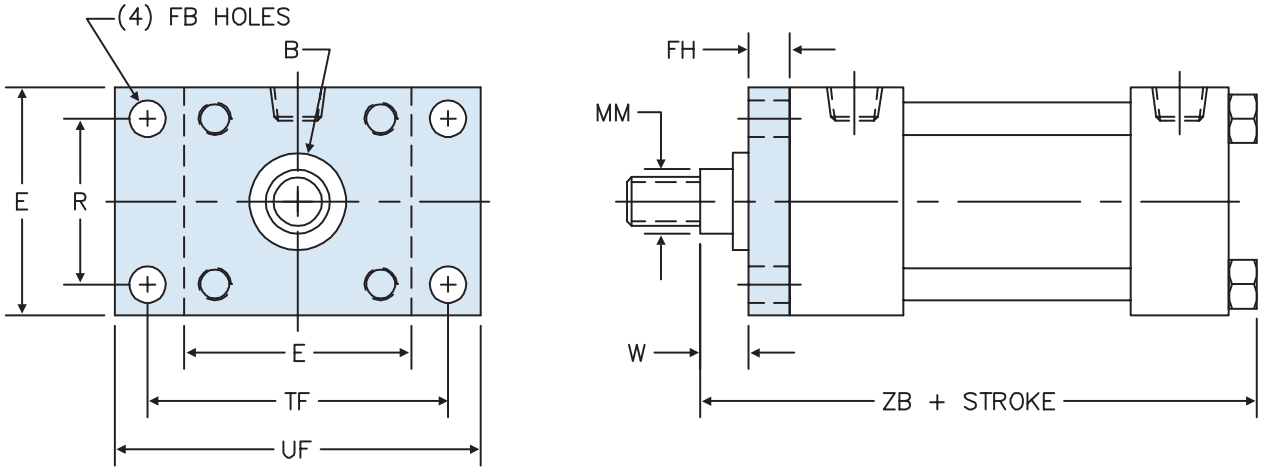
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② Where SQ is shown in chart, cylinder utilizes a full square retainer. ALL MX1 & MX3 MOUNTS USE FULL SQ. RETAINER.

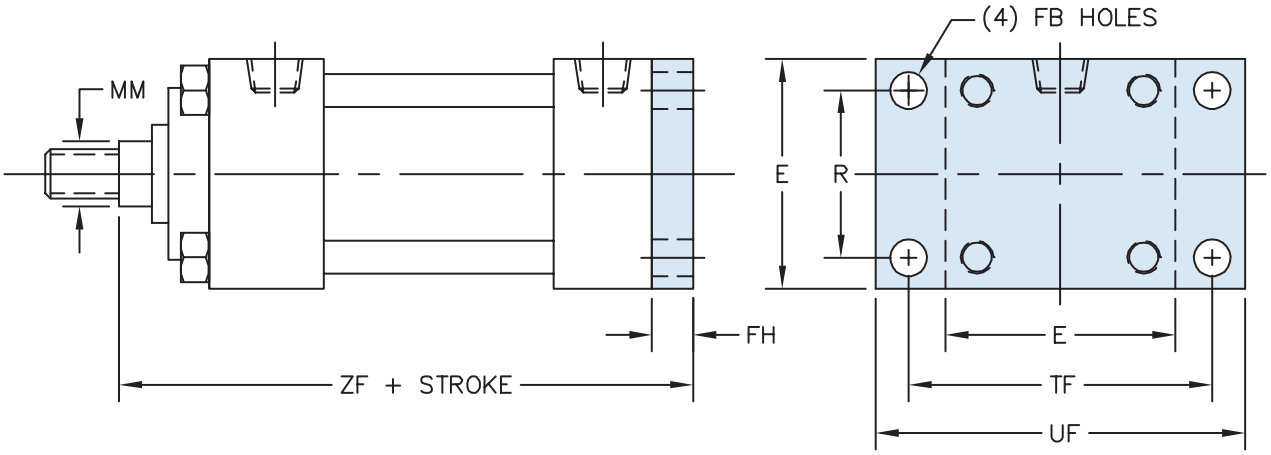
③ Round retainer used to retain bushing, not a full front plate as other bores. 'BB' is dimension from head on the 8.00" bore.

SERIES 'MH' DIMENSIONS: FLANGE MOUNTS

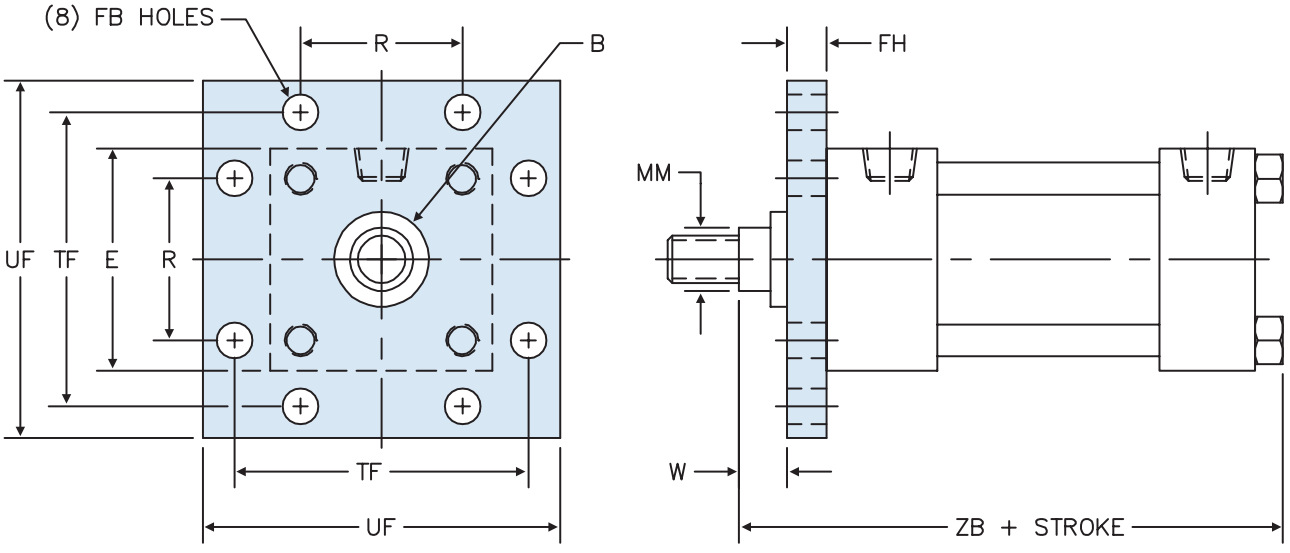
MF1: HEAD FLANGE



MF2: CAP FLANGE

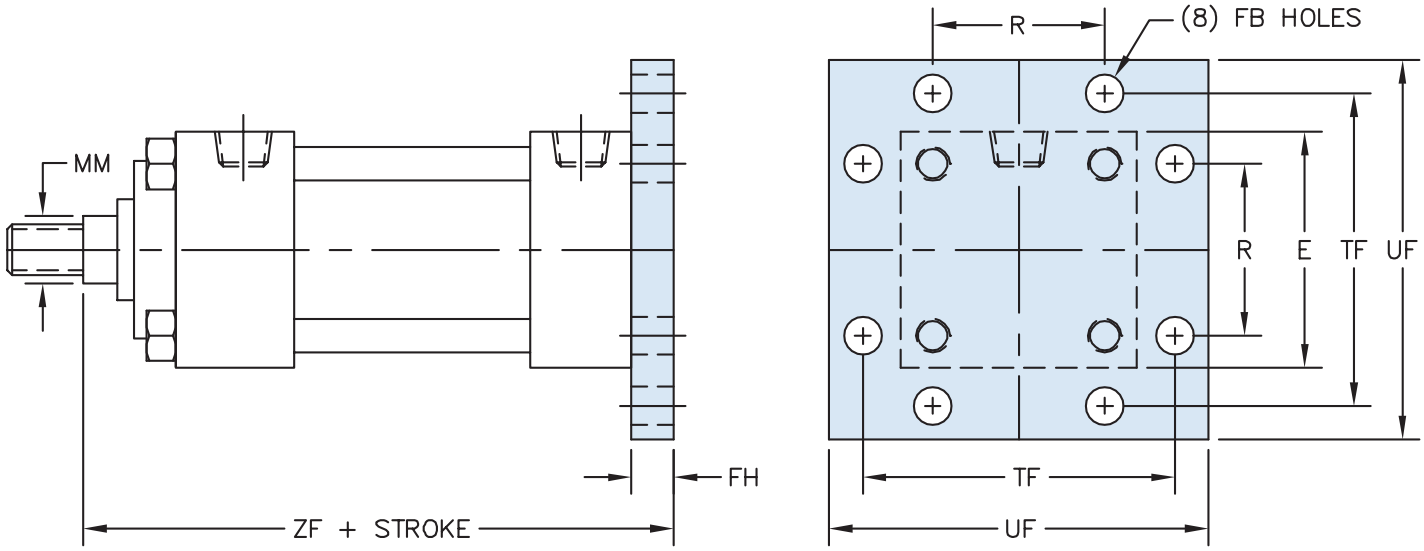


MF5: HEAD SQUARE FLANGE



SERIES 'MH' DIMENSIONS: FLANGE MOUNTS

MF6: CAP SQUARE FLANGE



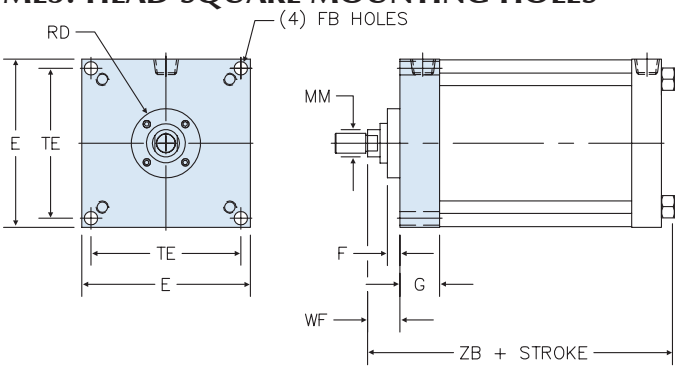
BORE	ROD DIA. (MM)	① MAX PSI RATING	② B	E	FB	FH	R	TF	UF	W	ADD TO STROKE ZB	ADD TO STROKE ZF
1.50	0.625	1500	1.124	2.000	0.313	0.375	1.438	2.750	3.375	0.625	4.875	5.000
	1.000	1500	1.499							1.000	5.250	5.375
2.00	0.625	1500	1.124	2.500	0.375	0.375	1.844	3.375	4.125	0.625	4.938	5.000
	1.000	1500	1.499							1.000	5.313	5.375
	1.375	1500	1.999							1.250	5.563	5.625
2.50	0.625	1000	1.124	3.000	0.375	0.375	2.188	3.875	4.625	0.625	5.063	5.125
	1.000	1500	1.499							1.000	5.438	5.500
	1.375	1500	1.999							1.250	5.688	5.750
	1.750	1500	2.374							1.500	5.938	6.000
3.25	1.000	1500	1.499	3.750	0.438	0.625	2.766	4.688	5.500	0.750	6.000	6.250
	1.375	1500	1.999							1.000	6.250	6.500
	1.750	1500	2.374							1.250	6.500	6.750
	2.000	1500	2.624							1.375	6.625	6.875
4.00	1.000	1000	1.499	4.500	0.438	0.625	3.328	5.438	6.250	0.750	6.000	6.250
	1.375	1000	1.999							1.000	6.250	6.500
	1.750	1000	2.374							1.250	6.500	6.750
	2.000	1000	2.624							1.375	6.625	6.875
	2.500	1000	3.124							1.625	6.875	7.125
5.00	1.000	750	1.499	5.500	0.563	0.625	4.109	6.625	7.625	0.750	6.313	6.500
	1.375	1000	1.999							1.000	6.563	6.750
	1.750	1000	2.374							1.250	6.813	7.000
	2.000	1000	2.624							1.375	6.938	7.125
	2.500	1000	3.124							1.625	7.188	7.375
	3.000	1000	3.749							1.625	7.188	7.375
	3.500	1000	4.249							1.625	7.188	7.375
6.00	1.375	750	1.999	6.500	0.563	0.750	4.875	7.625	8.625	0.875	7.063	7.375
	1.750	750	2.374							1.125	7.313	7.625
	2.000	750	2.624							1.250	7.438	7.750
	2.500	750	3.124							1.500	7.688	8.000
	3.000	750	3.749							1.500	7.688	8.000
	3.500	750	4.249							1.500	7.688	8.000
	4.000	750	4.749							1.500	7.688	8.000

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

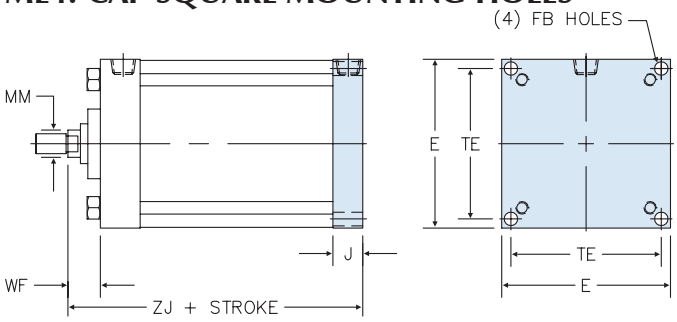
② 'B' dimension tolerance is +.000 / -.002

SERIES 'MH' DIMENSIONS: FLANGE MOUNTS

ME3: HEAD SQUARE MOUNTING HOLES

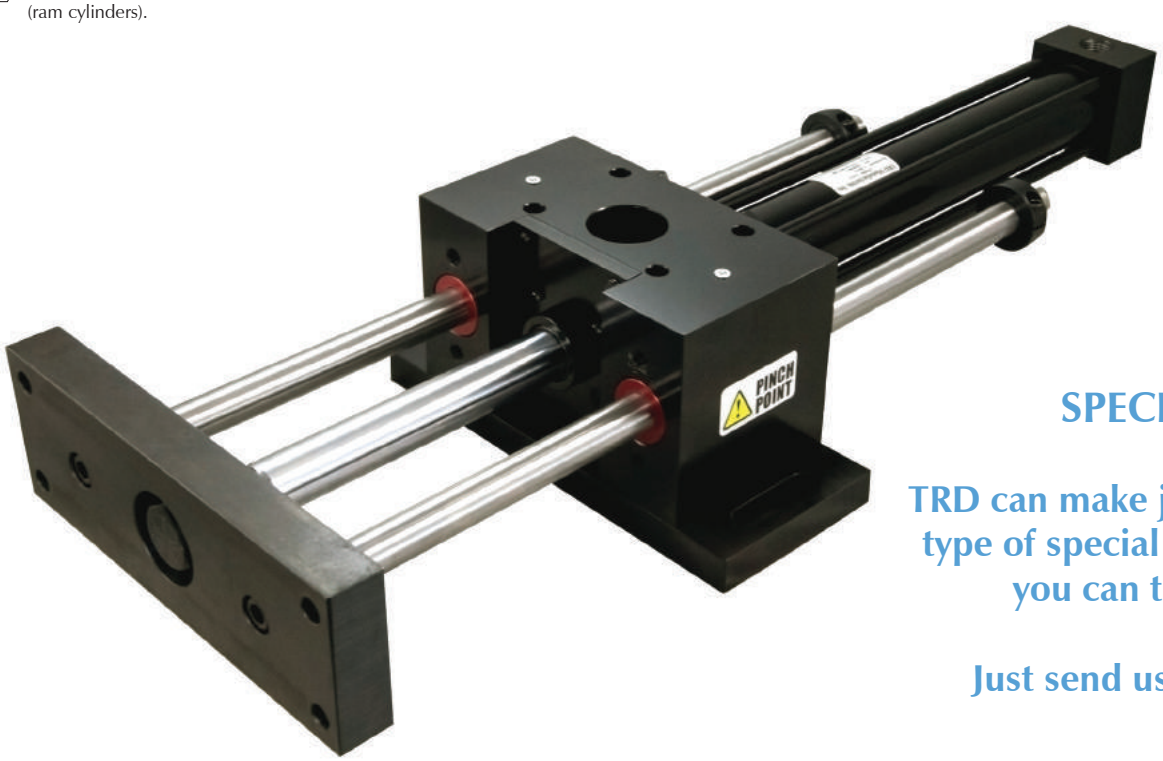


ME4: CAP SQUARE MOUNTING HOLES



BORE	ROD DIA. (MM)	① MAX PSI RATING	E	F	FB	G	J	TE	RD	WF	ADD TO STROKE ZB	ADD TO STROKE ZJ
8.00	1.375	500	8.500	0.750	0.688	2.000	1.500	7.570	3.500	1.625	7.313	6.750
	1.750	500							3.875	1.875	7.563	7.000
	2.000	675							4.250	2.000	7.688	7.125
	2.500	675							4.625	2.250	7.938	7.375
	3.000	675							5.250	2.250	7.938	7.375
	3.500	675							5.750	2.250	7.938	7.375
	4.000	675							6.500	2.250	7.938	7.375
	4.500	675							7.250	2.250	7.938	7.375
	5.000	675							7.500	2.250	7.938	7.375
	5.500	675							7.500	2.250	7.938	7.375

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).



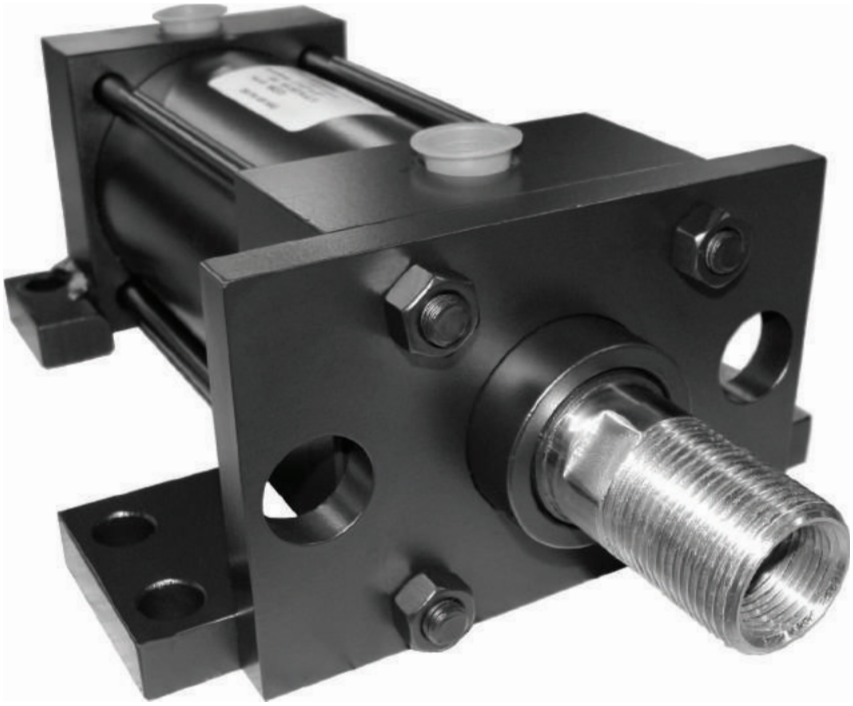
SPECIALS

TRD can make just about any type of special cylinder that you can think of.

Just send us a sketch!

Design Tips - Multiple Mounts on One Cylinder

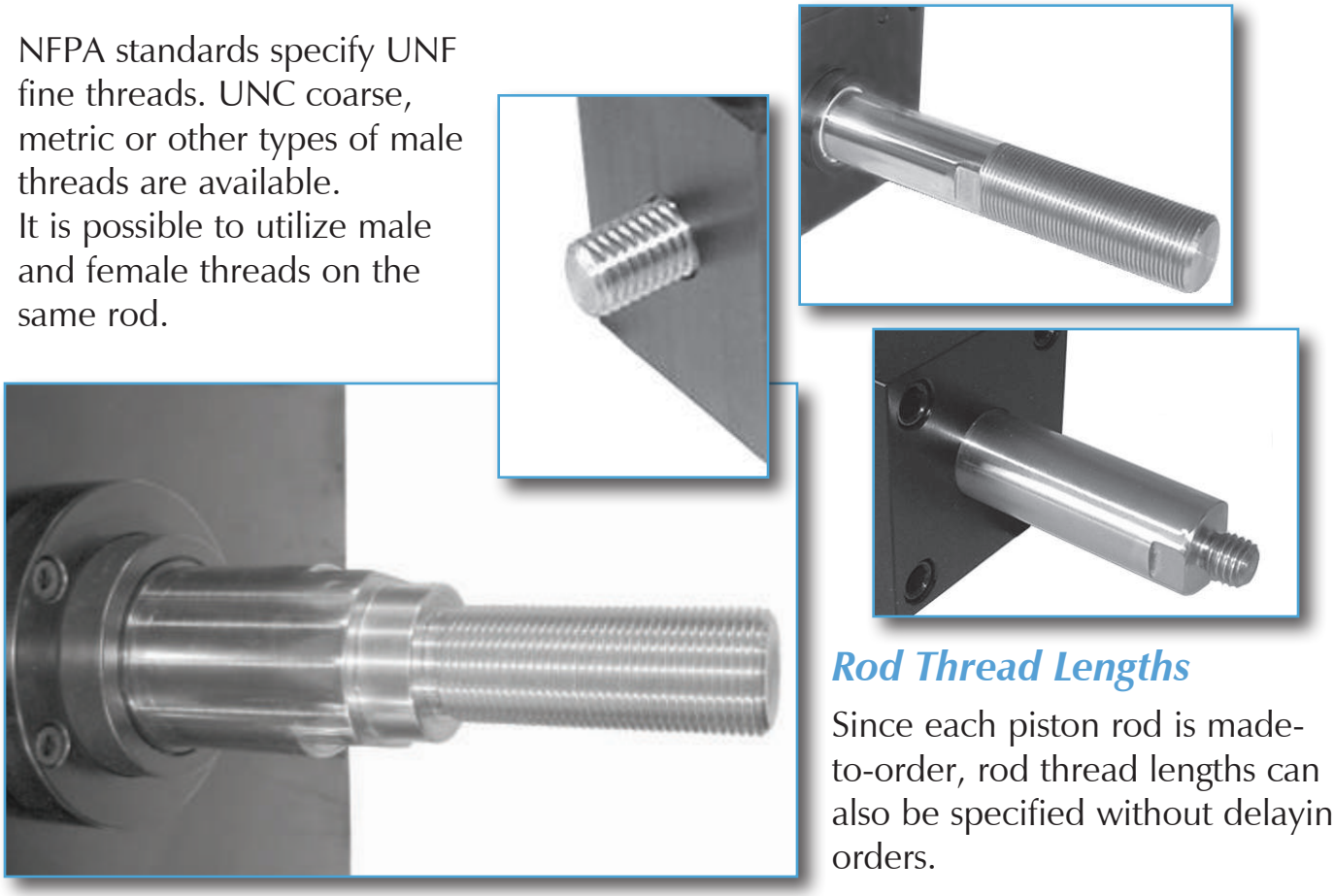
Designers and maintenance staff don't have to be limited to just one NFPA mount. Cylinders can contain multiple mounts or even special mounts to fit every possible application. Multiple mounts do not typically delay orders.



Note: 'HH' and 'MH' Series can limit thread options. Check with factory to ensure that your special thread can handle the intended loads.

Design Tips - Rod Threads

NFPA standards specify UNF fine threads. UNC coarse, metric or other types of male threads are available.
It is possible to utilize male and female threads on the same rod.

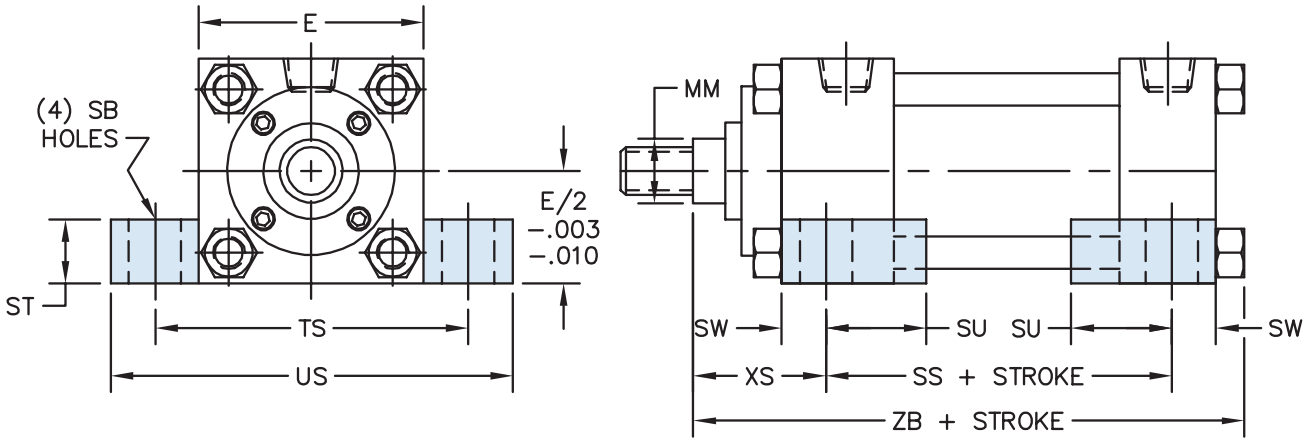


Rod Thread Lengths

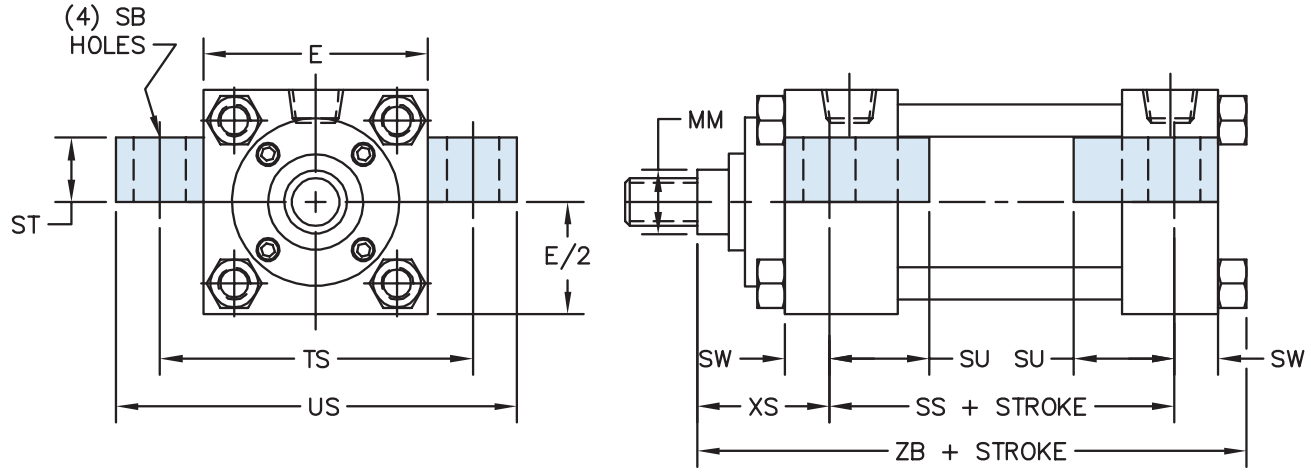
Since each piston rod is made-to-order, rod thread lengths can also be specified without delaying orders.

SERIES 'MH' DIMENSIONS: LUG MOUNTS

MS2: SIDE LUGS



MS3: CENTER LINE LUGS



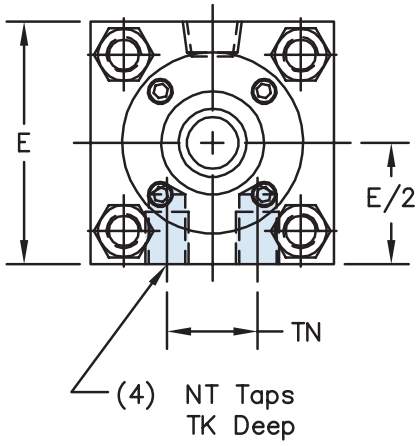
SERIES 'MH' DIMENSIONS: LUG MOUNTS

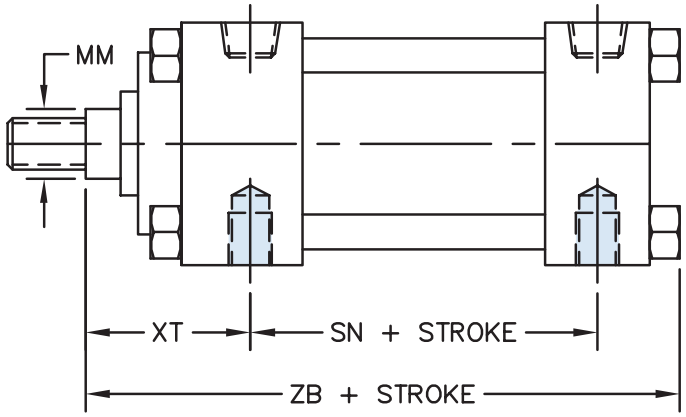
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE	
											SS	ZB
1.50	0.625	1500	2.000	0.438	0.500	1.125	0.375	2.750	3.500	1.375	2.875	4.875
	1.000	1500								1.750		5.250
2.00	0.625	1500	2.500	0.438	0.500	1.125	0.375	3.250	4.000	1.375	2.875	4.938
	1.000	1500								1.750		5.313
	1.375	1500								2.000		5.563
2.50	0.625	1000	3.000	0.438	0.500	1.125	0.375	3.750	4.500	1.375	3.000	5.063
	1.000	1500								1.750		5.438
	1.375	1500								2.000		5.688
	1.750	1500								2.250		5.938
3.25	1.000	1500	3.750	0.563	0.750	1.250	0.500	4.750	5.750	1.875	3.250	6.000
	1.375	1500								2.125		6.250
	1.750	1500								2.375		6.500
	2.000	1500								2.500		6.625
4.00	1.000	1000	4.500	0.563	0.750	1.250	0.500	5.500	6.500	1.875	3.250	6.000
	1.375	1000								2.125		6.250
	1.750	1000								2.375		6.500
	2.000	1000								2.500		6.625
	2.500	1000								2.750		6.875
5.00	1.000	750	5.500	0.813	1.000	1.063	0.688	6.875	8.250	2.063	3.125	6.313
	1.375	1000								2.313		6.563
	1.750	1000								2.563		6.813
	2.000	1000								2.688		6.938
	2.500	1000								2.938		7.188
	3.000	1000								2.938		7.188
	3.500	1000								2.938		7.188
6.00	1.375	750	6.500	0.813	1.000	1.313	0.688	7.875	9.250	2.313	3.625	7.063
	1.750	750								2.563		7.313
	2.000	750								2.688		7.438
	2.500	750								2.938		7.688
	3.000	750								2.938		7.688
	3.500	750								2.938		7.688
	4.000	750								2.938		7.688
8.00	1.375	500	8.500	0.813	1.000	1.313	0.688	9.875	11.250	2.313	3.750	7.313
	1.750	500								2.563		7.563
	2.000	675								2.688		7.688
	2.500	675								2.938		7.938
	3.000	675								2.938		7.938
	3.500	675								2.938		7.938
	4.000	675								2.938		7.938
	4.500	675								2.938		7.938
	5.000	675								2.938		7.938
	5.500	675								2.938		7.938

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

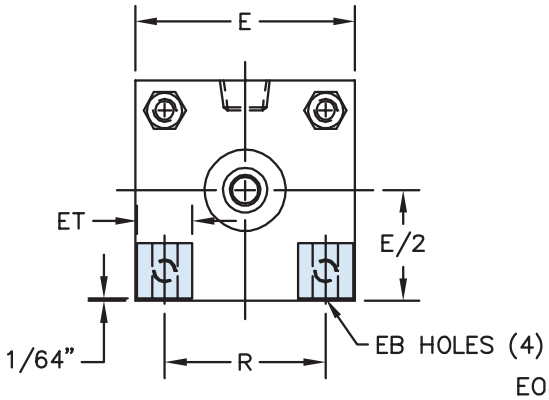
SERIES 'MH' DIMENSIONS: BOTTOM MOUNTS

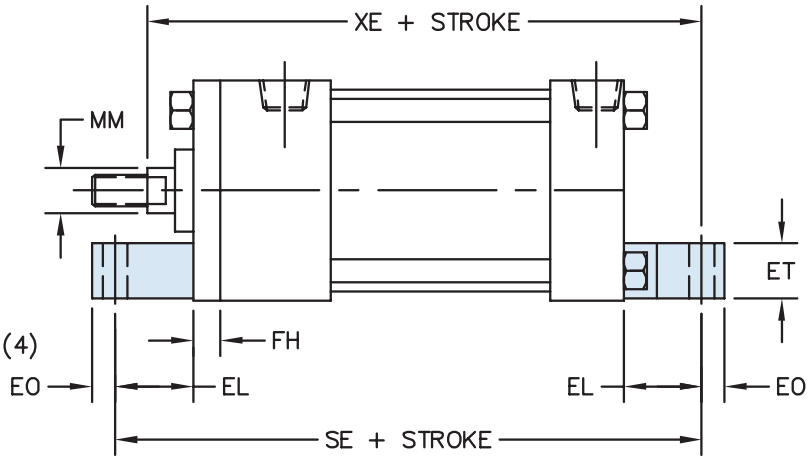
MS4: BOTTOM TAPPED HOLES





MS7: END LUGS





SERIES 'MH' DIMENSIONS: BOTTOM MOUNTS

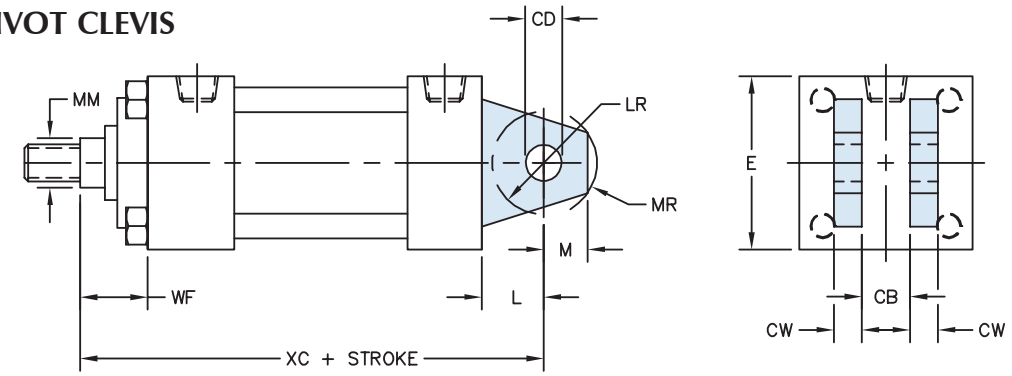
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	EB	EL	EO	ET	FH	NT	R	TN	TK	XT	ADD TO STROKE			
														SN	ZB	SE	XE
1.50	0.625	1500	2.000	0.281	0.750	0.250	0.563	0.375	1/4 - 20	1.438	0.625	0.375	1.938	2.250	4.875	5.500	5.375
	1.000	1500											2.313		5.250		5.750
2.00	0.625	1500	2.500	0.344	0.938	0.313	0.625	0.375	5/16 - 18	1.844	0.875	0.406	1.938	2.250	4.938	5.875	5.563
	1.000	1500											2.313		5.313		5.938
	1.375	1500											2.563		5.563		6.188
2.50	0.625	1000	3.000	0.344	1.063	0.313	0.750	0.375	3/8 - 16	2.188	1.250	0.438	1.938	2.375	5.063	6.250	5.813
	1.000	1500											2.313		5.438		6.188
	1.375	1500											2.563		5.688		6.438
	1.750	1500											2.813		5.938		6.688
3.25	1.000	1500	3.750	0.406	0.875	0.375	0.938	0.625	1/2 - 13	2.766	1.500	0.500	2.438	2.625	6.000	6.625	6.500
	1.375	1500											2.688		6.250		6.750
	1.750	1500											2.938		6.500		7.000
	2.000	1500											3.063		6.625		7.125
4.00	1.000	1000	4.500	0.406	1.000	0.375	1.125	0.625	1/2 - 13	3.328	2.063	0.625	2.438	2.625	6.000	6.875	6.625
	1.375	1000											2.688		6.250		6.875
	1.750	1000											2.938		6.500		7.125
	2.000	1000											3.063		6.625		7.250
	2.500	1000											3.313		6.875		7.500
5.00	1.000	750	5.500	0.531	1.063	0.500	1.375	0.625	5/8 - 11	4.109	2.688	0.750	2.438	2.875	6.313	7.250	6.938
	1.375	1000											2.688		6.563		7.188
	1.750	1000											2.938		6.813		7.438
	2.000	1000											3.063		6.938		7.563
	2.500	1000											3.313		7.188		7.813
	3.000	1000											3.313		7.188		7.813
	3.500	1000											3.313		7.188		7.813
6.00	1.375	750	6.500	0.531	1.000	0.500	1.563	0.750	3/4 - 10	4.875	3.250	1.000	2.813	3.125	7.063	7.750	7.625
	1.750	750											3.063		7.313		7.875
	2.000	750											3.188		7.438		8.000
	2.500	750											3.438		7.688		8.250
	3.000	750											3.438		7.688		8.250
	3.500	750											3.438		7.688		8.250
	4.000	750											3.438		7.688		8.250
8.00	1.375	500	8.500	0.688	1.125	0.625	2.000	②	3/4 - 10	6.438	4.500	1.250	2.813	3.250	7.313	7.375	7.875
	1.750	500											3.063		7.563		8.125
	2.000	675											3.188		7.688		8.250
	2.500	675											3.438		7.938		8.500
	3.000	675											3.438		7.938		8.500
	3.500	675											3.438		7.938		8.500
	4.000	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		7.938	N/A	N/A
	4.500	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		7.938	N/A	N/A
	5.000	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		7.938	N/A	N/A
	5.500	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		7.938	N/A	N/A

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② (1) piece MS7 brackets bolted directly to head & cap (uses round retainer).

SERIES 'MH' DIMENSIONS: PIVOT MOUNTS

MP1: REAR PIVOT CLEVIS



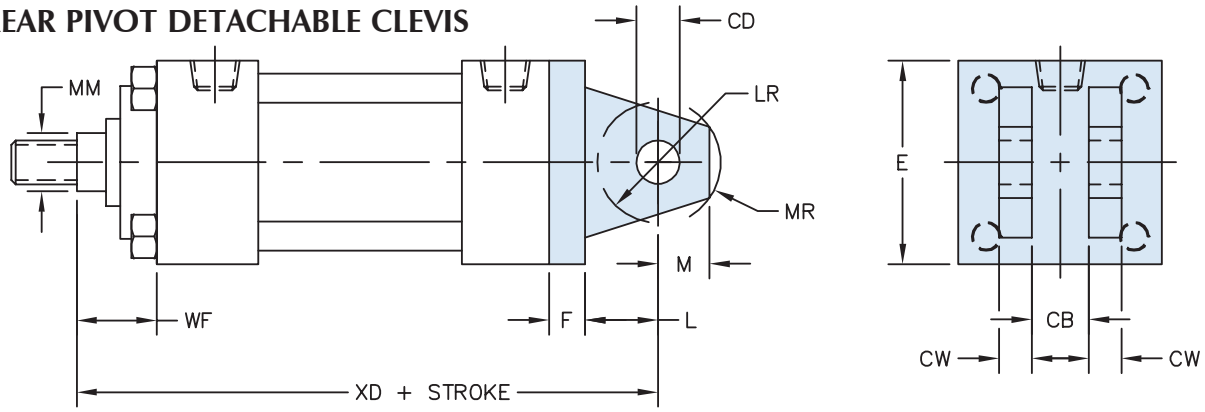
BORE	ROD DIA. (MM)	① MAX PSI RATING	CB	CD	CW	E	L	LR	M	MR	WF	ADD TO STROKE XC
1.50	0.625	1500	0.750	0.500	0.500	2.000	0.750	0.563	0.500	0.625	1.000	5.375
	1.000	1500									1.375	5.750
2.00	0.625	1500	0.750	0.500	0.500	2.500	0.750	0.563	0.500	0.625	1.000	5.375
	1.000	1500									1.375	5.750
	1.375	1500									1.625	6.000
2.50	0.625	1000	0.750	0.500	0.500	3.000	0.750	0.563	0.500	0.625	1.000	5.500
	1.000	1500									1.375	5.875
	1.375	1500									1.625	6.125
	1.750	1500									1.875	6.375
3.25	1.000	1500	1.250	0.750	0.625	3.750	1.250	1.000	0.750	0.938	1.375	6.875
	1.375	1500									1.625	7.125
	1.750	1500									1.875	7.375
	2.000	1500									2.000	7.500
4.00	1.000	1000	1.250	0.750	0.625	4.500	1.250	1.000	0.750	0.938	1.375	6.875
	1.375	1000									1.625	7.125
	1.750	1000									1.875	7.375
	2.000	1000									2.000	7.500
	2.500	1000									2.250	7.750
5.00	1.000	750	1.250	0.750	0.625	5.500	1.250	1.000	0.750	0.938	1.375	7.125
	1.375	1000									1.625	7.375
	1.750	1000									1.875	7.625
	2.000	1000									2.000	7.750
	2.500	1000									2.250	8.000
	3.000	1000									2.250	8.000
	3.500	1000									2.250	8.000
6.00	1.375	750	1.500	1.000	0.750	6.500	1.500	1.250	1.000	1.188	1.625	8.125
	1.750	750									1.875	8.375
	2.000	750									2.000	8.500
	2.500	750									2.250	8.750
	3.000	750									2.250	8.750
	3.500	750									2.250	8.750
	4.000	750									2.250	8.750
8.00	1.375	500	1.500	1.000	0.750	8.500	1.500	1.250	1.000	1.188	1.625	8.250
	1.750	500									1.875	8.500
	2.000	675									2.000	8.625
	2.500	675									2.250	8.875
	3.000	675									2.250	8.875
	3.500	675									2.250	8.875
	4.000	675									2.250	8.875
	4.500	675									2.250	8.875
	5.000	675									2.250	8.875
	5.500	675									2.250	8.875

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

Note: Pivot pin included with cylinder cap end only.

SERIES 'MH' DIMENSIONS: PIVOT MOUNTS

MP2: REAR PIVOT DETACHABLE CLEVIS



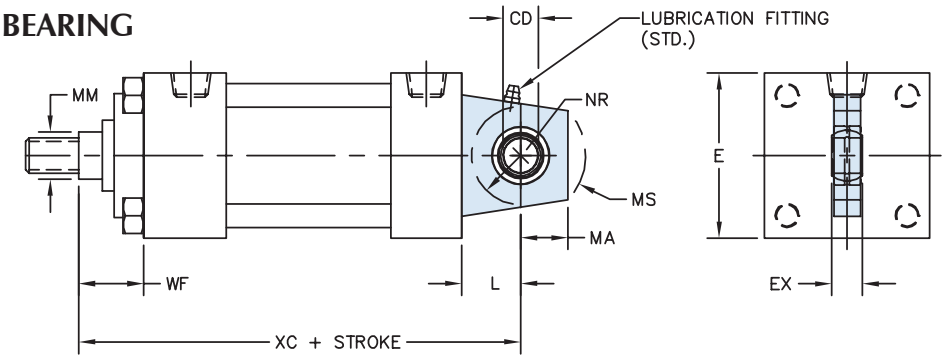
BORE	ROD DIA. (MM)	① MAX PSI RATING	CB	CD	CW	E	F	L	LR	M	MR	WF	ADD TO STROKE XD
1.50	0.625	1500	0.750	0.500	0.500	2.000	0.375	0.750	0.563	0.500	0.625	1.000	5.750
	1.000	1500										1.375	6.125
2.00	0.625	1500	0.750	0.500	0.500	2.500	0.375	0.750	0.563	0.500	0.625	1.000	5.750
	1.000	1500										1.375	6.125
	1.375	1500										1.625	6.375
2.50	0.625	1000	0.750	0.500	0.500	3.000	0.375	0.750	0.563	0.500	0.625	1.000	5.875
	1.000	1500										1.375	6.250
	1.375	1500										1.625	6.500
	1.750	1500										1.875	6.750
3.25	1.000	1500	1.250	0.750	0.625	3.750	0.625	1.250	1.000	0.750	0.938	1.375	7.500
	1.375	1500										1.625	7.750
	1.750	1500										1.875	8.000
	2.000	1500										2.000	8.125
4.00	1.000	1000	1.250	0.750	0.625	4.500	0.625	1.250	1.000	0.750	0.938	1.375	7.500
	1.375	1000										1.625	7.750
	1.750	1000										1.875	8.000
	2.000	1000										2.000	8.125
	2.500	1000										2.250	8.375
5.00	1.000	750	1.250	0.750	0.625	5.500	0.625	1.250	1.000	0.750	0.938	1.375	7.750
	1.375	1000										1.625	8.000
	1.750	1000										1.875	8.250
	2.000	1000										2.000	8.375
	2.500	1000										2.250	8.625
	3.000	1000										2.250	8.625
	3.500	1000										2.250	8.625
6.00	1.375	750	1.500	1.000	0.750	6.500	0.750	1.500	1.250	1.000	1.188	1.625	8.875
	1.750	750										1.875	9.125
	2.000	750										2.000	9.250
	2.500	750										2.250	9.500
	3.000	750										2.250	9.500
	3.500	750										2.250	9.500
	4.000	750										2.250	9.500

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

Note: Pivot pin included with cylinder cap end only.

SERIES 'MH' DIMENSIONS: SPHERICAL BEARING MOUNT

SB: SPHERICAL BEARING



BORE	ROD DIA. (MM)	① MAX PSI RATING	CD	E	EX	L	MA	MS	NR	WF	ADD TO STROKE XC
1.50	0.625	1500	0.500	2.000	0.437	0.750	0.750	0.938	0.625	1.000	5.375
	1.000	1500								1.375	5.750
2.00	0.625	980	0.500	2.500	0.437	0.750	0.750	0.938	0.625	1.000	5.375
	1.000	980								1.375	5.750
	1.375	980								1.625	6.000
2.50	0.625	630	0.500	3.000	0.437	0.750	0.750	0.938	0.625	1.000	5.500
	1.000	630								1.375	5.875
	1.375	630								1.625	6.125
	1.750	630								1.875	6.375
3.25	1.000	830	0.750	3.750	0.656	1.250	1.000	1.375	1.000	1.375	6.875
	1.375	830								1.625	7.125
	1.750	830								1.875	7.375
	2.000	830								2.000	7.500
4.00	1.000	550	0.750	4.500	0.656	1.250	1.000	1.375	1.000	1.375	6.875
	1.375	550								1.625	7.125
	1.750	550								1.875	7.375
	2.000	550								2.000	7.500
	2.500	550								2.250	7.750
5.00	1.000	350	0.750	5.500	0.656	1.250	1.000	1.375	1.000	1.375	7.125
	1.375	350								1.625	7.375
	1.750	350								1.875	7.625
	2.000	350								2.000	7.750
	2.500	350								2.250	8.000
	3.000	350								2.250	8.000
	3.500	350								2.250	8.000
6.00	1.375	440	1.000	6.500	0.875	1.500	1.250	1.688	1.250	1.625	8.125
	1.750	440								1.875	8.375
	2.000	440								2.000	8.500
	2.500	440								2.250	8.750
	3.000	440								2.250	8.750
	3.500	440								2.250	8.750
	4.000	440								2.250	8.750
8.00	1.375	250	1.000	8.500	0.875	1.500	1.250	1.688	1.250	1.625	8.250
	1.750	250								1.875	8.500
	2.000	250								2.000	8.625
	2.500	250								2.250	8.875
	3.000	250								2.250	8.875
	3.500	250								2.250	8.875
	4.000	250								2.250	8.875
	4.500	250								2.250	8.875
	5.000	250								2.250	8.875
	5.500	250								2.250	8.875

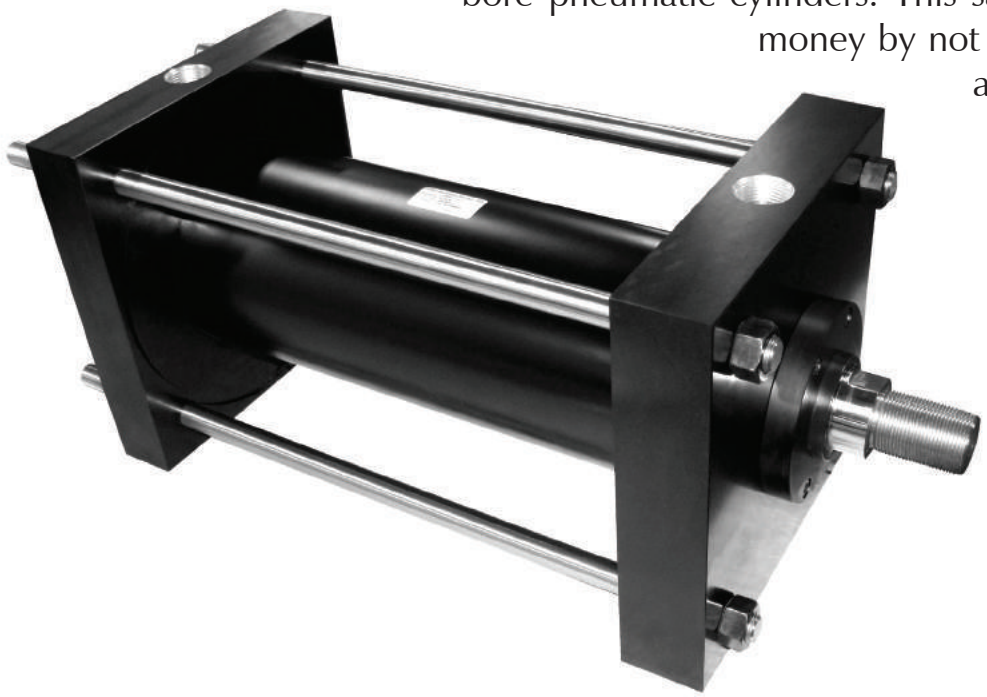
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

Note 1: Pivot pin included with cylinder cap end only; 5.00", 6.00" & 8.00" bores have tie rod nuts exposed on cap end.

Note 2: Must specify KK3 rod end if to be used with 'HH-MSRE' series rod eye.

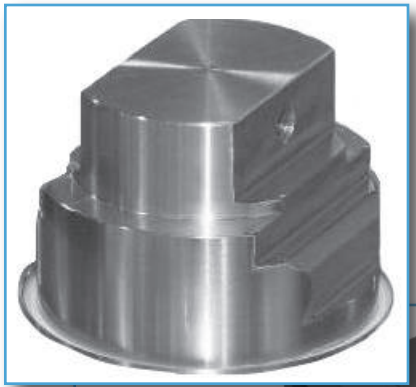
Design Tip

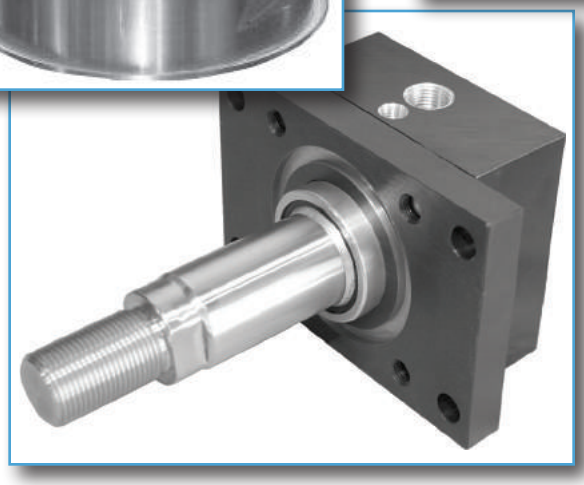
When pneumatic cylinders do not offer the required force, you don't have to change your tooling or application. TRD can provide a smaller bore 'MH' Series hydraulic cylinder that can be used as a drop-in, direct replacement to many large bore pneumatic cylinders. This saves you time and money by not having to retool as applications change over time.

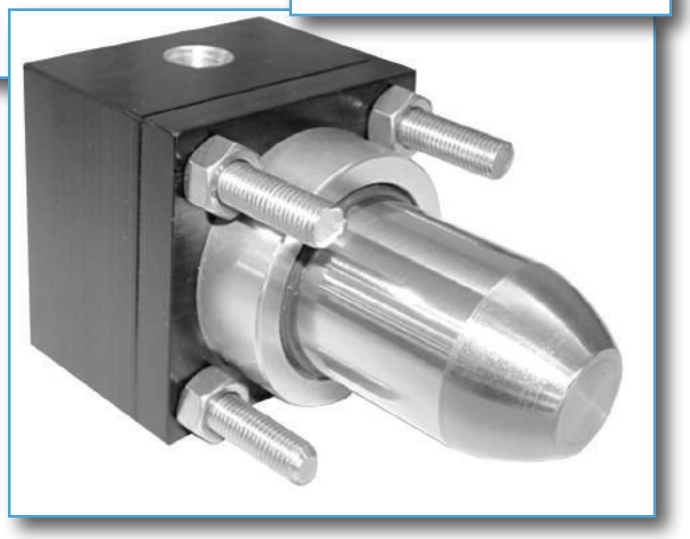


Custom Rod Ends

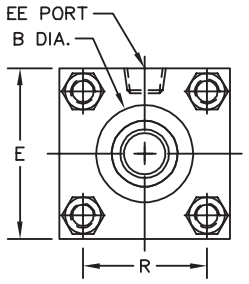
Each piston rod is made-to-order. Rod extensions are very low in cost and do not delay delivery. Custom machined rod ends can also be easily added to your cylinder!



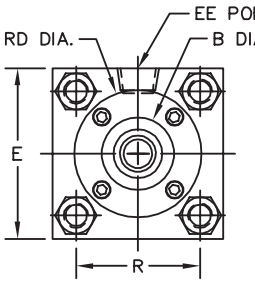




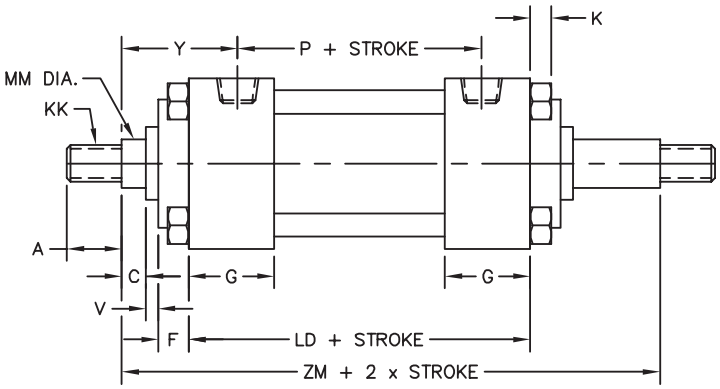
SERIES 'MH' DIMENSIONS: BASIC DOUBLE END (MX0 MOUNT)



WITH SQUARE RETAINER



WITH ROUND RETAINER



MX0D: NO MOUNT

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	A	② B	C	EE NPTF	EE SAE	F	G	K	KK	R	③ RD	V	Y	ADD TO STROKE LD	ADD TO STROKE P	ADD 2X STROKE ZM
1.50	0.625	1500	2.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	0.250	SEE ROD END DETAIL CHART ON PAGE 61	1.438	SQ	0.250	1.875	4.125	2.375	6.125
	1.000	1500		1.125	1.499	0.500								SQ	0.500	2.250			6.875
2.00	0.625	1500	2.500	0.750	1.124	0.375	3/8	#6	0.375	1.500	0.313		1.844	2.000	0.250	1.875	4.125	2.375	6.125
	1.000	1500		1.125	1.499	0.500								SQ	0.500	2.250			6.875
	1.375	1500		1.625	1.999	0.625								SQ	0.625	2.500			7.375
2.50	0.625	1000	3.000	0.750	1.124	0.375	3/8	#6	0.375	1.500	0.313		2.188	2.000	0.250	1.875	4.250	2.500	6.250
	1.000	1500		1.125	1.499	0.500								SQ	0.500	2.250			7.000
	1.375	1500		1.625	1.999	0.625								SQ	0.625	2.500			7.500
	1.750	1500		2.000	2.374	0.750								SQ	0.750	2.750			8.000
3.25	1.000	1500	3.750	1.125	1.499	0.500	1/2	#10	0.625	1.750	0.375		2.766	2.750	0.250	2.375	4.750	2.750	7.500
	1.375	1500		1.625	1.999	0.625								SQ	0.375	2.625			8.000
	1.750	1500		2.000	2.374	0.750								SQ	0.500	2.875			8.500
	2.000	1500		2.250	2.624	0.875								SQ	0.500	3.000			8.750
4.00	1.000	1000	4.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	0.375		3.328	2.750	0.250	2.375	4.750	2.750	7.500
	1.375	1000		1.625	1.999	0.625								3.500	0.375	2.625			8.000
	1.750	1000		2.000	2.374	0.750								3.500	0.500	2.875			8.500
	2.000	1000		2.250	2.624	0.875								SQ	0.500	3.000			8.750
	2.500	1000		3.000	3.124	1.000								SQ	0.625	3.250			9.250
5.00	1.000	750	5.500	1.125	1.499	0.500	1/2	#10	0.625	1.750	0.438		4.109	2.750	0.250	2.375	5.000	3.000	7.750
	1.375	1000		1.625	1.999	0.625								3.500	0.375	2.625			8.250
	1.750	1000		2.000	2.374	0.750								3.500	0.500	2.875			8.750
	2.000	1000		2.250	2.624	0.875								4.250	0.500	3.000			9.000
	2.500	1000		3.000	3.124	1.000								SQ	0.625	3.250			9.500
	3.000	1000		3.500	3.749	1.000								SQ	0.625	3.250			9.500
	3.500	1000		3.500	4.249	1.000								SQ	0.625	3.250			9.500
6.00	1.375	750	6.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	0.438		4.875	3.500	0.250	2.750	5.500	3.250	8.750
	1.750	750		2.000	2.374	0.750								3.875	0.375	3.000			9.250
	2.000	750		2.250	2.624	0.875								4.250	0.375	3.125			9.500
	2.500	750		3.000	3.124	1.000								4.625	0.500	3.375			10.000
	3.000	750		3.500	3.749	1.000								5.250	0.500	3.375			10.000
	3.500	750		3.500	4.249	1.000								5.750	0.500	3.375			10.000
	4.000	750		4.000	4.749	1.000								SQ	0.500	3.375			10.000
8.00	1.375	500	8.500	1.625	1.999	0.625	3/4	#12	0.750	2.000	0.563		6.438	3.500	0.250	2.750	5.625	3.375	8.875
	1.750	500		2.000	2.374	0.750								3.875	0.375	3.000			9.375
	2.000	675		2.250	2.624	0.875								4.250	0.375	3.125			9.625
	2.500	675		3.000	3.124	1.000								4.625	0.500	3.375			10.125
	3.000	675		3.500	3.749	1.000								5.250	0.500	3.375			10.125
	3.500	675		3.500	4.249	1.000								5.750	0.500	3.375			10.125
	4.000	675		4.000	4.749	1.000								6.500	0.500	3.375			10.125
	4.500	675		4.500	5.249	1.000								7.250	0.500	3.375			10.125
	5.000	675		5.000	5.749	1.000								7.500	0.500	3.375			10.125
	5.500	675		5.500	6.249	1.000								7.500	0.500	3.375			10.125

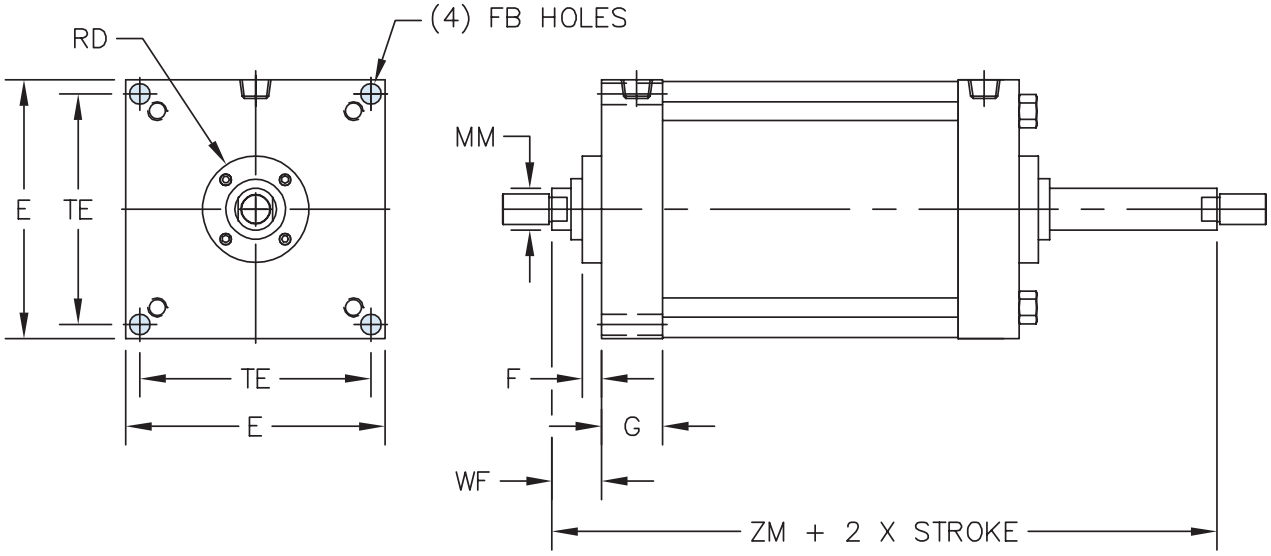
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'B' dimension tolerance is +.000 / -.002

③ Where SQ is shown in chart, cylinder utilizes a full square retainer.

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

ME3D: HEAD SQUARE MOUNTING HOLES

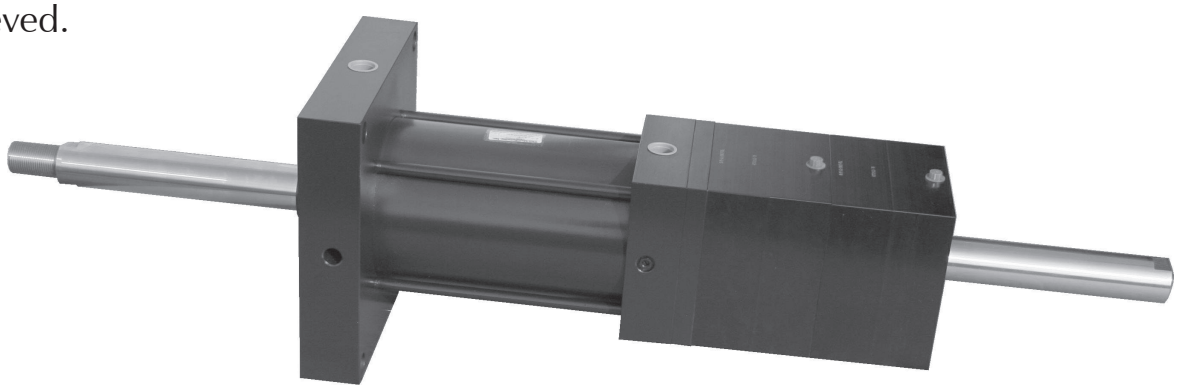


BORE	ROD DIA. (MM)	① MAX PSI RATING	E	F	FB	G	TE	RD	WF	ADD 2X STROKE ZM
8.00	1.375	500	8.500	0.750	0.688	2.000	7.570	3.500	1.625	8.875
	1.750	500						3.875	1.875	9.375
	2.000	675						4.250	2.000	9.625
	2.500	675						4.625	2.250	10.125
	3.000	675						5.250	2.250	10.125
	3.500	675						5.750	2.250	10.125
	4.000	675						6.500	2.250	10.125
	4.500	675						7.250	2.250	10.125
	5.000	675						7.500	2.250	10.125
	5.500	675						7.500	2.250	10.125

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

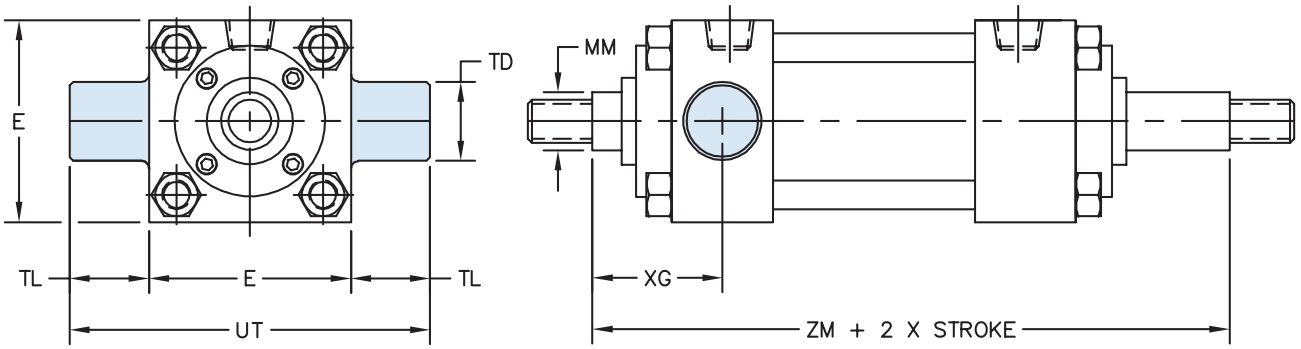
Design Tips

TRD makes a full line of pneumatic rod locks that can be adapted to 'MH' Series hydraulic cylinders. By using multiple rod locks, higher holding forces can be achieved.

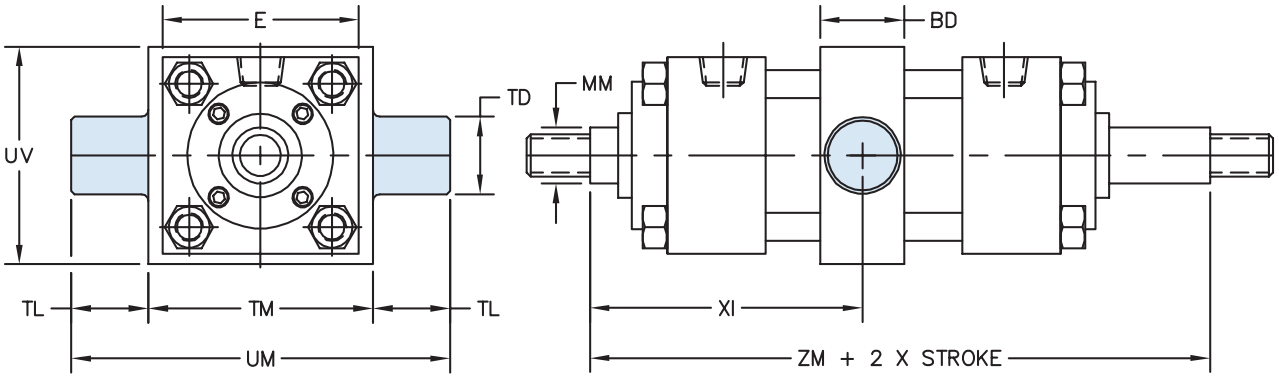


SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

MT1D: HEAD TRUNNION



MT4D: INTERMEDIATE TRUNNION



NOTE:
'XI' DIMENSION TO BE SPECIFIED BY CUSTOMER

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	BD	② TD	TL	TM	UM	UT	UV	XG	③ XI	MT4D MIN STROKE	ADD 2X STROKE ZM
1.50	0.625	1500	2.000	1.250	1.000	1.000	2.500	4.500	4.000	2.500	1.750	3.250	0.375	6.125
	1.000	1500									2.125	3.625		6.875
2.00	0.625	1500	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.750	3.375	0.625	6.125
	1.000	1500									2.125	3.750		6.875
	1.375	1500									2.375	4.000		7.375
2.50	0.625	1000	3.000	1.500	1.000	1.000	3.500	5.500	5.000	3.500	1.750	3.375	0.500	6.250
	1.000	1500									2.125	3.750		7.000
	1.375	1500									2.375	4.000		7.500
	1.750	1500									2.625	4.250		8.000
3.25	1.000	1500	3.750	2.000	1.000	1.000	4.500	6.500	5.750	4.250	2.250	4.250	1.000	7.500
	1.375	1500									2.500	4.500		8.000
	1.750	1500									2.750	4.750		8.500
	2.000	1500									2.875	4.875		8.750
4.00	1.000	1000	4.500	2.000	1.000	1.000	5.250	7.250	6.500	5.000	2.250	4.250	1.000	7.500
	1.375	1000									2.500	4.500		8.000
	1.750	1000									2.750	4.750		8.500
	2.000	1000									2.875	4.875		8.750
	2.500	1000									3.125	5.125		9.250
5.00	1.000	750	5.500	2.000	1.000	1.000	6.250	8.250	7.500	6.000	2.250	4.250	0.750	7.750
	1.375	1000									2.500	4.500		8.250
	1.750	1000									2.750	4.750		8.750
	2.000	1000									2.875	4.875		9.000
	2.500	1000									3.125	5.125		9.500
	3.000	1000									3.125	5.125		9.500
	3.500	1000									3.125	5.125		9.500
6.00	1.375	750	6.500	2.000	1.375	1.375	7.625	10.375	9.250	7.000	2.625	4.750	0.750	8.750
	1.750	750									2.875	5.000		9.250
	2.000	750									3.000	5.125		9.500
	2.500	750									3.250	5.375		10.000
	3.000	750									3.250	5.375		10.000
	3.500	750									3.250	5.375		10.000
	4.000	750									3.250	5.375		10.000
8.00	1.375	500	8.500	2.500	1.375	1.375	9.750	12.500	11.250	9.500	2.625	5.000	1.125	8.875
	1.750	500									2.875	5.250		9.375
	2.000	675									3.000	5.375		9.625
	2.500	675									3.250	5.625		10.125
	3.000	675									3.250	5.625		10.125
	3.500	675									3.250	5.625		10.125
	4.000	675									3.250	5.625		10.125
	4.500	675									3.250	5.625		10.125
	5.000	675									3.250	5.625		10.125
	5.500	675									3.250	5.625		10.125

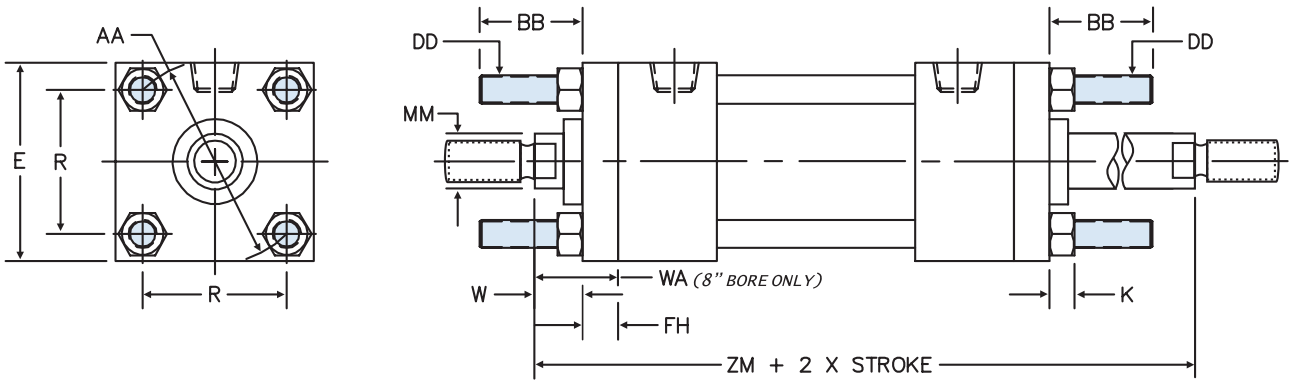
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② 'TD' dimension tolerance is + .000 / - .001

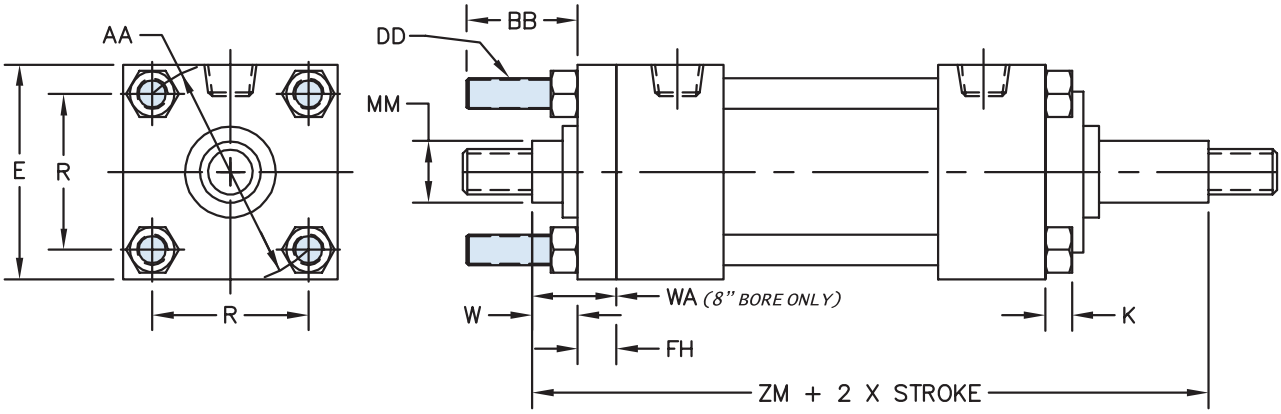
③ 'XI' dimension is the minimum that can be supplied and leaves 1/4" gap between head & trunnion block (customer to specify 'XI' dimension).

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

MX1D: EXTENDED TIE RODS - HEAD & CAP



MX3D: EXTENDED TIE RODS - HEAD END



SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

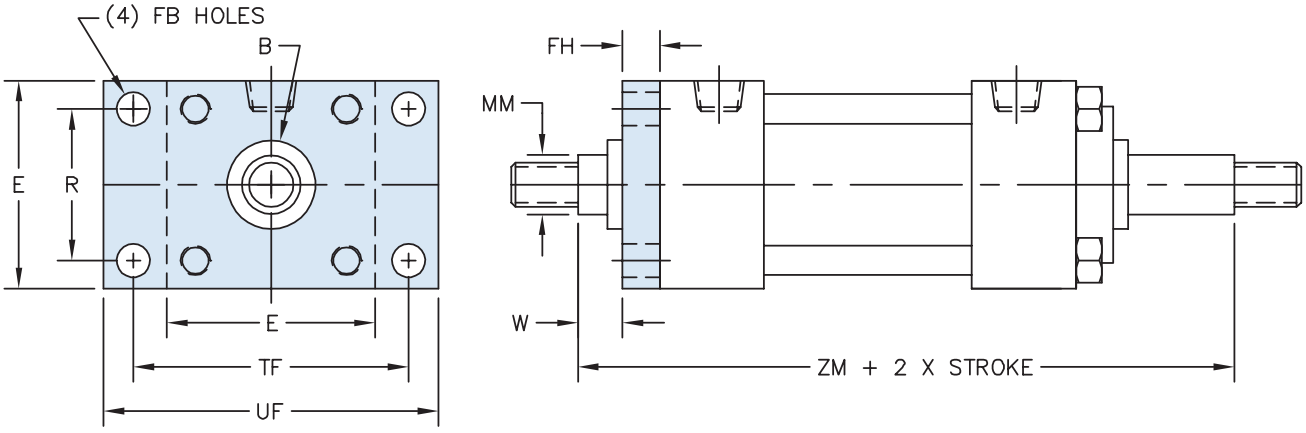
BORE	ROD DIA. (MM)	① MAX PSI RATING	E	FH	AA	BB	DD	K	R	W or WA (8″)	ADD 2X STROKE ZM
1.50	0.625	1500	2.000	0.375	2.020	1.000	1/4 - 28	0.250	1.430	0.625	6.125
	1.000	1500								1.000	6.875
2.00	0.625	1500	2.500	0.375	2.600	1.125	5/16 - 24	0.313	1.840	0.625	6.125
	1.000	1500								1.000	6.875
	1.375	1500								1.250	7.375
2.50	0.625	1000	3.000	0.375	3.100	1.125	5/16 - 24	0.313	2.190	0.625	6.250
	1.000	1500								1.000	7.000
	1.375	1500								1.250	7.500
	1.750	1500								1.500	8.000
3.25	1.000	1500	3.750	0.625	3.900	1.375	3/8 - 24	0.375	2.760	0.750	7.500
	1.375	1500								1.000	8.000
	1.750	1500								1.250	8.500
	2.000	1500								1.375	8.750
4.00	1.000	1000	4.500	0.625	4.700	1.375	3/8 - 24	0.375	3.320	0.750	7.500
	1.375	1000								1.000	8.000
	1.750	1000								1.250	8.500
	2.000	1000								1.375	8.750
	2.500	1000								1.625	9.250
5.00	1.000	750	5.500	0.625	5.800	1.813	1/2 - 20	0.438	4.100	0.750	7.750
	1.375	1000								1.000	8.250
	1.750	1000								1.250	8.750
	2.000	1000								1.375	9.000
	2.500	1000								1.625	9.500
	3.000	1000								1.625	9.500
	3.500	1000								1.625	9.500
6.00	1.375	750	6.500	0.750	6.900	1.813	1/2 - 20	0.438	4.880	0.875	8.750
	1.750	750								1.125	9.250
	2.000	750								1.250	9.500
	2.500	750								1.500	10.000
	3.000	750								1.500	10.000
	3.500	750								1.500	10.000
	4.000	750								1.500	10.000
8.00	1.375	500	8.500	② 0.625	9.10	2.313	5/8 - 18	0.563	6.440	1.500	8.875
	1.750	500								1.750	9.375
	2.000	675								1.875	9.625
	2.500	675								2.125	10.125
	3.000	675								2.125	10.125
	3.500	675								2.125	10.125
	4.000	675								2.125	10.125
	4.500	675								2.125	10.125
	5.000	675								2.125	10.125
	5.500	675								2.125	10.125

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

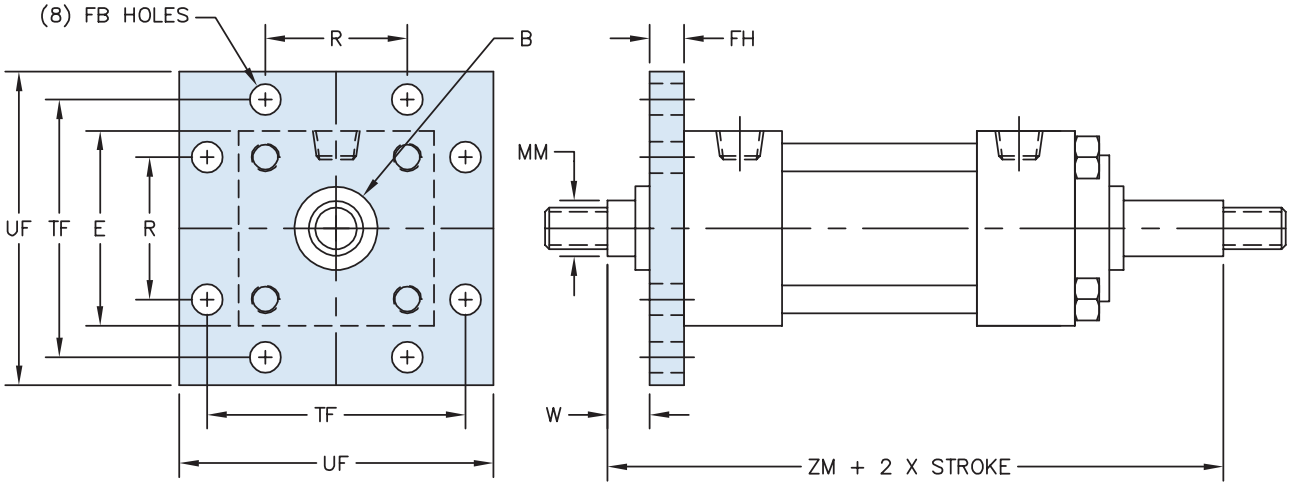
② Round retainer used to retain bushing, not a full front plate as other bores. 'BB' is dimension from head on the 8.00″ bore.

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

MF1D: HEAD FLANGE



MF5D: HEAD SQUARE FLANGE



SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

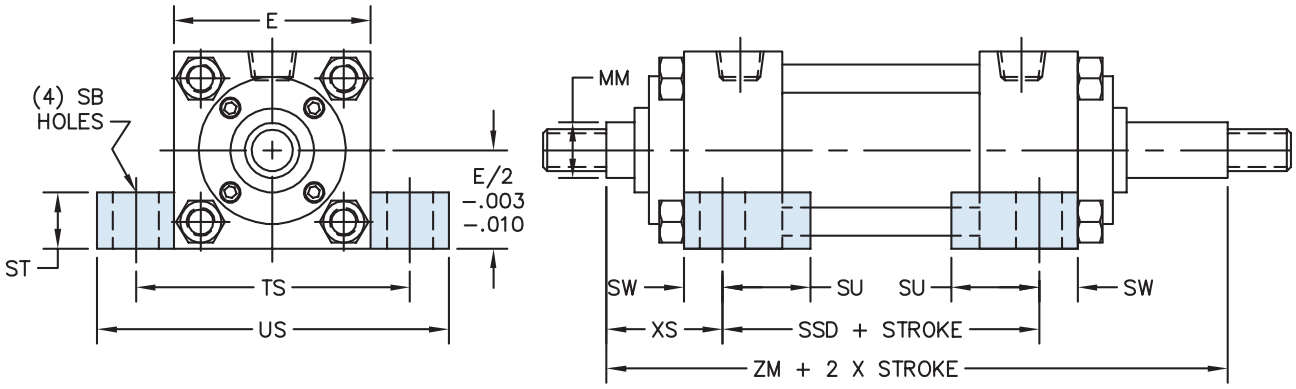
BORE	ROD DIA. (MM)	① MAX PSI RATING	② B	E	FB	FH	R	TF	UF	W	ADD 2X STROKE ZM
1.50	0.625	1500	1.124	2.000	0.313	0.375	1.430	2.750	3.375	0.625	6.125
	1.000	1500	1.499							1.000	6.875
2.00	0.625	1500	1.124	2.500	0.375	0.375	1.840	3.375	4.125	0.625	6.125
	1.000	1500	1.499							1.000	6.875
	1.375	1500	1.999							1.250	7.375
2.50	0.625	1000	1.124	3.000	0.375	0.375	2.190	3.875	4.625	0.625	6.250
	1.000	1500	1.499							1.000	7.000
	1.375	1500	1.999							1.250	7.500
	1.750	1500	2.374							1.500	8.000
3.25	1.000	1500	1.499	3.750	0.438	0.625	2.760	4.688	5.500	0.750	7.500
	1.375	1500	1.999							1.000	8.000
	1.750	1500	2.374							1.250	8.500
	2.000	1500	2.624							1.375	8.750
4.00	1.000	1000	1.499	4.500	0.438	0.625	3.320	5.438	6.250	0.750	7.500
	1.375	1000	1.999							1.000	8.000
	1.750	1000	2.374							1.250	8.500
	2.000	1000	2.624							1.375	8.750
	2.500	1000	3.124							1.625	9.250
5.00	1.000	750	1.499	5.500	0.563	0.625	4.100	6.625	7.625	0.750	7.750
	1.375	1000	1.999							1.000	8.250
	1.750	1000	2.374							1.250	8.750
	2.000	1000	2.624							1.375	9.000
	2.500	1000	3.124							1.625	9.500
	3.000	1000	3.749							1.625	9.500
	3.500	1000	4.249							1.625	9.500
6.00	1.375	750	1.999	6.500	0.563	0.750	4.880	7.625	8.625	0.875	8.750
	1.750	750	2.374							1.125	9.250
	2.000	750	2.624							1.250	9.500
	2.500	750	3.124							1.500	10.000
	3.000	750	3.749							1.500	10.000
	3.500	750	4.249							1.500	10.000
	4.000	750	4.749							1.500	10.000

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

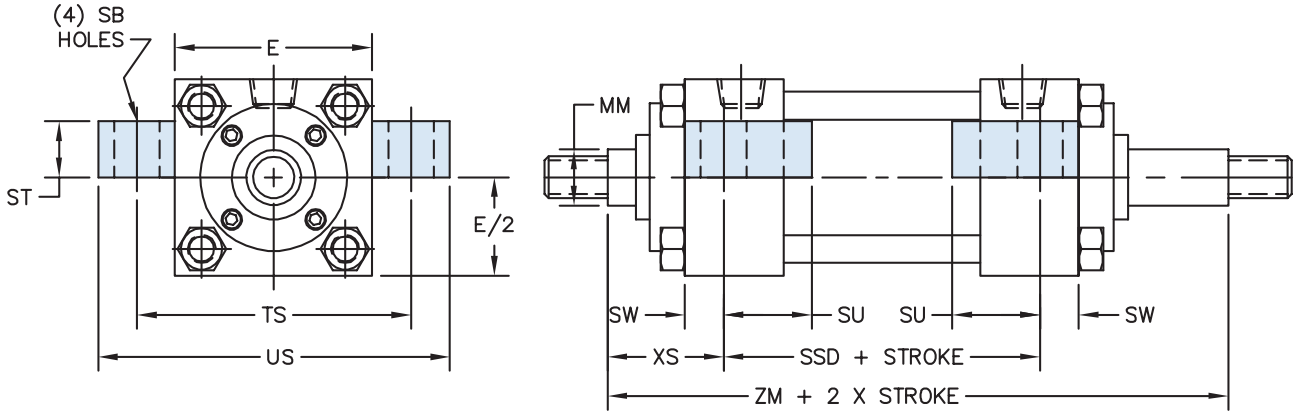
② 'B' dimension tolerance is +.000 / -.002

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

MS2D: SIDE LUGS



MS3D: CENTER LINE LUGS



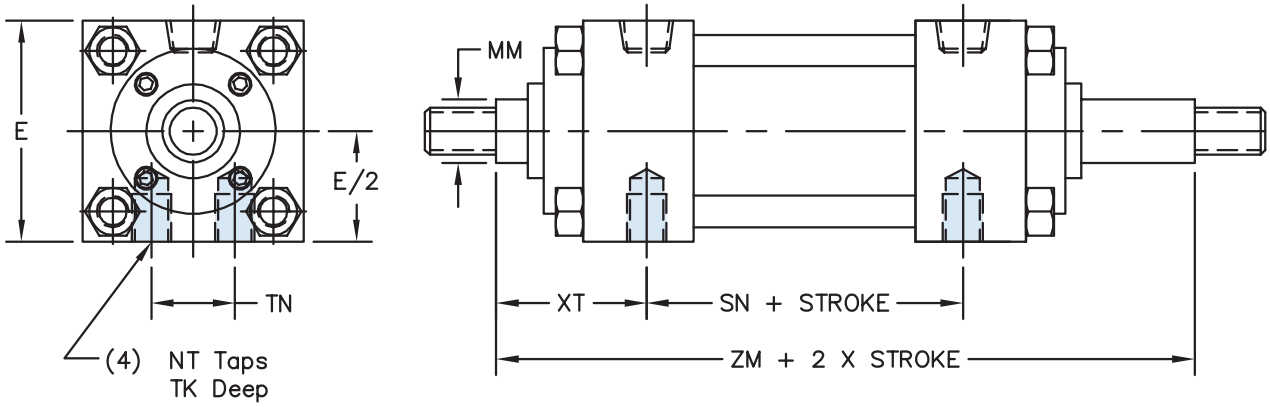
SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE SSD	ADD 2X STROKE ZM
1.50	0.625	1500	2.000	0.438	0.500	1.125	0.375	2.750	3.500	1.375	3.375	6.125
	1.000	1500								1.750		6.875
2.00	0.625	1500	2.500	0.438	0.500	1.125	0.375	3.250	4.000	1.375	3.375	6.125
	1.000	1500								1.750		6.875
	1.375	1500								2.000		7.375
2.50	0.625	1000	3.000	0.438	0.500	1.125	0.375	3.750	4.500	1.375	3.500	6.250
	1.000	1500								1.750		7.000
	1.375	1500								2.000		7.500
	1.750	1500								2.250		8.000
3.25	1.000	1500	3.750	0.563	0.750	1.250	0.500	4.75	5.750	1.875	3.750	7.500
	1.375	1500								2.125		8.000
	1.750	1500								2.375		8.500
	2.000	1500								2.500		8.750
4.00	1.000	1000	4.500	0.563	0.750	1.250	0.500	5.500	6.500	1.875	3.750	7.500
	1.375	1000								2.125		8.000
	1.750	1000								2.375		8.500
	2.000	1000								2.500		8.750
	2.500	1000								2.750		9.250
5.00	1.000	750	5.500	0.813	1.000	1.063	0.688	6.875	8.250	2.063	3.625	7.750
	1.375	1000								2.313		8.250
	1.750	1000								2.563		8.750
	2.000	1000								2.688		9.000
	2.500	1000								2.938		9.500
	3.000	1000								2.938		9.500
	3.500	1000								2.938		9.500
6.00	1.375	750	6.500	0.813	1.000	1.313	0.688	7.875	9.250	2.313	4.125	8.750
	1.750	750								2.563		9.250
	2.000	750								2.688		9.500
	2.500	750								2.938		10.000
	3.000	750								2.938		10.000
	3.500	750								2.938		10.000
	4.000	750								2.938		10.000
8.00	1.375	500	8.500	0.813	1.000	1.313	0.688	9.875	11.250	2.313	4.250	8.875
	1.750	500								2.563		9.375
	2.000	675								2.688		9.625
	2.500	675								2.938		10.125
	3.000	675								2.938		10.125
	3.500	675								2.938		10.125
	4.000	675								2.938		10.125
	4.500	675								2.938		10.125
	5.000	675								2.938		10.125
	5.500	675								2.938		10.125

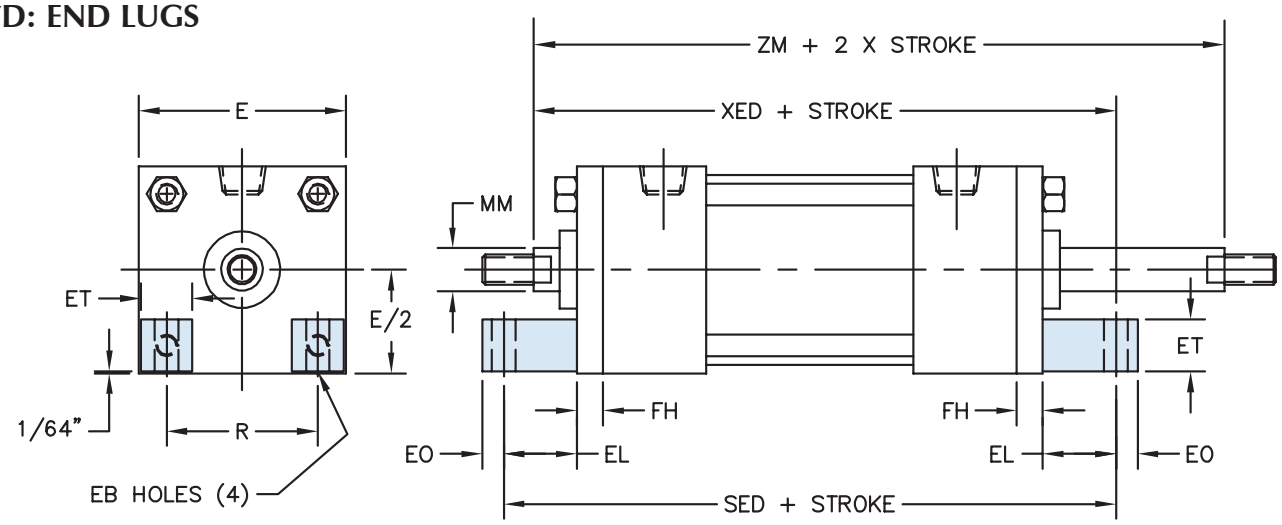
① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

MS4D: BOTTOM TAPPED HOLES



MS7D: END LUGS



SERIES 'MH' DIMENSIONS: DOUBLE END MOUNTS

BORE	ROD DIA. (MM)	① MAX PSI RATING	E	EB	EL	EO	ET	FH	NT	R	TN	TK	XT	ADD TO STROKE			ADD 2X STROKE
														SN	SED	XED	ZM
1.50	0.625	1500	2.000	N/A	N/A	N/A	N/A	N/A	1/4 - 20	N/A	0.625	0.375	1.938	2.250	N/A	N/A	6.125
	1.000	1500											2.313				6.875
2.00	0.625	1500	2.500	0.344	0.938	0.313	0.375	0.375	5/16 - 18	1.844	0.875	0.406	1.938	2.250	6.750	6.438	6.125
	1.000	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.313		N/A	N/A	6.875
	1.375	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.563		N/A	N/A	7.375
2.50	0.625	1000	3.000	0.344	1.063	0.313	0.750	0.375	3/8 - 16	2.188	1.250	0.438	1.938	2.375	7.125	6.688	6.250
	1.000	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.313		N/A	N/A	7.000
	1.375	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.563		N/A	N/A	7.500
	1.750	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.813		N/A	N/A	8.000
3.25	1.000	1500	3.750	0.406	0.875	0.375	0.938	0.625	1/2 - 13	2.766	1.500	0.500	2.438	2.625	7.750	7.625	7.500
	1.375	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.688		N/A	N/A	8.000
	1.750	1500		N/A	N/A	N/A	N/A	N/A		N/A			2.938		N/A	N/A	8.500
	2.000	1500		N/A	N/A	N/A	N/A	N/A		N/A			3.063		N/A	N/A	8.750
4.00	1.000	1000	4.500	0.406	1.000	0.375	1.125	0.625	1/2 - 13	3.328	2.063	0.625	2.438	2.625	8.000	7.750	7.500
	1.375	1000		0.406	1.000	0.375	1.125	0.625		3.328			2.688		8.000	8.000	8.000
	1.750	1000		N/A	N/A	N/A	N/A	N/A		N/A			2.938		N/A	N/A	8.500
	2.000	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.063		N/A	N/A	8.750
	2.500	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.313		N/A	N/A	9.250
5.00	1.000	750	5.500	0.531	1.063	0.500	1.375	0.625	5/8 - 11	4.109	2.688	0.750	2.438	2.875	8.375	8.063	7.750
	1.375	1000		0.531	1.063	0.500	1.375	0.625		4.109			2.688		8.375	8.313	8.250
	1.750	1000		0.531	1.063	0.500	1.375	0.625		4.109			2.938		8.375	8.563	8.750
	2.000	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.063		N/A	N/A	9.000
	2.500	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.313		N/A	N/A	9.500
	3.000	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.313		N/A	N/A	9.500
	3.500	1000		N/A	N/A	N/A	N/A	N/A		N/A			3.313		N/A	N/A	9.500
6.00	1.375	750	6.500	0.531	1.000	0.500	1.563	0.750	3/4 - 10	4.875	3.250	1.000	2.813	3.125	9.000	8.875	8.750
	1.750	750		0.531	1.000	0.500	1.563	0.750		4.875			3.063		9.000	9.125	9.250
	2.000	750		0.531	1.000	0.500	1.563	0.750		4.875			3.188		9.000	9.250	9.500
	2.500	750		0.531	1.000	0.500	1.563	0.750		4.875			3.438		9.000	9.500	10.000
	3.000	750		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.000
	3.500	750		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.000
	4.000	750		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.000
8.00	1.375	500	8.500	0.688	1.125	0.625	2.000	②	3/4 - 10	6.438	4.500	1.250	2.813	3.250	7.875	8.375	8.875
	1.750	500		0.688	1.125	0.625	2.000	②		6.438			3.063		7.875	8.625	9.375
	2.000	675		0.688	1.125	0.625	2.000	②		6.438			3.188		7.875	8.750	9.625
	2.500	675		0.688	1.125	0.625	2.000	②		6.438			3.438		7.875	9.000	10.125
	3.000	675		0.688	1.125	0.625	2.000	②		6.438			3.438		7.875	9.000	10.125
	3.500	675		0.688	1.125	0.625	2.000	②		6.438			3.438		7.875	9.000	10.125
	4.000	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.125
	4.500	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.125
	5.000	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.125
	5.500	675		N/A	N/A	N/A	N/A	N/A		N/A			3.438		N/A	N/A	10.125

① Max single acting pressure rating (NON-Shock). Any additional opposed intensified pressure related to varying impact area within the cylinder is not taken into consideration (ram cylinders).

② MS7 bracket bolted directly to head (uses round retainer).

SERIES 'MH' BASIC OPTIONS

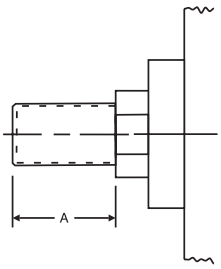
Index To Standard Options:

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!*

Note: Maximum thread length is double the standard "A" length.

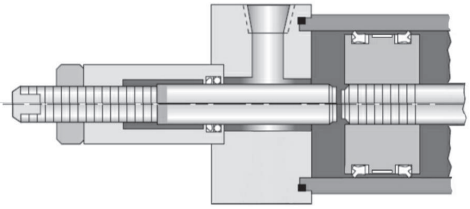


AS Adjustable Stroke (Retract)

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

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

ADJUSTABLE STROKE	
BORE	MAX "AS"
1.50	Up to 8 inch
2.00-3.25	Up to 6 inch
4.00-6.00	Up to 5 inch
8.00	Up to 4 inch



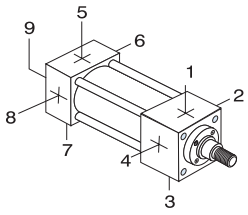
Consult factory for additional adjustable strokes offerings.

ABP= Air Bleed Ports

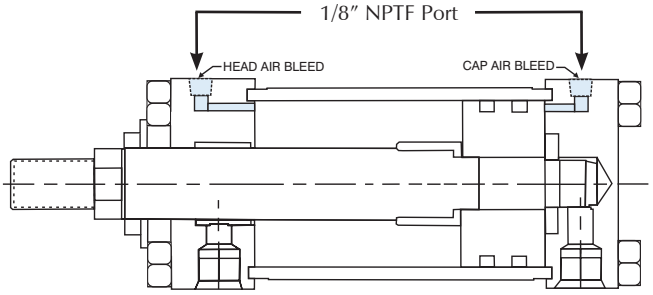
Air bleeds can be provided at either or both ends of the cylinder. Air bleeds should be located at the highest point in the cylinder for maximum effectiveness. The location needs to be specified, similar to port locations.

Example: ABP=15
(Air Bleed ports at position 1 & 5)

Plugged from factory.

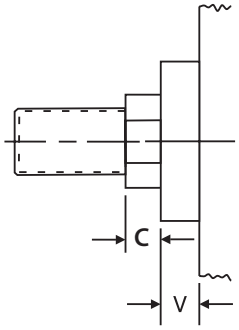


Location 9 is center of cap face.



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.



Example: If C=0.50", then 1" rod extension is C=1.50"

Be sure to check piston rod column strength charts to properly size the rod and prevent buckling.

Extended piston rods do not delay delivery.

SERIES 'MH' BASIC OPTIONS

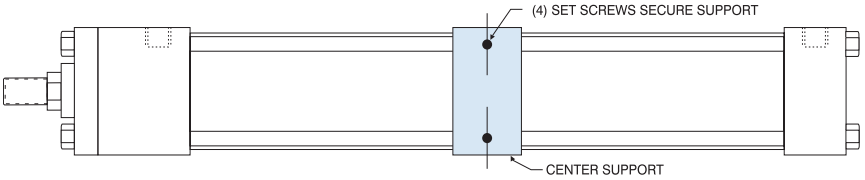
CS Center Supports

Center supports are recommended for long stroke cylinders to support tube and prevent the tie rods from sagging. Properly supported cylinders will eliminate premature cylinder wear and eliminate tie rod vibration.

Center supports can include MS2 mounts.

Contact TRD for more information.

MAXIMUM STROKE RECOMMENDATIONS			
BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION)	
		ONE SUPPORT	TWO SUPPORTS
1.50", 2.00" & 2.50"	48 INCHES	OVER 48 INCHES	OVER 72 INCHES
3.25", 4.00" & 5.00"	65 INCHES	OVER 65 INCHES	OVER 92 INCHES
6.00"	72 INCHES	OVER 72 INCHES	NOT REQUIRED



H C Cushions

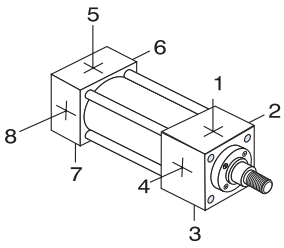
TRD's cushion design features industry proven technology and ultra fine adjustment needles for perfect deceleration and long life. Cushion adjustment needle positions need to be specified.

Example: H2C6

CUSHION LOCATIONS	
HEAD CUSHION	CAP CUSHION
H1	C5
H2	C6
H3	C7
H4	C8

STANDARD CUSHION LOCATIONS	
MOST MOUNTS	H2 C6
MS3 MOUNT	H3 C7
MT1 MOUNT	H3 C6
MT2 MOUNT	H2 C7

UNAVAILABLE CUSHION LOCATIONS BY MOUNT		
MOUNT	HEAD CUSHION	CAP CUSHION
ME5	H2, H4	
ME6		C6, C8
MS3	H2, H4	C6, C8
MT1	H2, H4	
MT2		C6, C8

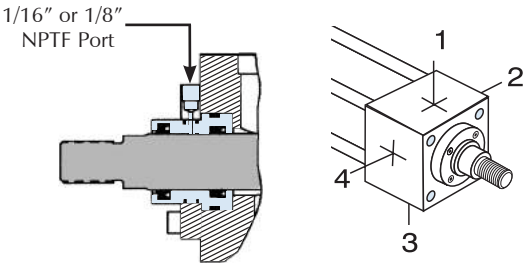


Note: Cylinders with a short stroke (value varies with bore/rod diameter and cushion combinations) may result in improper cylinder operation. Consult factory for availability.

DBB= Drain Back Bushing

When oil leakage cannot be tolerated, a rod bushing drain port can be provided. Since there isn't any pressure in the drain line, clear tubing can offer a visual inspection of any leakage. A constant leak indicates that the rod seal is worn and needs to be replaced.

Example: DBB=1 (drain port at position 1)



EK Extended Key Plate

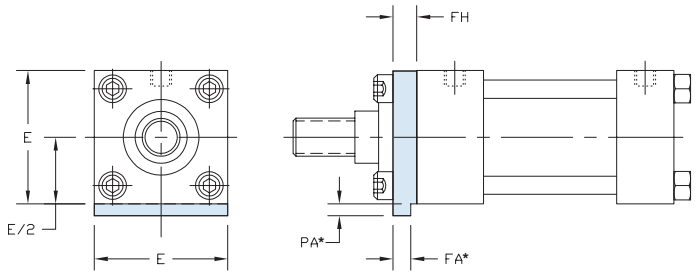
Extended key plate or thrust key is made from a full square bushing retainer plate. The key is designed to fit in a milled slot on the equipment to prevent the cylinder from shifting.

An additional mount needs to be specified to secure cylinder.

Available bore sizes: MH - 1.50" to 6.00" Bore

'MH' DIMENSIONS FOR EXTENDED KEY PLATE				
BORE	E	FA*	FH	PA*
1.50	2.000	0.312 / 0.310	0.375	0.188
2.00	2.500	0.312 / 0.310	0.375	0.188
2.50	3.000	0.312 / 0.310	0.375	0.188
3.25	3.750	0.562 / 0.560	0.625	0.313
4.00	4.500	0.562 / 0.560	0.625	0.313
5.00	5.500	0.562 / 0.560	0.625	0.313
6.00	6.500	0.687 / 0.685	0.750	0.375

*FA & PA dimensions will have a black oxide finish and will not be painted.



SERIES 'MH' BASIC OPTIONS

Option T (PTFE) Piston Seal - Recommended for High Load & Low Friction Applications

Long stroke cylinders and pivot type mounting can create severe cylinder piston-to-tube side loads. The PTFE piston seal provides increased side load capacity and low friction without increasing the cylinder base dimensions.

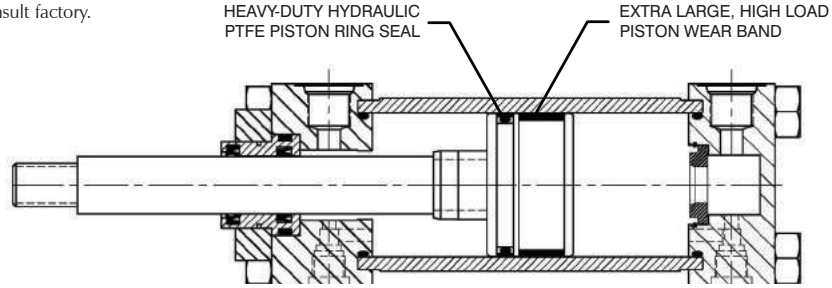
Design Benefits

- Bi-direction piston seal offers low leakage rating.
- Piston seal design offers lower friction than cast iron rings or lip seals, which eliminate stick/slip breakaway issues.
- Glass filled PTFE piston seal is 20% stronger than bronze filled seals.
- High contamination tolerant; offers the longest life of any seal type.
- Temperature Rating (PTFE): -100°F to 400°F (-73°C to 204°C)
- Temperature Rating (Nitrile): -20°F to 200°F (-29°C to 93°C)
- Temperature Rating (Viton): 0°F to 400°F (-18°C to 204°C)

High Load Piston Wear Band - Our superior design is 35% to 80% wider than competitive models and we locate the wear band at the furthest point from the rod bearing to increase overall effectiveness.

Piston Ring Seal - Glass filled PTFE with Nitrile* expander.

*Other materials are available, consult factory.

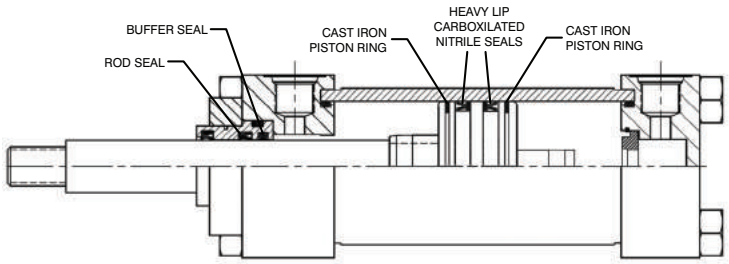


HSS *High Shock Seals*

High shock seal option provides shock protection to the rod and piston seal.

Piston Seal - Consists of two (2) bidirectional sealing, step-cut, cast iron piston rings to buffer the shock and two (2) heavy-lip design Carboxilated Nitrile seals (with back-up rings), to provide near leak-free operation.

Rod Seals - Consists of a buffer seal to handle the shock and a double lip polyurethane block vee seal for leak free operation.



KKX *Non-Standard Rod Threads*

Cylinders piston rods can be furnished with non-standard rod threads.

Ordering Example: MH - MF1 - 150 X 24 - 100 - KKX = 7/8 - 9UNC - P15 = N375 - SSSS

Add special thread to part number

KK3M *Female Metric Rod Threads*

Equipment that is imported to the United States will typically contain metric tie-rod cylinders. In general, ISO tie rod cylinders are not as robust as NFPA cylinder designs and some customers prefer to replace the metric cylinders with NFPA designs to provide longer life.

TRD can provide cylinders with metric piston rod end threads to assist customers in mating replacement cylinders to existing equipment.

Ordering Example: MH - MF1 - 150 X 24 - 100 - KK3M = M8 X 1 - P15 = N375 - SSSS

KK3X *Female Special Rod Threads*

TRD can machine a wide range of female rod threads. Standard NFPA rod threads are UNF (fine), class 2 threads. Common alternative choices are UNC (coarse) threads. Note: unless otherwise specified, the rod thread will be standard catalog "A" dimension lengths.

Ordering Example: MH - MF1 - 150 X 24 - 100 - KK3X = 3/4-10 - P15 = N375 - SSSS

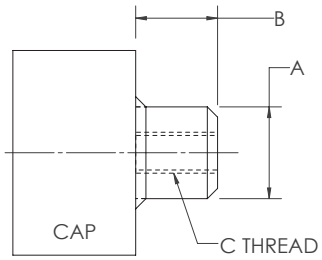
SERIES 'MH' BASIC OPTIONS

LRB *Lift Ring Boss*

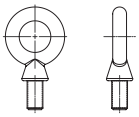
A steel, tapped lug is welded to the center of the cylinder cap.

UNC coarse threads are provided to accept high load type lifting eyes (lift eyes are available with the below options).

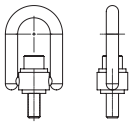
Also available in additional locations and styles.



LRE
Lift Ring Eye



LRS
Swivel Lift Ring



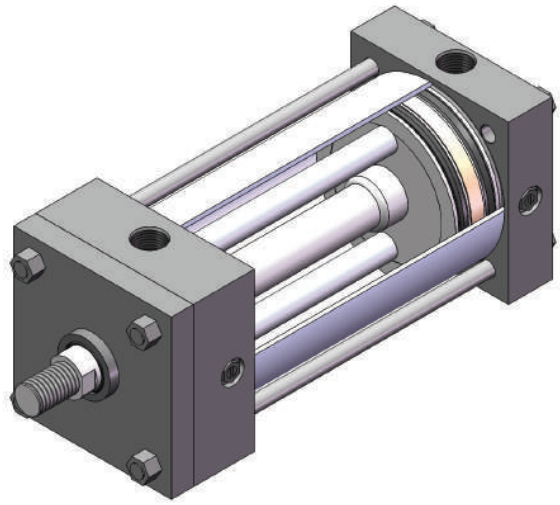
LIFT LUG DIMENSIONS				
BORE	A	B	C	STRAIGHT PULL LIFTING CAPACITY*
1.50	1.120	1.000	1/2-13	2500
2.00	1.500	1.250	5/8-11	4000
2.50	1.500	1.250	5/8-11	4000
3.25	2.000	1.500	3/4-10	6000
4.00	2.000	1.500	3/4-10	6000
5.00	2.000	1.500	3/4-10	6000
6.00	2.500	2.000	1-8	9000
8.00	2.500	2.000	1-8	9000

*Lifting capacity is the maximum capacity for intermittent lifting and placement of cylinder only. It is NOT intended to be used as the primary cylinder mount.
Note: Not available on MF2, MF6, ME6, MP1 and SB mounts.

NR *Non-Rotating (NFPA) Cylinders*

Benefits

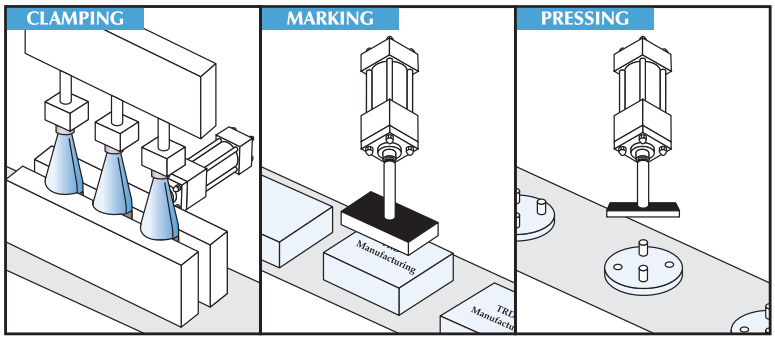
- Two internal guide rods throughout stroke
- High repeatability at each end of stroke (+/- 1 degree)
- All external dimensions are the same as standard cylinder (no additional length or width required)
- Standard diameter guide rod seals & bronze Bearings for long life and reliable operation
- Available in double rod end models



Advantages

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

Application Possibilities



AVAILABLE BORE SIZES WITH 'NR' GUIDE ROD SIZES AND MAX STROKE		
BORE	ROD DIA. (MM)	CUSHIONS
4.00	1.000 & 1.375	No Cushions
5.00	1.000, 1.375, 1.750 & 2.000	Cap Cushions Only
6.00	1.375 - 3.000	Both Cushioned (3.000" Rod - Cap Only)
8.00	1.375 - 3.500	Both Cushioned (3.500" Rod - Cap Only)

Note: Cushions restricted by some mounts on ALL bore and rod sizes.

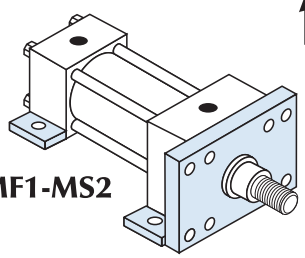
SERIES 'MH' BASIC OPTIONS

MULTIPLE MOUNTS

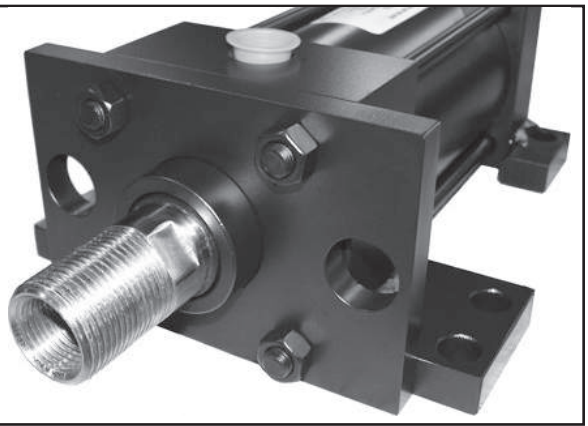
Cylinders can be furnished with a wide selection of multiple mounts.

Ordering Example: MH - MF1 - MS2 - 250 X 12 - 100 - KK1 - P15 = N375 - SSSS

Add additional mount to part number



MF1-MS2



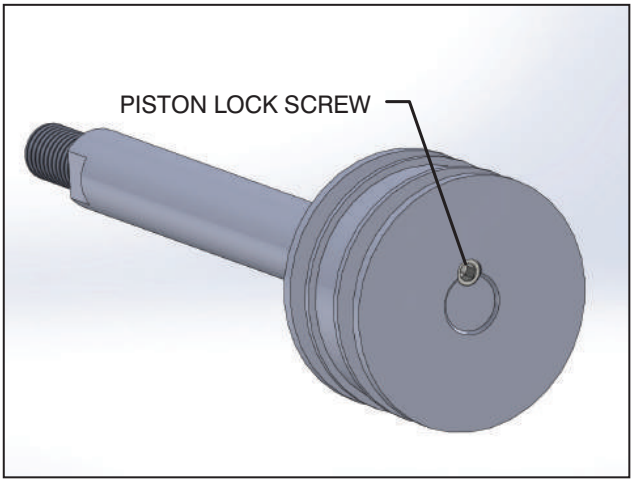
PLS *Piston Lock Screw* (For higher shock load applications)

Now standard on all hydraulic series!

Hydraulic cylinders develop high forces and can also be subjected to severe shock loads in demanding applications due to piston-to-end cap impact. The Piston Lock Screw acts as a shear pin between the piston and rod threads, eliminating any chance of a piston coming loose from the rod.

All TRD hydraulic cylinders use a specified torque with a permanent anaerobic thread lock/sealant to secure pistons to the piston rod; threads are then staked. This standard connection method has proven to be very effective in almost all applications. However, in severe shock load applications, the piston lock screw option provides a 100% positive connection that cannot come apart.

Note: Also referred to as Dutch Key or Skotch Key.



PORT OPTIONS

Cylinders can be furnished with NPTF or SAE O-Ring Boss (SAEJ514) ports at no-charge.

Cylinders can be furnished with BSPP or BSPT for additional cost.

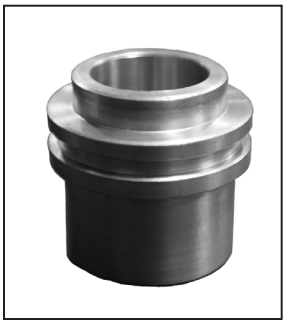
BSPT *British Standard Pipe Taper*

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)

RBB *Solid Bronze Rod Bushing*



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 uses are in water hydraulic applications.

Note: Since the mechanical properties of bronze is much lower than cast iron, bronze rod bushings typically do not provide the same long life that our standard PTFE coated cast iron rod bushings provide.

Specials: TRD can provide special length rod bushings; contact your local distributor for details

SERIES 'MH' BASIC OPTIONS

SSR — 17-4 Stainless Steel Hard Chrome Plated Piston Rod

Cylinders can be furnished with hard chrome plated stainless steel piston rods.

100,000 min. yield (rods up to 5.00)
75,000 min. yield (5.500 rod)

SEALS

The 'MH' Series allows for the use of different types of seal design and material compounds in every area, for maximum flexibility and performance.

HOW TO ORDER SEALS

S S S S

PISTON SEAL	
S	STANDARD (CARBOXILATED)
C	CAST-RING
E	EP
T	PTFE
V	FLUOROCARBON

ROD SEAL	
S	STANDARD (POLYURETHANE)
E	EP
V	FLUOROCARBON

TUBE SEAL	
S	STANDARD (BUNA)
E	EP
V	FLUOROCARBON

ROD WIPER	
S	STANDARD (FLOCKED NITRILE)
M	METALLIC SCRAPER
T	PTFE
V	FLUOROCARBON

S — Standard Seals

Piston: Carboxilated Nitrile
Rod Seal: Polyurethane
Tube Seals: Buna
Rod Wiper: Flocked Nitrile

Temperature Rating: -20°F to 200°F (-29°C to 93°C)

Compatible with: Mineral based hydraulic fluids

E — Ethylene Propylene

Temperature Rating: -50°F to 300°F (-45°C to 149°C)

Compatible with: Most Phosphate Ester (Skydrol 500 and 7000, type 2) fluids

C — Cast Iron Piston Rings

Temperature Range: -20°F to 400°F* (-29°C to 204°C)
Compatible with: Virtually all fluids
Uses: Hydraulic shock protection

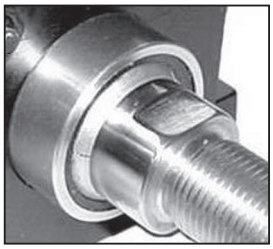
*When cylinder is equipped with Viton seals.

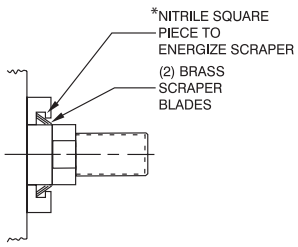
T — Glass Filled PTFE

Temperature Rating (PTFE): -100°F to 400°F (-73°C to 204°C)
Temperature Rating (Nitrile): -20°F to 200°F (-29°C to 93°C)
Temperature Rating (Viton): 0°F to 400°F (-18°C to 204°C)
Compatible with: All hydraulic fluids and almost any fluid
Use: Low friction and high side load

M — Metallic Rod Scraper

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





*Standard energizer will match cylinder seals.

V — Fluorocarbon

Temperature Rating: 0°F to 400°F (-18°C to 204°C)
(Up to 400°F with reduced service life)

Compatible with: Some Phosphate Ester (Houghto-Safe 1000, 1120; Pyrogard 42, 43, 53, 55) fluids; mineral based petroleum, halogenated hydrocarbons, silicate ester and diester fluids

XX — Special

Non-standard seals can be furnished.

Contact TRD for more information.

SERIES 'MH' BASIC OPTIONS

ST *Stop Tube and Rod Size Selection*

Stop tubes are designed to reduce the piston rod bushing stress to within the designed range of the bearing material. This will ensure proper cylinder performance in any given application. Stop tubes lower the cylinder bearing stress by adding length to the piston, which increases the overall length of the cylinder (Note: TRD uses a double piston design when possible).

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 has 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:

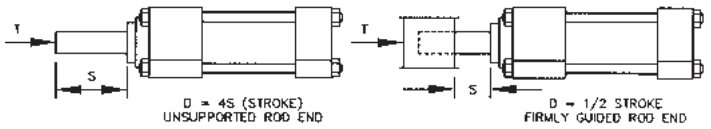
- **Add the stop tube prefix "ST=" and the stop tube length to the cylinder model number.**
- **Add "ES" after the cylinder stroke to indicate that the stroke is the effective stroke.**

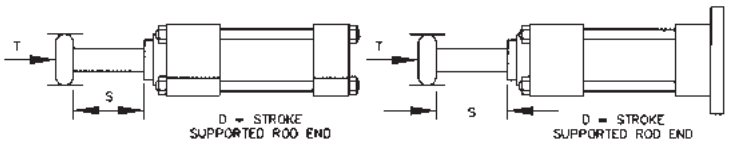
Example:
HH-MS2-2.50 X 42ES-100-KK2-P15=N375-SSSS-ST=2

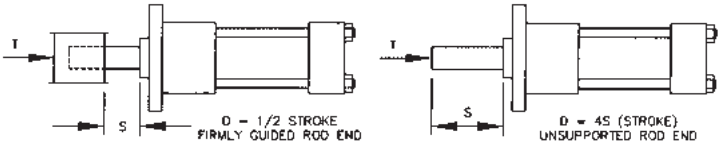
Chart 1

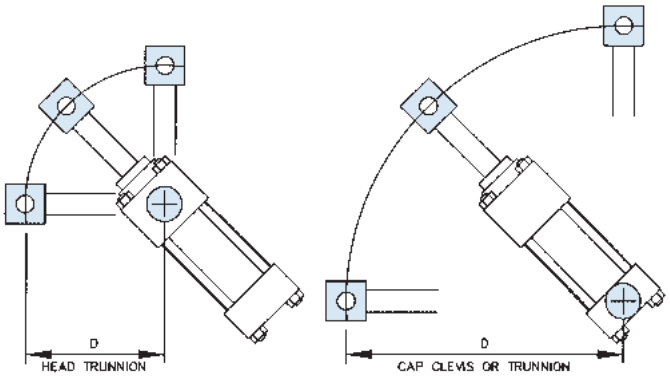
Find the value of "D" for your application

"D" = Stroke, adjusted for mounting condition
"S" = Actual cylinder stroke
"T" = Axial thrust (refer to Chart 3)





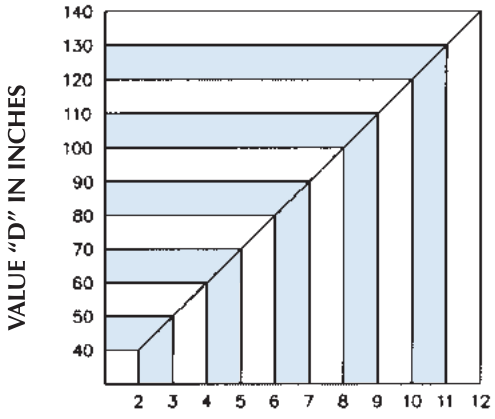




Note: Measure "D" when cylinder is fully extended.

Chart 2

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



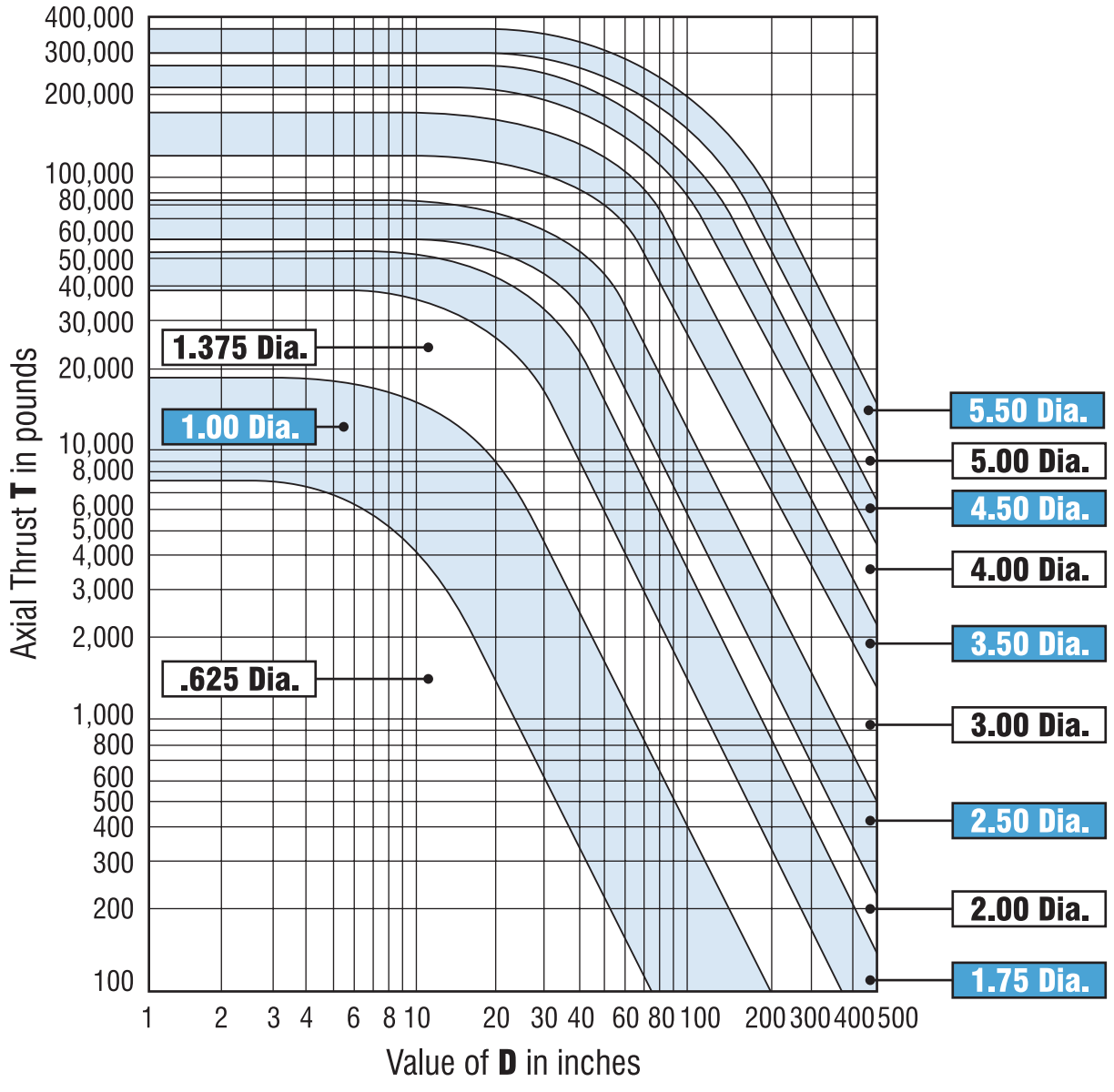
Refer to page 99 for Rod Size Selection Chart

Piston Rod Size Selection

Standard rod sizes are usually suitable for shorter stroke applications at lower hydraulic pressures. With high thrust force or long stroke applications, you must check the column strength of the rod in the mounting style to determine the proper rod diameter size.

1. Determine the total axial thrust by multiplying the bore area size (in inches) by the operating pressure (in PSI).
2. From page 98, determine the value of "D" for the application.
3. Find the value of "D" in the chart below. Follow the value of "D" vertically on the graph until it intersects with the axial thrust value of the cylinder. The intersection of these two values will fall within one of the shaded areas representing the piston rod diameter size required for the application.

Chart 3 (Piston Rod Diameter Selection)



SERIES 'MH' UNCOMMON OPTIONS

3P *Three-Position Cylinder*

You can create a 3-Position cylinder from two of the same bore size cylinders.

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

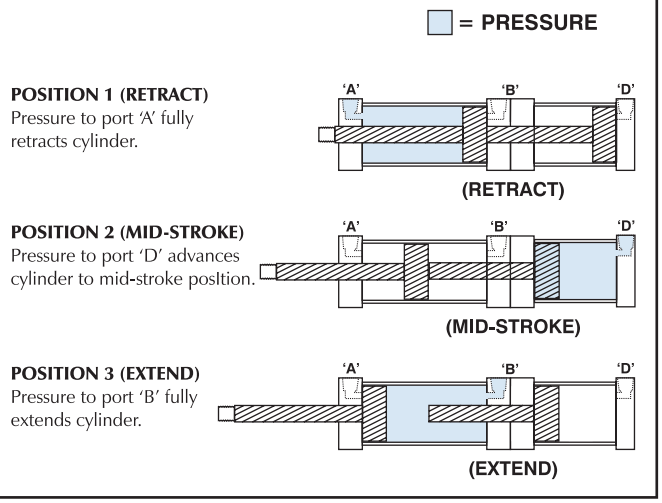
3-POSITION BENEFITS:

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

Note: Piston rods are not connected.

Contact TRD for more information.

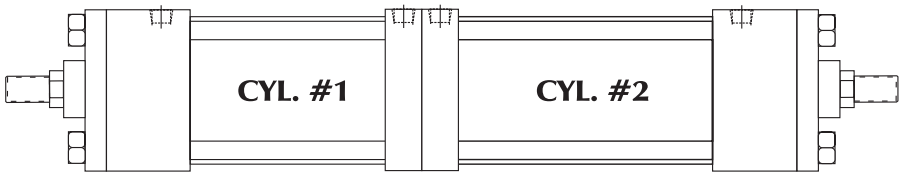
3-POSITION CYLINDERS
HOW THEY WORK



BTB *Back-To-Back Cylinders*

Back-to-Back cylinders consist of two individual cylinders built as one unit. These cylinders can act as a four position cylinder.

Contact TRD for more information.

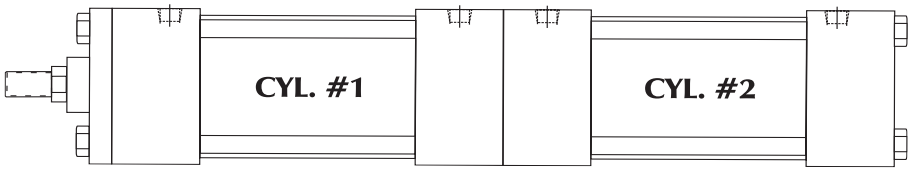


TM *Tandem Cylinders*

You can tandem different cylinders together to create unlimited design possibilities.

Note: Piston rods are connected.

Contact TRD for more information.



SPECIAL FINISHES

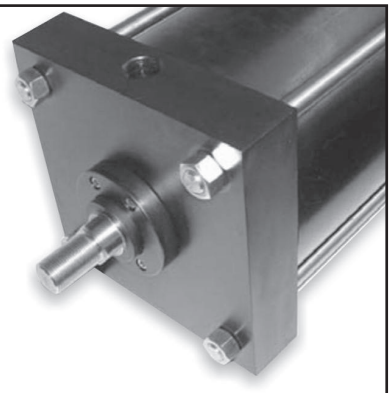
Standard Finish: Black Urethane Paint (suitable for indoor or outdoor use).

Optional Paint: Black Epoxy Paint (suitable for indoor use only).

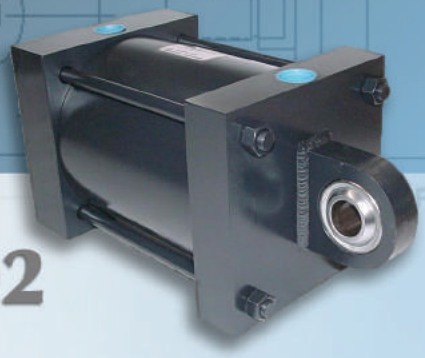
Additional Paint Choices: TRD can provide paint in any color or type.

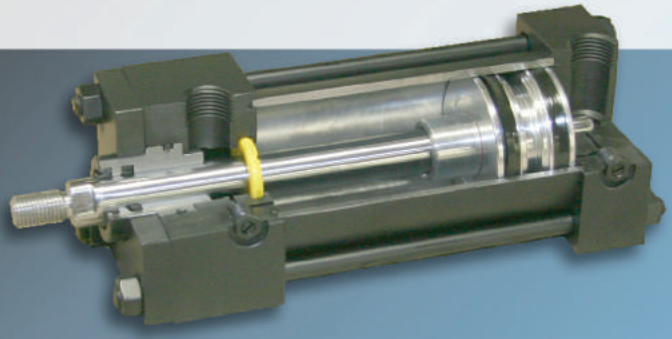
Additional Finishes: TRD can provide special finishes, i.e. Nutride Plate Heavy Chrome Plated Piston Rods.

Contact TRD with your specifications — we would be pleased to provide a quote!



TAS Series
Heavy Duty
Industrial Pneumatic
1.50″ to 8.00″ Bore





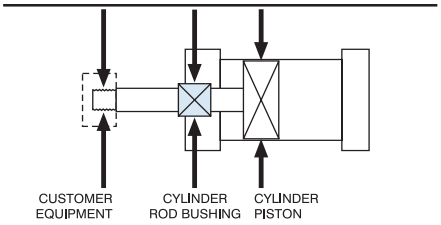
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

SERIES 'TAS' (NFPA) CYLINDER

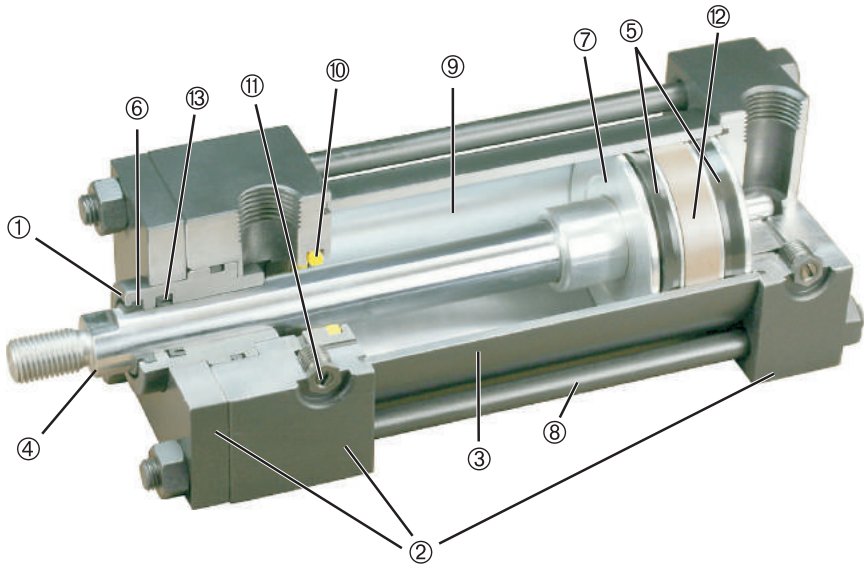
Floating Rod Bushing

SELF ALIGNMENT FEATURE

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



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



HEAVY-DUTY DESIGN FOR RELIABLE, CONSISTENT OPERATION

① ***FLOATING ROD BUSHING*** – Precision machined from 150,000 PSI rated graphite filled cast iron and PTFE coated to reduce friction and extend cycle life. Bushing design traps lubrication in effective bearing area.

② ***HEAD, CAP & RETAINER*** – Precision machined steel head, cap and retainer are held to close tolerances and ensure 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 SEALS*** – Heavy lip design Carboxilated Nitrile construction. Seals are pressure activated and wear compensating for extended life.

⑥ ***ROD WIPER*** – Urethane construction on 3.5" rod and under. Flocked Nitrile construction on the other rod diameters. 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.

⑬ ***ROD SEAL*** – Carboxilated Nitrile construction on 3.5" rod and under. Polyurethane construction on the other rod diameters. Both seals are pressure activated and wear compensating for extended life.

FINISH – Black urethane paint.

OPERATING PRESSURE	250 PSI (17 BAR)

OPERATING TEMPERATURE	Standard Seals: -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 141 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. Refer to Series 'SS' for a complete stainless steel solution.
- ***LF*** – Low friction seals reduce breakaway and running friction. Effective at all operating pressures.

HOW TO ORDER: SERIES 'TAS' (HEAVY-DUTY STEEL CYLINDERS)

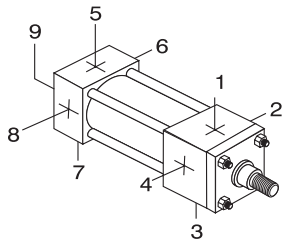
TAS - MF1 __ - 2.50 x 10 - HC - KK3

SERIES	
TAS	250 PSI AIR

NFPA MOUNTS	
MF1	FRONT FLANGE (1.50"- 6.00" Bore)
MF2	REAR FLANGE (1.50"- 6.00" Bore)
MF5	FRONT SQUARE FLANGE (1.50"- 6.00" Bore)
MF6	REAR SQUARE 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)

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.



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

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

EXAMPLE: FCLH

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

BORE	OPTION B	OPTION BC	OPTION BH	OPTION ST* (STOP TUBE) EXAMPLE: ST=2
1.50	0.500	0.250	0.250	2
2.00	0.500	0.250	0.250	2
2.50	0.500	0.250	0.250	2
3.25	0.500	0.250	0.250	2
4.00	0.500	0.250	0.250	2
5.00	0.500	0.250	0.250	2
6.00	0.500	0.250	0.250	2
8.00	0.500	0.250	0.250	2

*The desired stop tube length adds to the overall cylinder length.

MAXIMUM STROKE RECOMMENDATIONS

BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION) ONE SUPPORT	WITH CENTER SUPPORTS (CS OPTION) TWO SUPPORTS
1.50", 2.00" & 2.50"	48 INCHES	OVER 48 INCHES	OVER 72 INCHES
3.25", 4.00" & 5.00"	65 INCHES	OVER 65 INCHES	OVER 92 INCHES
6.00"	72 INCHES	OVER 72 INCHES	NOT REQUIRED

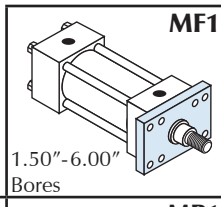
OPTIONS

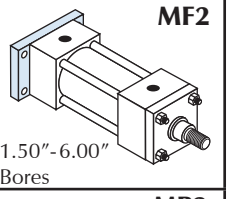
ADDS LENGTH TO CYLINDER - "OPTION LENGTH ADDER" CHART BELOW.

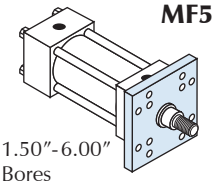
	A=	EXTENDED PISTON ROD THREAD (EXAMPLE: A=2")
	AS	ADJUSTABLE STROKE - RETRACT (SPECIFY LENGTH, EXAMPLE: AS=4")
	A/O	AIR / OIL PISTON
X	B	0.250" URETHANE BUMPER BOTH ENDS
X	BC	0.250" URETHANE BUMPER CAP ONLY
X	BH	0.250" URETHANE BUMPER HEAD ONLY
	BP	BUMPER PISTON SEALS
	BSP	BSPP OR BSPT PORTS (SPECIFY SIZE, EXAMPLE: BSPP=.25")
	C=	EXTENDED PISTON ROD (EXAMPLE: IF C=0.50", THEN 1" ROD EXTENSION IS C=1.50")
	CS	CENTER SUPPORT
	EK	EXTENDED KEY PLATE
	KK2	LARGE MALE ROD THREAD
	KK3	FEMALE ROD THREAD
	KK3M	FEMALE METRIC ROD THREAD
	KK3S	STUDDED PISTON ROD (KK3 WITH STUD, LOCTITE IN PLACE)
	KK3X	FEMALE SPECIAL THREAD
	KK4	FULL DIAMETER MALE ROD THREAD
	KK5	BLANK ROD END (NO THREADS, A=0")
	KK10	ROD COUPLER END
	KKM	MALE METRIC THREAD
	KKX	MALE SPECIAL THREAD
	LF	LOW FRICTION SEALS
	LT	LOW TEMPERATURE SEALS (TEMP RATING: -30°F to 200°F)
	LTE	LOW TEMPERATURE EXTREME SEALS (TEMP RATING:-65°F to 200°F)
	MA	MICRO-ADJUST (12" MAX. STROKE) AVAILABLE ON DOUBLE ROD ENDS
	MAB	MICRO-ADJUST WITH SOUND DAMPENING BUMPER (12" MAX. STROKE)
	MS	METALLIC ROD SCRAPER (BRASS CONSTRUCTION)
	NR	NON-ROTATING
	OP	OPTIONAL PORT LOCATION (EXAMPLE: PORTS @ 3 & 7)
	OS	OVERSIZE ROD DIAMETER (SPECIFY SIZE, EXAMPLE: OS=1.375")
	PLS	PISTON LOCK SCREW
	PMC	SOLID CAST IRON PISTON
	RBB	ROD BUSHING MATERIAL: BRONZE
	SAE	SAE PORTS (SPECIFY SIZE, EXAMPLE: SAE #6)
	SE	SPRING EXTEND
	SR	SPRING RETRACT
	SSA	STAINLESS STEEL PISTON ROD, TIE RODS & NUTS, AND FASTENERS
	SSC	STAINLESS STEEL CUSHION NEEDLES
	SSF	STAINLESS STEEL FASTENERS
	SSN	STAINLESS STEEL TIE ROD NUTS
	SSR	STAINLESS STEEL PISTON ROD
	SST	STAINLESS STEEL TIE RODS & NUTS
X	ST	STOP TUBE NOTE: SPECIFY STOP TUBE LENGTH (IN INCHES) SPECIFY STROKE AS ES (EFFECTIVE STROKE) (EXAMPLE: TAS MS4 2 X 24ES-ST=3)*
	TH	400 PSI HYD. NON-SHOCK
	VS	FLUOROCARBON SEALS
	XX	SPECIAL VARIATION (SPECIFY)

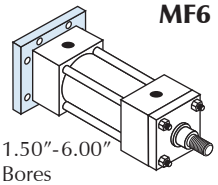
Note: Refer to TAS Options for specifications.

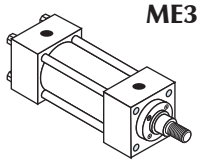
NFPA MOUNTS

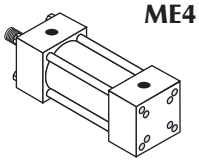

MF1
1.50"-6.00" Bores

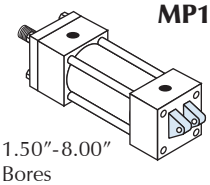

MF2
1.50"-6.00" Bores

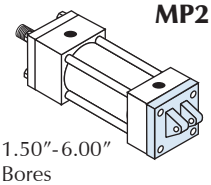

MF5
1.50"-6.00" Bores

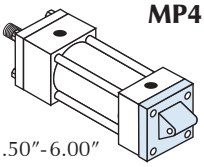

MF6
1.50"-6.00" Bores

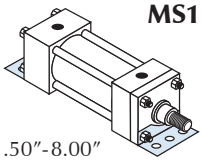

ME3
8.00" Bore

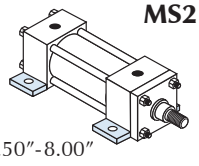

ME4
8.00" Bore

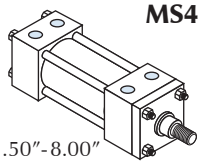

MP1
1.50"-8.00" Bores

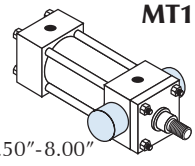

MP2
1.50"-6.00" Bores

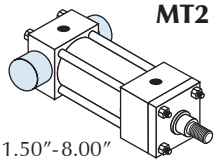

MP4
1.50"-6.00" Bores

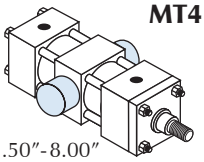

MS1
1.50"-8.00" Bores

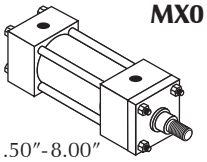

MS2
1.50"-8.00" Bores

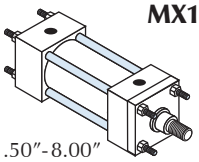

MS4
1.50"-8.00" Bores

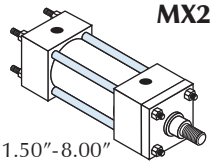

MT1
1.50"-8.00" Bores

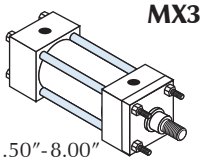

MT2
1.50"-8.00" Bores

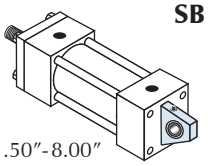

MT4
1.50"-8.00" Bores


MX0
1.50"-8.00" Bores


MX1
1.50"-8.00" Bores

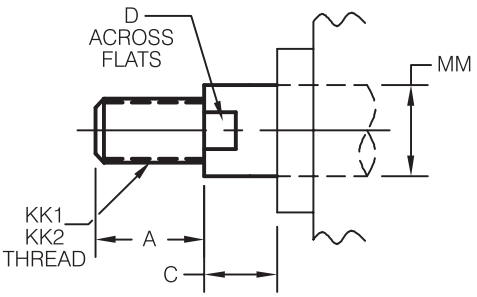

MX2
1.50"-8.00" Bores


MX3
1.50"-8.00" Bores

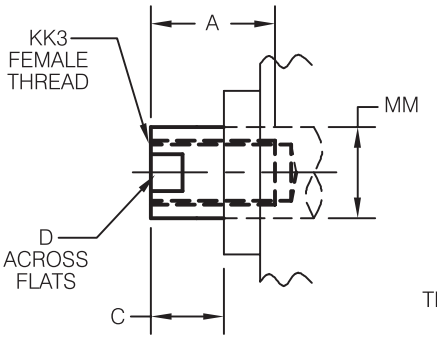

SB
1.50"-8.00" Bores

SERIES 'TAS' DIMENSIONS: THREADS

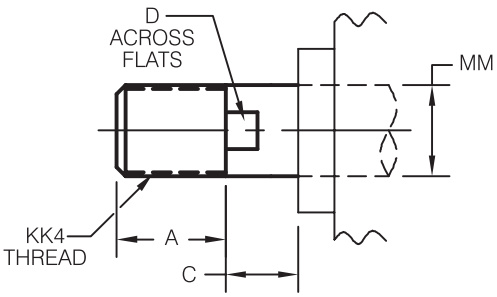
ROD END STYLE: KK1 KK2



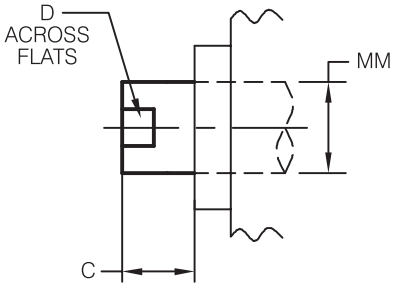
ROD END STYLE: KK3



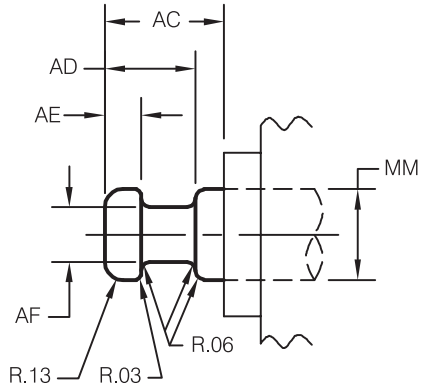
ROD END STYLE: KK4



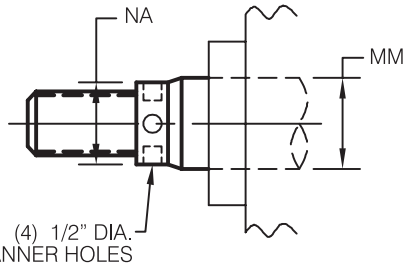
ROD END STYLE: KK5



ROD END STYLE: KK10



SPANNER HOLES (4.000-5.500 RODS) (SHOWN ON KK1-KK2)



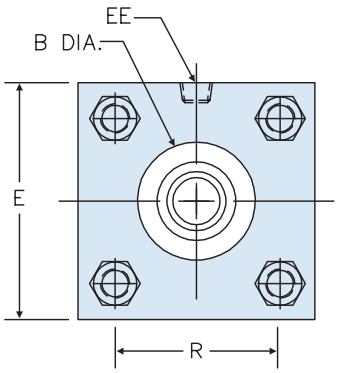
ROD DIA. (MM)	A	C	D	AC	AD	AE	AF	KK1	KK2	KK3	KK4	NA ±.002
0.625	0.750	0.375	0.500	1.125	0.625	0.250	0.375	7/16 - 20	1/2 - 20	7/16 - 20	5/8 - 18	—
1.000	1.125	0.500	0.875	1.625	0.938	0.375	0.688	3/4 - 16	7/8 - 14	3/4 - 16	1 - 14	—
1.375	1.625	0.625	1.125	1.750	1.062	0.375	0.875	1 - 14	1 1/4 - 12	1 - 14	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	—
2.000	2.250	0.875	1.750	2.625	1.688	0.625	1.375	1 1/2 - 12	1 3/4 - 12	1 1/2 - 12	2 - 12	—
2.500	3.000	1.000	2.250	3.250	1.938	0.750	1.750	1 7/8 - 12	2 1/4 - 12	1 7/8 - 12	2 1/2 - 12	—
3.000	3.500	1.000	2.625	3.625	2.438	0.875	2.250	2 1/4 - 12	2 3/4 - 12	2 1/4 - 12	3 - 12	—
3.500	3.500	1.000	3.000	4.375	2.688	1.000	2.500	2 1/2 - 12	3 1/4 - 12	2 1/2 - 12	3 1/2 - 12	—
4.000	4.000	1.000	—	4.500	2.688	1.000	3.000	3 - 12	3 3/4 - 12	3 - 12	4 - 12	3.875
4.500	4.500	1.000	—	5.250	3.188	1.500	3.500	3 1/4 - 12	4 1/4 - 12	3 1/4 - 12	4 1/2 - 12	4.375
5.000	5.000	1.000	—	5.375	3.188	1.500	3.875	3 1/2 - 12	4 3/4 - 12	3 1/2 - 12	5 - 12	4.875
5.500	5.500	1.000	—	6.250	3.938	1.875	4.375	4 - 12	5 1/4 - 12	4 - 12	5 1/2 - 12	5.375

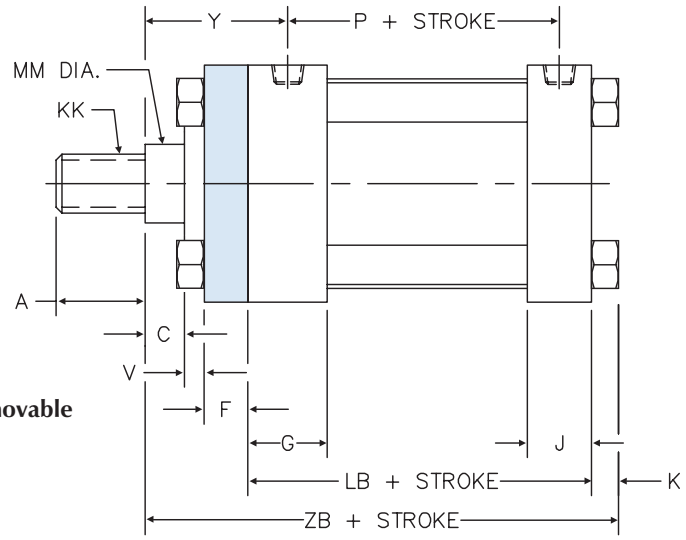
Four (4) wrench flats is an option.
Rods larger than 3.50" dia. utilize four (4) 0.50" dia. spanner holes 0.50" deep in place of wrench flats and also utilize rod end turn down above.

SERIES 'TAS' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)

SQUARE RETAINER CONSTRUCTION

FULL SQUARE RETAINER USED ON:	
BORE	ROD DIA.
1.50	0.625
	1.000
2.00	0.625
	1.000
	1.375
2.50	0.625
	1.000
	1.375
	1.750
3.25	1.000
	1.375
	1.750
	2.000
4.00	1.000
	1.375
	1.750
	2.000
	2.500
5.00	1.000
	1.375
	1.750
	2.000
	2.500
	3.000
	3.500
6.00	1.375
	1.750
	2.000
	2.500
	3.000
	3.500
	4.000

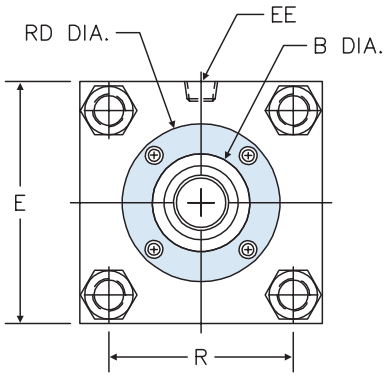


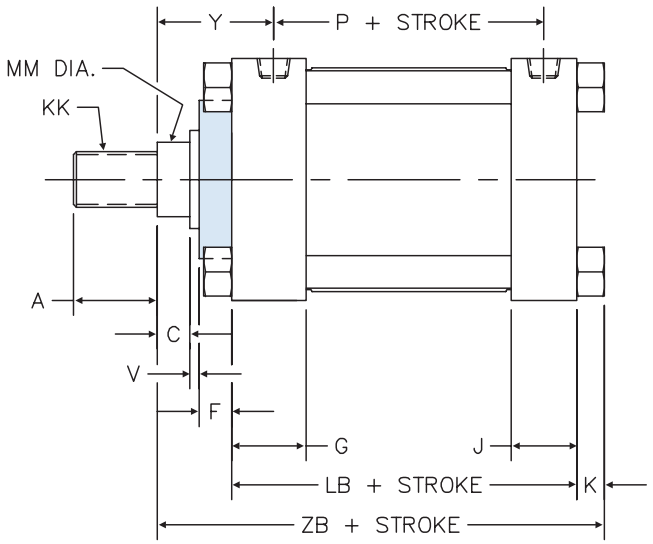


Note: Full square retainer is removable to service rod bushing.

ROUND RETAINER CONSTRUCTION

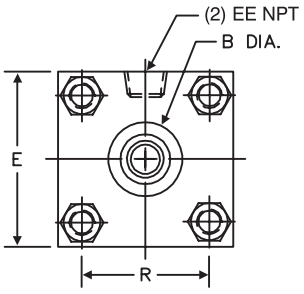
ROUND RETAINER USED ON:	
BORE	ROD DIA.
8.00	1.375
	1.750
	2.000
	2.500
	3.000
	3.500
	4.000
	4.500
	5.000
	5.500



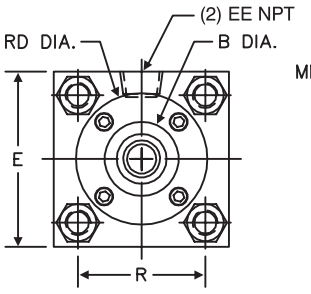


Note: Round retainer is removable to service rod bushing.

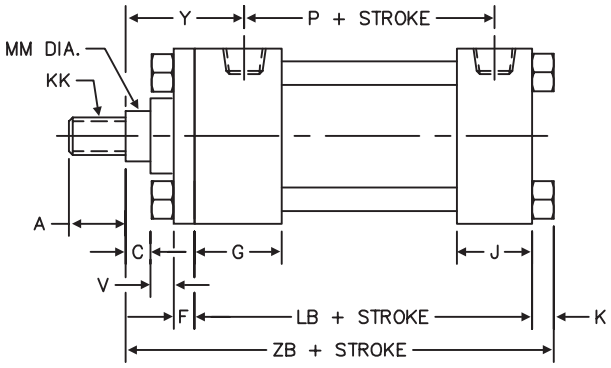
SERIES 'TAS' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)



WITH SQUARE RETAINER



WITH ROUND RETAINER (8.00" BORE ONLY)



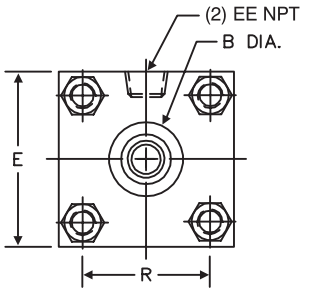
BORE	ROD DIA. (MM)	A	B	C	E	EE NPT	F	G	J	K	KK	LB	P	R	① RD	V	Y	ZB
1.50	0.625	0.750	1.124	0.375	2.000	3/8	0.375	1.500	1.000	0.250	SEE ROD END DETAIL CHART ON PAGE 104	3.625	2.375	1.430	SQ	0.250	1.875	4.875
	1.000	1.125	1.499	0.500												0.500	2.250	5.250
2.00	0.625	0.750	1.124	0.375	2.500	3/8	0.375	1.500	1.000	0.313		3.625	2.375	1.840	SQ	0.250	1.875	4.938
	1.000	1.125	1.499	0.500												0.500	2.250	5.313
	1.375	1.625	1.999	0.625												0.625	2.500	5.563
2.50	0.625	0.750	1.124	0.375	3.000	3/8	0.375	1.500	1.000	0.313		3.750	2.500	2.190	SQ	0.250	1.875	5.063
	1.000	1.125	1.499	0.500												0.500	2.250	5.438
	1.375	1.625	1.999	0.625												0.625	2.500	5.688
	1.750	2.000	2.374	0.750												0.750	2.750	5.938
3.25	1.000	1.125	1.499	0.500	3.750	1/2	0.625	1.750	1.250	0.375		4.250	2.750	2.760	SQ	0.250	2.375	6.000
	1.375	1.625	1.999	0.625												0.375	2.625	6.250
	1.750	2.000	2.374	0.750												0.500	2.875	6.500
	2.000	2.250	2.624	0.875												0.500	3.000	6.625
4.00	1.000	1.125	1.499	0.500	4.500	1/2	0.625	1.750	1.250	0.375		4.250	2.750	3.320	SQ	0.250	2.375	6.000
	1.375	1.625	1.999	0.625												0.375	2.625	6.250
	1.750	2.000	2.374	0.750												0.500	2.875	6.500
	2.000	2.250	2.624	0.875												0.500	3.000	6.625
	2.500	3.000	3.124	1.000												0.625	3.250	6.875
5.00	1.000	1.125	1.499	0.500	5.500	1/2	0.625	1.750	1.250	0.438		4.500	3.000	4.100	SQ	0.250	2.375	6.313
	1.375	1.625	1.999	0.625												0.375	2.625	6.563
	1.750	2.000	2.374	0.750												0.500	2.875	6.813
	2.000	2.250	2.624	0.875												0.500	3.000	6.983
	2.500	3.000	3.124	1.000												0.625	3.250	7.188
	3.000	3.500	3.749	1.000												0.625	3.250	7.188
	3.500	3.500	4.249	1.000												0.625	3.250	7.188
6.00	1.375	1.625	1.999	0.625	6.500	3/4	0.750	2.000	1.500	0.438		5.000	3.250	4.880	SQ	0.250	2.750	7.063
	1.750	2.000	2.374	0.750												0.375	3.000	7.313
	2.000	2.250	2.624	0.875												0.375	3.125	7.438
	2.500	3.000	3.124	1.000												0.500	3.375	7.688
	3.000	3.500	3.749	1.000												0.500	3.375	7.688
	3.500	3.500	4.249	1.000												0.500	3.375	7.688
	4.000	4.000	4.749	1.000												0.500	3.375	7.688
8.00	1.375	1.625	1.999	0.625	8.500	3/4	0.625	2.000	1.500	0.563		5.125	3.375	6.440	3.500	0.375	2.750	7.313
	1.750	2.000	2.374	0.750			0.625								3.500	0.500	3.000	7.563
	2.000	2.250	2.624	0.875			0.625								5.000	0.500	3.125	7.688
	2.500	3.000	3.124	1.000			0.750								5.000	0.500	3.375	7.938
	3.000	3.500	3.749	1.000			0.750								5.250	0.500	3.375	7.938
	3.500	3.500	4.249	1.000			0.750								5.625	0.500	3.375	7.938
	4.000	4.000	4.749	1.000			0.750								6.500	0.500	3.375	7.938
	4.500	4.500	5.249	1.000			0.750								7.250	0.500	3.375	7.938
	5.000	5.000	5.749	1.000			0.750								7.500	0.500	3.375	7.938
	5.500	5.500	6.249	1.000			0.750								7.500	0.500	3.375	7.938

① Where SQ is shown in chart, cylinder utilizes a full square retainer.

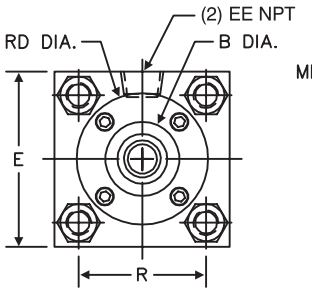
EASY FLIP OUT PAGE FOR REFERENCE

EASY FLIP OUT PAGE FOR REFERENCE

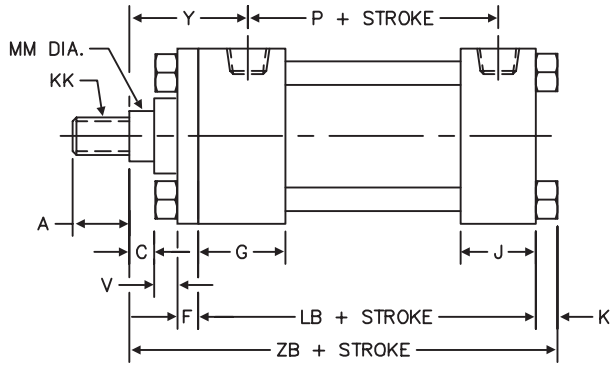
SERIES 'TAS' DIMENSIONS: BASIC CYLINDER (MX0 MOUNT)



WITH SQUARE RETAINER



WITH ROUND RETAINER
(8.00" BORE ONLY)

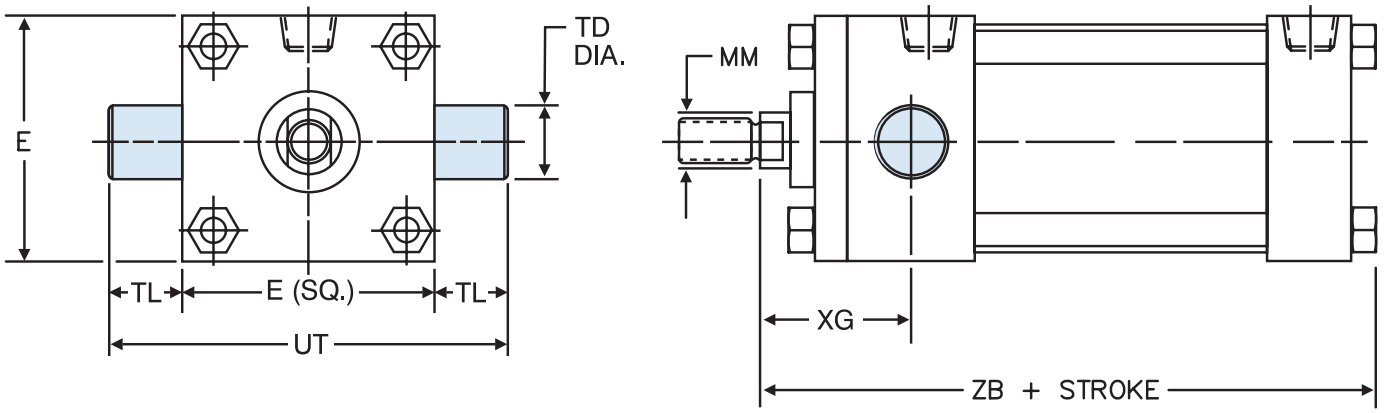


BORE	ROD DIA. (MM)	A	B	C	E	EE NPT	F	G	J	K	KK	LB	P	R	① RD	V	Y	ZB
1.50	0.625	0.750	1.124	0.375	2.000	3/8	0.375	1.500	1.000	0.250	SEE ROD END DETAIL CHART ON PAGE 104	3.625	2.375	1.430	SQ	0.250	1.875	4.875
	1.000	1.125	1.499	0.500												0.500	2.250	5.250
2.00	0.625	0.750	1.124	0.375	2.500	3/8	0.375	1.500	1.000	0.313		3.625	2.375	1.840	SQ	0.250	1.875	4.938
	1.000	1.125	1.499	0.500												0.500	2.250	5.313
	1.375	1.625	1.999	0.625												0.625	2.500	5.563
2.50	0.625	0.750	1.124	0.375	3.000	3/8	0.375	1.500	1.000	0.313		3.750	2.500	2.190	SQ	0.250	1.875	5.063
	1.000	1.125	1.499	0.500												0.500	2.250	5.438
	1.375	1.625	1.999	0.625												0.625	2.500	5.688
	1.750	2.000	2.374	0.750												0.750	2.750	5.938
3.25	1.000	1.125	1.499	0.500	3.750	1/2	0.625	1.750	1.250	0.375		4.250	2.750	2.760	SQ	0.250	2.375	6.000
	1.375	1.625	1.999	0.625												0.375	2.625	6.250
	1.750	2.000	2.374	0.750												0.500	2.875	6.500
	2.000	2.250	2.624	0.875												0.500	3.000	6.625
4.00	1.000	1.125	1.499	0.500	4.500	1/2	0.625	1.750	1.250	0.375		4.250	2.750	3.320	SQ	0.250	2.375	6.000
	1.375	1.625	1.999	0.625												0.375	2.625	6.250
	1.750	2.000	2.374	0.750												0.500	2.875	6.500
	2.000	2.250	2.624	0.875												0.500	3.000	6.625
	2.500	3.000	3.124	1.000												0.625	3.250	6.875
5.00	1.000	1.125	1.499	0.500	5.500	1/2	0.625	1.750	1.250	0.438		4.500	3.000	4.100	SQ	0.250	2.375	6.313
	1.375	1.625	1.999	0.625												0.375	2.625	6.563
	1.750	2.000	2.374	0.750												0.500	2.875	6.813
	2.000	2.250	2.624	0.875												0.500	3.000	6.983
	2.500	3.000	3.124	1.000												0.625	3.250	7.188
	3.000	3.500	3.749	1.000												0.625	3.250	7.188
	3.500	3.500	4.249	1.000												0.625	3.250	7.188
6.00	1.375	1.625	1.999	0.625	6.500	3/4	0.750	2.000	1.500	0.438		5.000	3.250	4.880	SQ	0.250	2.750	7.063
	1.750	2.000	2.374	0.750												0.375	3.000	7.313
	2.000	2.250	2.624	0.875												0.375	3.125	7.438
	2.500	3.000	3.124	1.000												0.500	3.375	7.688
	3.000	3.500	3.749	1.000												0.500	3.375	7.688
	3.500	3.500	4.249	1.000												0.500	3.375	7.688
	4.000	4.000	4.749	1.000												0.500	3.375	7.688
8.00	1.375	1.625	1.999	0.625	8.500	3/4	0.625	2.000	1.500	0.563		5.125	3.375	6.440	3.500	0.375	2.750	7.313
	1.750	2.000	2.374	0.750			0.625								3.500	0.500	3.000	7.563
	2.000	2.250	2.624	0.875			0.625								5.000	0.500	3.125	7.688
	2.500	3.000	3.124	1.000			0.750								5.000	0.500	3.375	7.938
	3.000	3.500	3.749	1.000			0.750								5.250	0.500	3.375	7.938
	3.500	3.500	4.249	1.000			0.750								5.625	0.500	3.375	7.938
	4.000	4.000	4.749	1.000			0.750								6.500	0.500	3.375	7.938
	4.500	4.500	5.249	1.000			0.750								7.250	0.500	3.375	7.938
	5.000	5.000	5.749	1.000			0.750								7.500	0.500	3.375	7.938
	5.500	5.500	6.249	1.000			0.750								7.500	0.500	3.375	7.938

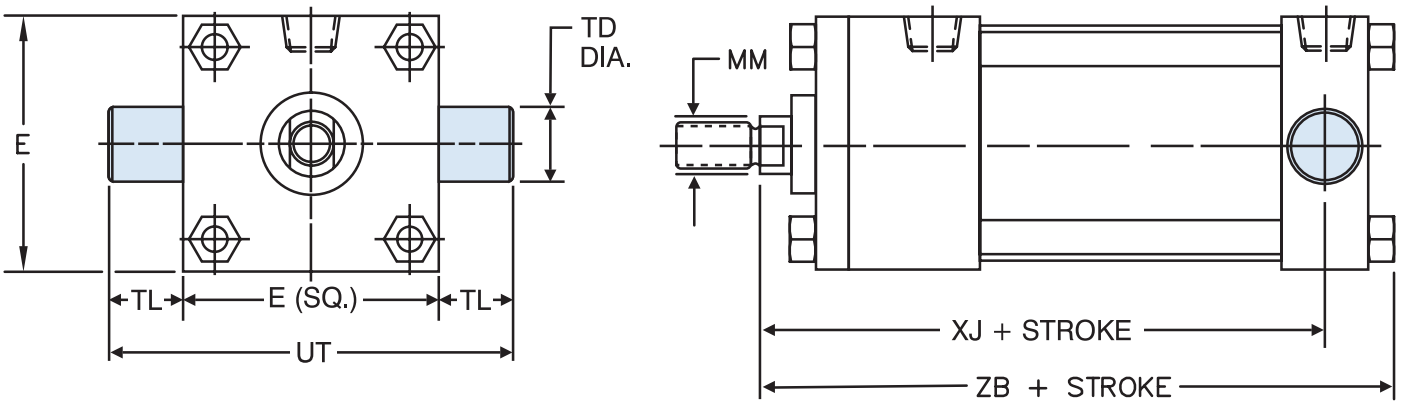
① Where SQ is shown in chart, cylinder utilizes a full square retainer.

SERIES 'TAS' DIMENSIONS: TRUNNION MOUNTS

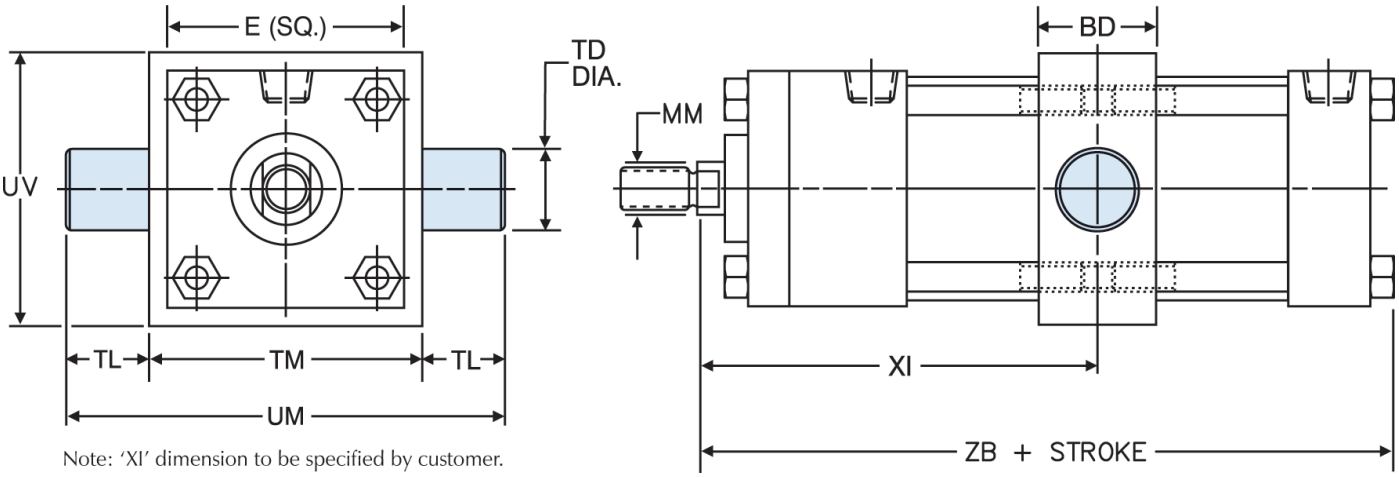
MT1: HEAD TRUNNION



MT2: CAP TRUNNION



MT4: INTERMEDIATE TRUNNION



Note: 'XI' dimension to be specified by customer.

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

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

SERIES 'TAS' DIMENSIONS: TRUNNION MOUNTS

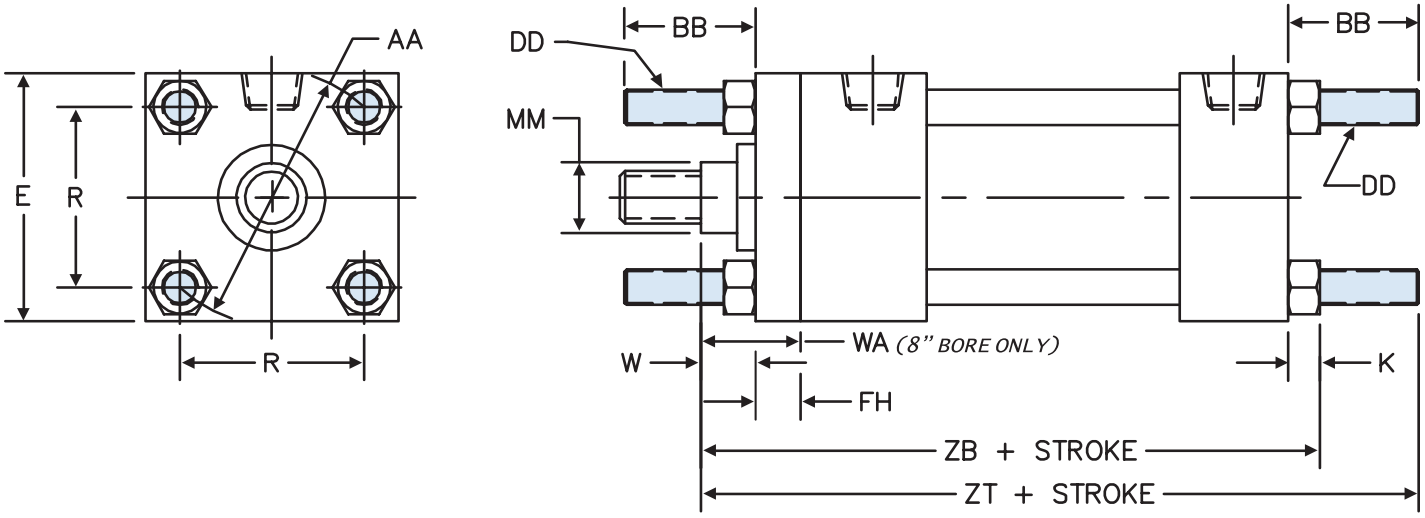
BORE	ROD DIA. (MM)	E	BD	① TD	TL	TM	UM	UT	UV	XG	② XI	MT4 MIN STROKE	ADD TO STROKE XJ	ADD TO STROKE ZB
1.50	0.625	2.000	1.250	1.000	1.000	2.500	4.500	4.000	2.500	1.750	3.250	0.375	4.125	4.875
	1.000									2.125	3.625		4.500	5.250
2.00	0.625	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.750	3.375	0.625	4.125	4.938
	1.000									2.125	3.750		4.500	5.313
	1.375									2.375	4.000		4.750	5.563
2.50	0.625	3.000	1.500	1.000	1.000	3.500	5.500	5.000	3.500	1.750	3.375	0.500	4.250	5.063
	1.000									2.125	3.750		4.625	5.438
	1.375									2.375	4.000		4.875	5.688
	1.750									2.625	4.250		5.125	5.938
3.25	1.000	3.750	2.000	1.000	1.000	4.500	6.500	5.750	4.250	2.250	4.250	1.000	5.000	6.000
	1.375									2.500	4.500		5.250	6.250
	1.750									2.750	4.750		5.500	6.500
	2.000									2.875	4.875		5.625	6.625
4.00	1.000	4.500	2.000	1.000	1.000	5.250	7.250	6.500	5.000	2.250	4.250	1.000	5.000	6.000
	1.375									2.500	4.500		5.250	6.250
	1.750									2.750	4.750		5.500	6.500
	2.000									2.875	4.875		5.625	6.625
	2.500									3.125	5.125		5.875	6.875
5.00	1.000	5.500	2.000	1.000	1.000	6.250	8.250	7.500	6.000	2.250	4.250	0.750	5.250	6.313
	1.375									2.500	4.500		5.500	6.563
	1.750									2.750	4.750		5.750	6.813
	2.000									2.875	4.875		5.875	6.938
	2.500									3.125	5.125		6.125	7.188
	3.000									3.125	5.125		6.125	7.188
	3.500									3.125	5.125		6.125	7.188
6.00	1.375	6.500	2.000	1.375	1.375	7.625	10.375	9.250	7.000	2.625	4.750	0.750	5.875	7.063
	1.750									2.875	5.000		6.125	7.313
	2.000									3.000	5.125		6.250	7.438
	2.500									3.250	5.375		6.500	7.688
	3.000									3.250	5.375		6.500	7.688
	3.500									3.250	5.375		6.500	7.688
	4.000									3.250	5.375		6.500	7.688
8.00	1.375	8.500	2.500	1.375	1.375	9.750	12.500	11.250	9.500	2.625	5.000	1.125	6.000	7.313
	1.750									2.875	5.250		6.250	7.563
	2.000									3.000	5.375		6.375	7.688
	2.500									3.250	5.625		6.625	7.938
	3.000									3.250	5.625		6.625	7.938
	3.500									3.250	5.625		6.625	7.938
	4.000									3.250	5.625		6.625	7.938
	4.500									3.250	5.625		6.625	7.938
	5.000									3.250	5.625		6.625	7.938
	5.500									3.250	5.625		6.625	7.938

① 'TD' dimension tolerance is + .000 / - .001

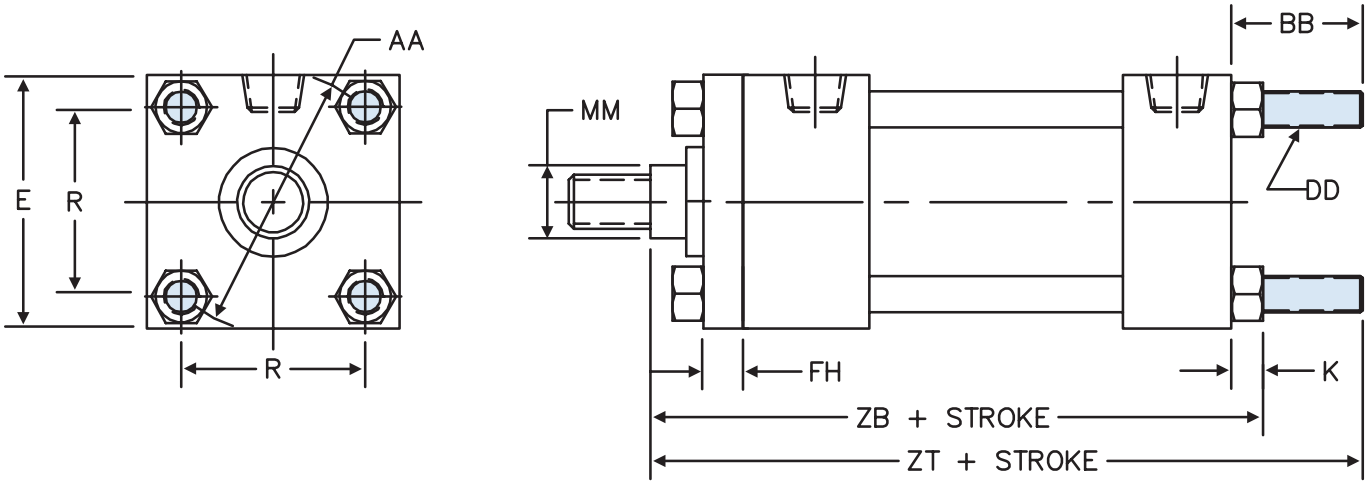
② 'XI' dimension is the minimum that can be supplied and leaves 1/8" gap between head & trunnion block; customer to specify 'XI' dimension.

SERIES 'TAS' DIMENSIONS: EXTENDED TIE ROD MOUNTS

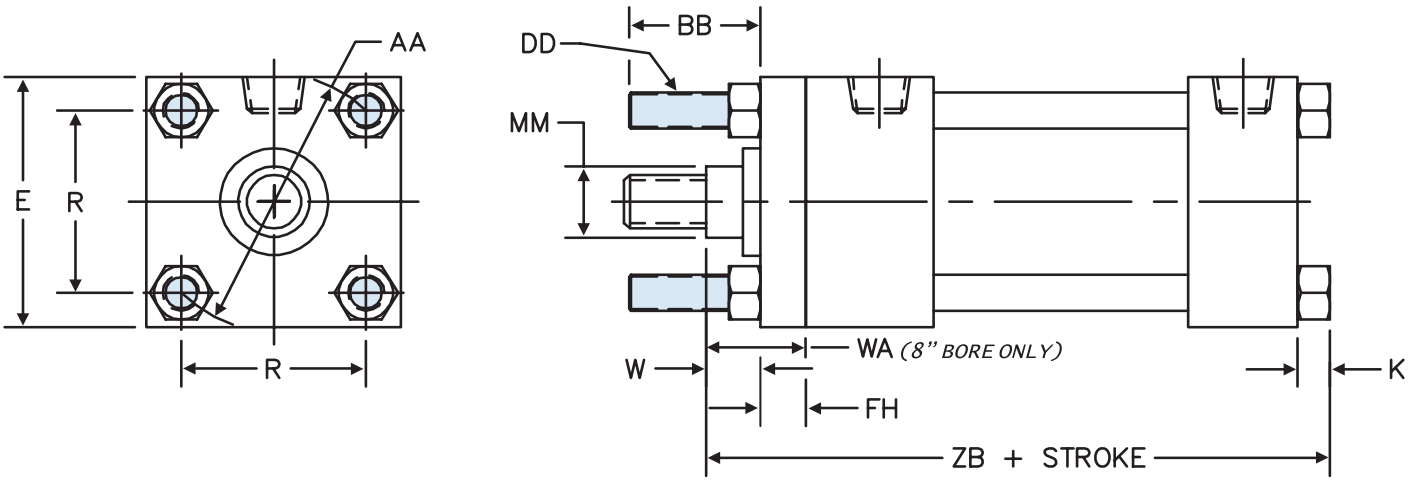
MX1: EXTENDED TIE-RODS - HEAD & CAP



MX2: EXTENDED TIE-RODS - CAP END



MX3: EXTENDED TIE-RODS - HEAD END



SERIES 'TAS' DIMENSIONS: EXTENDED TIE ROD MOUNTS

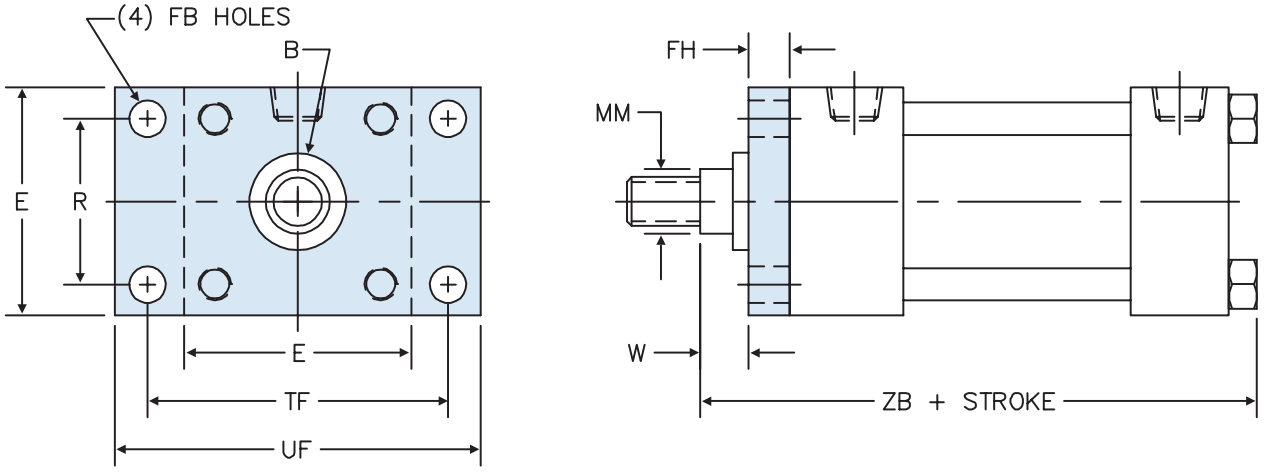
BORE	ROD DIA. (MM)	E	FH	AA	BB	DD	K	R	① RD	W or WA (8")	ADD TO STROKE ZB	ADD TO STROKE ZT
1.50	0.625	2.000	0.375	2.020	1.000	1/4 - 28	0.250	1.430	SQ	0.625	4.875	5.625
	1.000									1.000	5.250	6.000
2.00	0.625	2.500	0.375	2.600	1.125	5/16 - 24	0.313	1.840	SQ	0.625	4.938	5.750
	1.000									1.000	5.313	6.125
	1.375									1.250	5.563	6.375
2.50	0.625	3.000	0.375	3.100	1.125	5/16 - 24	0.313	2.190	SQ	0.625	5.063	5.875
	1.000									1.000	5.438	6.250
	1.375									1.250	5.688	6.500
	1.750									1.500	5.938	6.750
3.25	1.000	3.750	0.625	3.900	1.375	3/8 - 24	0.375	2.760	SQ	0.750	6.000	7.000
	1.375									1.000	6.250	7.250
	1.750									1.250	6.500	7.500
	2.000									1.375	6.625	7.625
4.00	1.000	4.500	0.625	4.700	1.375	3/8 - 24	0.375	3.320	SQ	0.750	6.000	7.000
	1.375									1.000	6.250	7.250
	1.750									1.250	6.500	7.500
	2.000									1.375	6.625	7.625
	2.500									1.625	6.875	7.875
5.00	1.000	5.500	0.625	5.800	1.813	1/2 - 20	0.438	4.100	SQ	0.750	6.313	7.688
	1.375									1.000	6.563	7.938
	1.750									1.250	6.813	8.188
	2.000									1.375	6.938	8.313
	2.500									1.625	7.188	8.563
	3.000									1.625	7.188	8.563
	3.500									1.625	7.188	8.563
6.00	1.375	6.500	0.750	6.900	1.813	1/2 - 20	0.438	4.880	SQ	0.875	7.063	8.438
	1.750									1.125	7.313	8.688
	2.000									1.250	7.438	8.813
	2.500									1.500	7.688	9.063
	3.000									1.500	7.688	9.063
	3.500									1.500	7.688	9.063
	4.000									1.500	7.688	9.063
8.00	1.375	8.500	0.625	9.100	② 2.313	5/8 - 18	0.563	6.440	3.500	1.625	7.313	9.063
	1.750		0.625						3.500	1.875	7.563	9.313
	2.000		0.625						5.000	2.000	7.688	9.438
	2.500		0.750						5.000	2.250	7.938	9.688
	3.000		0.750						5.250	2.250	7.938	9.688
	3.500		0.750						5.625	2.250	7.938	9.688
	4.000		0.750						6.500	2.250	7.938	9.688
	4.500		0.750						7.250	2.250	7.938	9.688
	5.000		0.750						7.500	2.250	7.938	9.688
	5.500		0.750						7.500	2.250	7.938	9.688

① Where SQ is shown in chart, cylinder utilizes a full square retainer. ALL MX1 & MX3 MOUNTS USE FULL SQ. RETAINER.

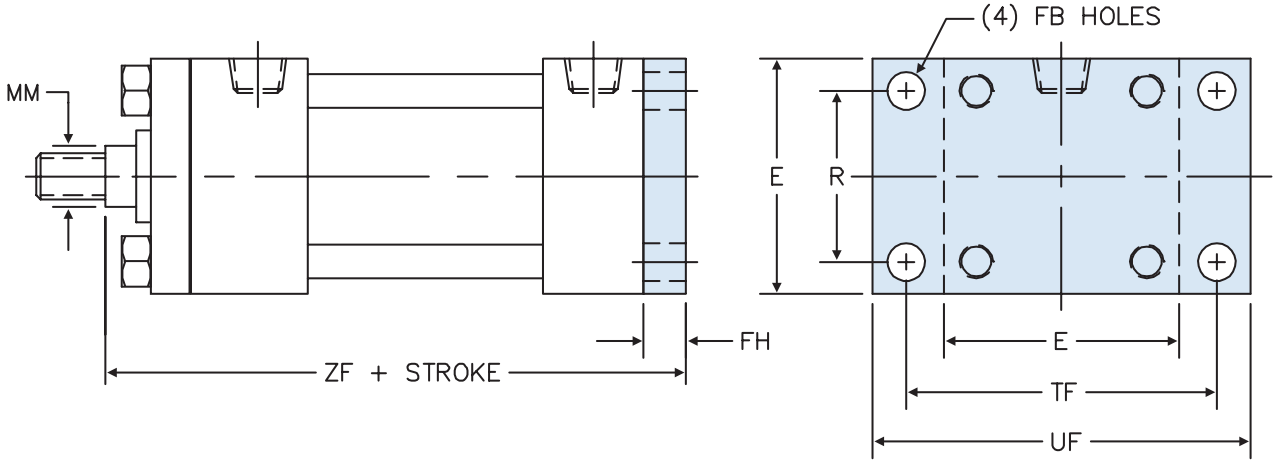
② Round retainer used to retain bushing, not a full front plate as other bores. 'BB' is dimension from head on the 8.00" bore.

SERIES 'TAS' DIMENSIONS: FLANGE MOUNTS

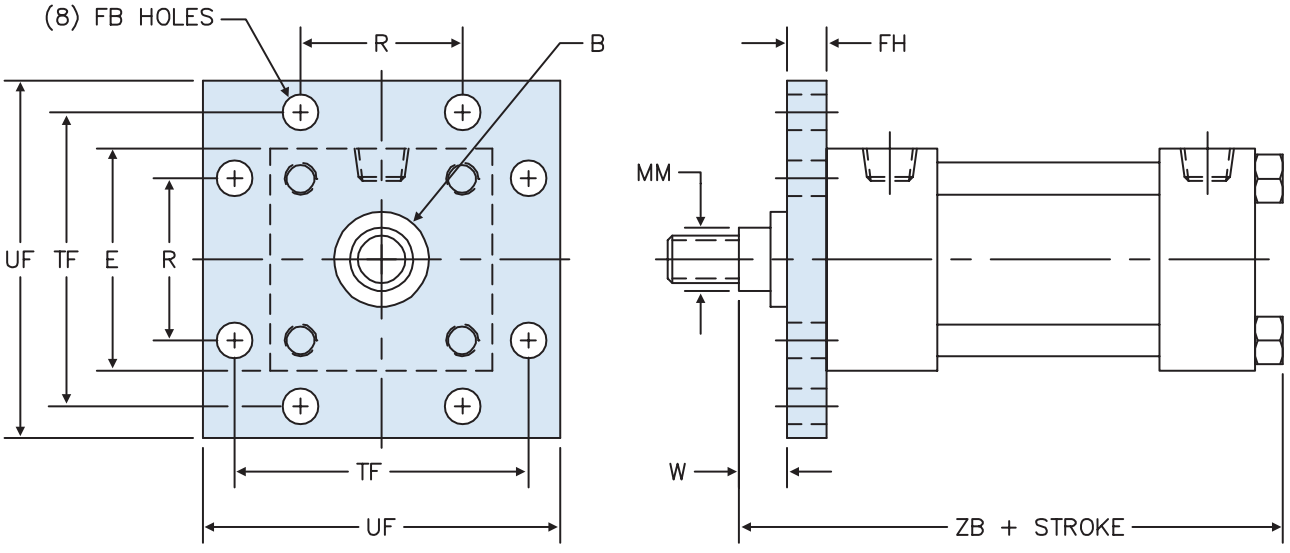
MF1: HEAD FLANGE



MF2: CAP FLANGE

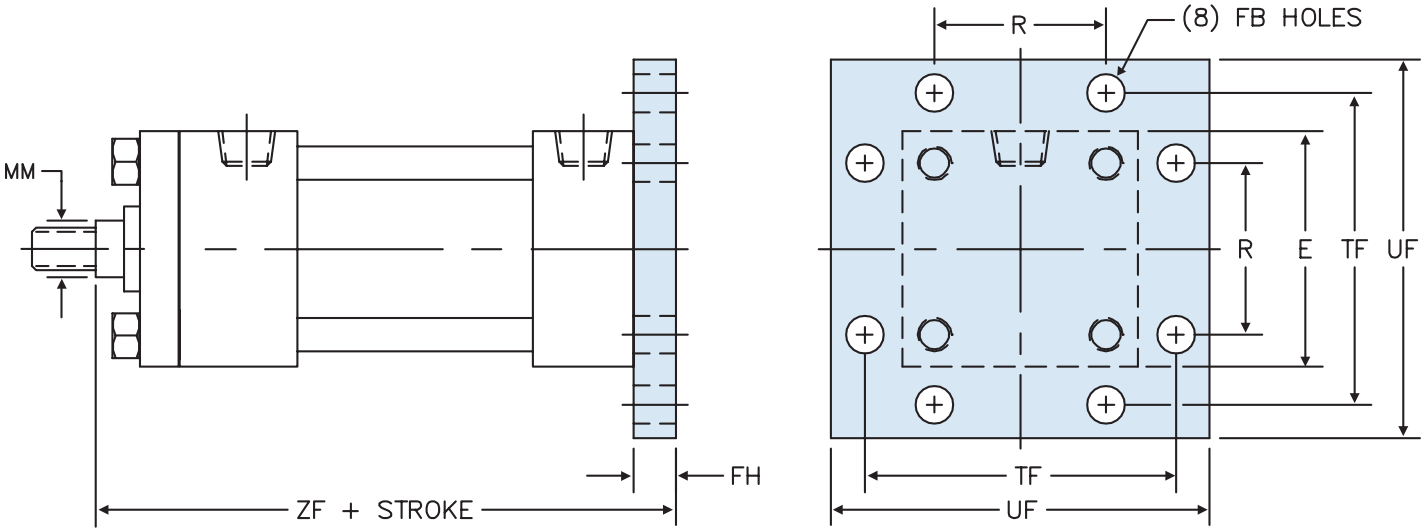


MF5: HEAD SQUARE FLANGE



SERIES 'TAS' DIMENSIONS: FLANGE MOUNTS

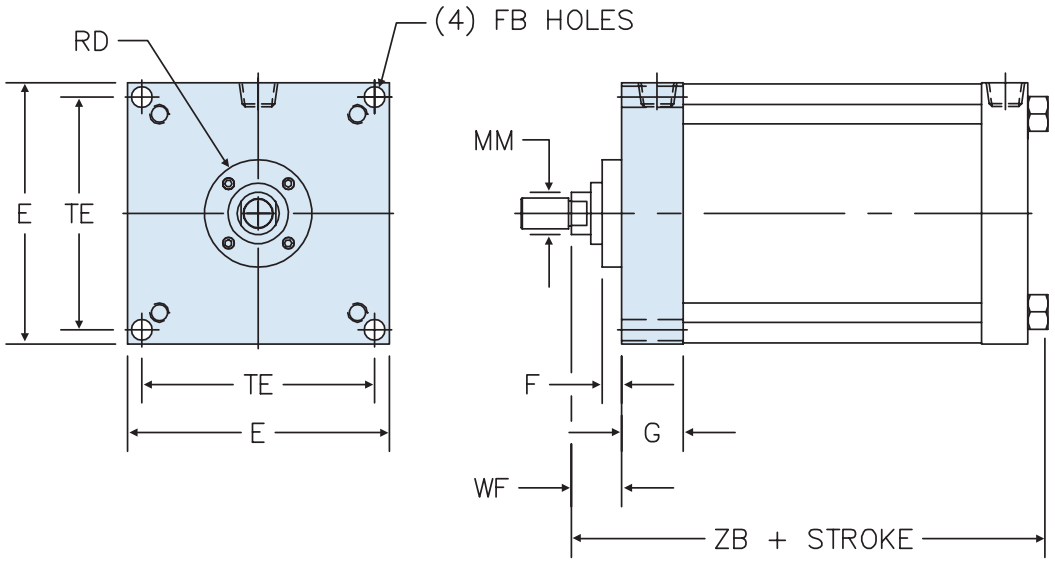
MF6: CAP SQUARE FLANGE



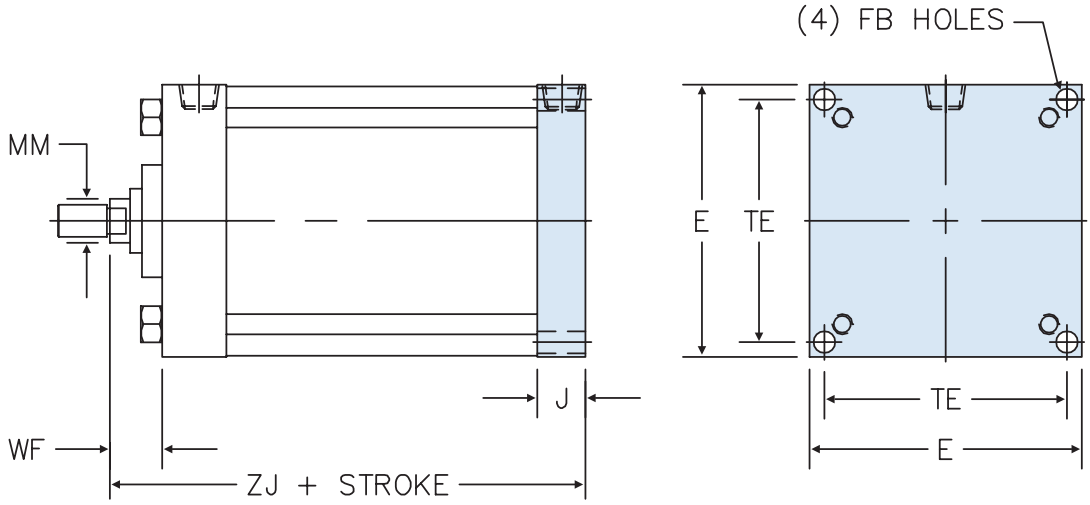
BORE	ROD DIA. (MM)	B	E	FB	FH	R	TF	UF	W	ADD TO STROKE ZB	ADD TO STROKE ZF
1.50	0.625	1.124	2.000	0.313	0.375	1.438	2.750	3.375	0.625	4.875	5.000
	1.000	1.499							1.000	5.250	5.375
2.00	0.625	1.124	2.500	0.375	0.375	1.844	3.375	4.125	0.625	4.938	5.000
	1.000	1.499							1.000	5.313	5.375
	1.375	1.999							1.250	5.563	5.625
2.50	0.625	1.124	3.000	0.375	0.375	2.188	3.875	4.625	0.625	5.063	5.125
	1.000	1.499							1.000	5.438	5.500
	1.375	1.999							1.250	5.688	5.750
	1.750	2.374							1.500	5.938	6.000
3.25	1.000	1.499	3.750	0.438	0.625	2.766	4.688	5.500	0.750	6.000	6.250
	1.375	1.999							1.000	6.250	6.500
	1.750	2.374							1.250	6.500	6.750
	2.000	2.624							1.375	6.625	6.875
4.00	1.000	1.499	4.500	0.438	0.625	3.328	5.438	6.250	0.750	6.000	6.250
	1.375	1.999							1.000	6.250	6.500
	1.750	2.374							1.250	6.500	6.750
	2.000	2.624							1.375	6.625	6.875
	2.500	3.124							1.625	6.875	7.125
5.00	1.000	1.499	5.500	0.563	0.625	4.109	6.625	7.625	0.750	6.313	6.500
	1.375	1.999							1.000	6.563	6.750
	1.750	2.374							1.250	6.813	7.000
	2.000	2.624							1.375	6.938	7.125
	2.500	3.124							1.625	7.188	7.375
	3.000	3.749							1.625	7.188	7.375
	3.500	4.249							1.625	7.188	7.375
6.00	1.375	1.999	6.500	0.563	0.750	4.875	7.625	8.625	0.875	7.063	7.375
	1.750	2.374							1.125	7.313	7.625
	2.000	2.624							1.250	7.438	7.750
	2.500	3.124							1.500	7.688	8.000
	3.000	3.749							1.500	7.688	8.000
	3.500	4.249							1.500	7.688	8.000
	4.000	4.749							1.500	7.688	8.000

SERIES 'TAS' DIMENSIONS: FLANGE MOUNTS

ME3: HEAD SQUARE MOUNTING HOLES



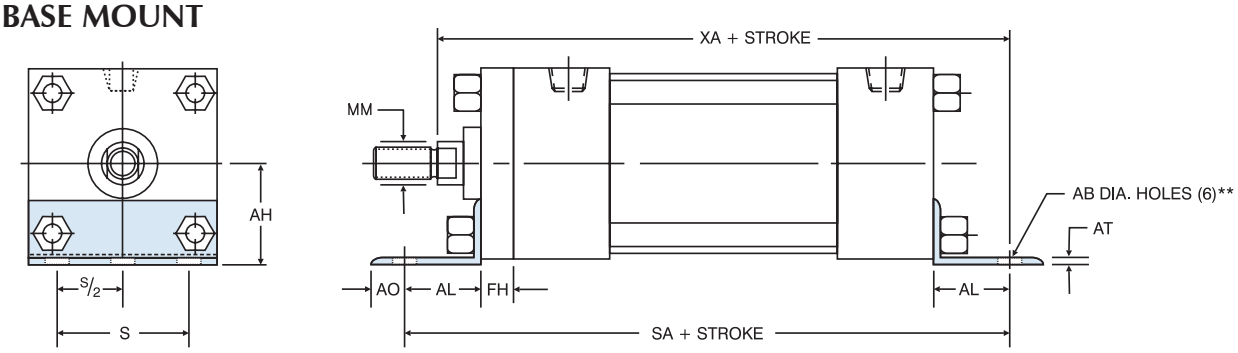
ME4: CAP SQUARE MOUNTING HOLES



BORE	ROD DIA. (MM)	E	F	FB	G	J	TE	RD	WF	ADD TO STROKE ZB	ADD TO STROKE ZJ
8.00	1.375	8.500	0.625	0.688	2.000	1.500	7.570	3.500	1.625	7.313	6.750
	1.750		0.625					3.500	1.875	7.563	7.000
	2.000		0.625					5.000	2.000	7.688	7.125
	2.500		0.750					5.000	2.250	7.938	7.375
	3.000		0.750					5.250	2.250	7.938	7.375
	3.500		0.750					5.625	2.250	7.938	7.375
	4.000		0.750					6.500	2.250	7.938	7.375
	4.500		0.750					7.250	2.250	7.938	7.375
	5.000		0.750					7.500	2.250	7.938	7.375
	5.500		0.750					7.500	2.250	7.938	7.375

SERIES 'TAS' DIMENSIONS: BASE MOUNTS

MS1: BASE MOUNT

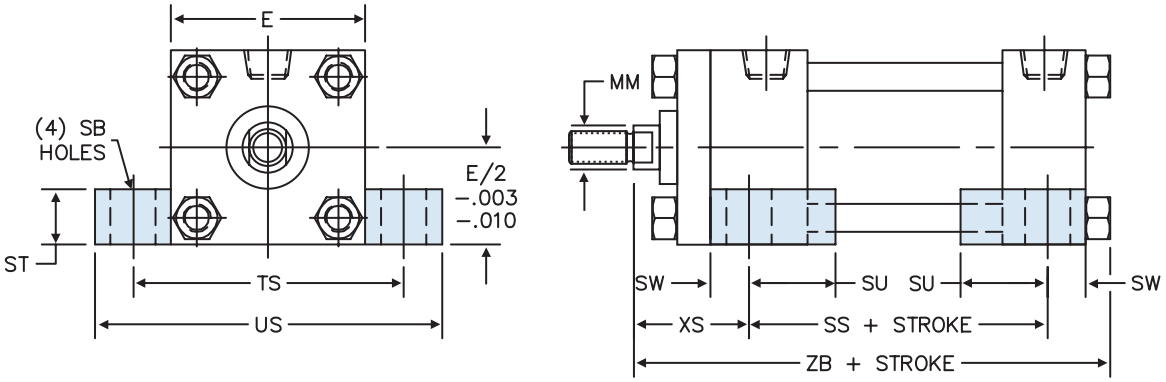


'MS1' ANGLE MOUNT DIMENSIONS										
									ADD TO STROKE	
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	SA	XA
1.50	0.625	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.000	5.625
	1.000									6.000
2.00	0.625	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.000	5.625
	1.000									6.000
	1.375									6.250
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
	1.375									6.375
	1.750									6.625
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
	1.750									7.375
	2.000									7.500
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
	1.750									7.375
	2.000									7.500
	2.500									7.750
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
	1.750									7.750
	2.000									7.875
	2.500									8.125
	3.000									8.125
	3.500									8.125
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
	2.000									8.375
	2.500									8.625
	3.000									8.625
	3.500									8.625
	4.000									8.625
8.00*	1.375	0.813	4.250	1.813	0.688	0.250	0.625	7.125	8.750	8.563
	1.750						0.625			8.813
	2.000						0.625			8.938
	2.500						0.750			9.188
	3.000						0.750			9.188
	3.500						0.750			9.188
	4.000						0.750			9.188
	4.500						0.750			9.188
	5.000						0.750			9.188
	5.500						0.750			9.188

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

SERIES 'TAS' DIMENSIONS: LUG MOUNTS

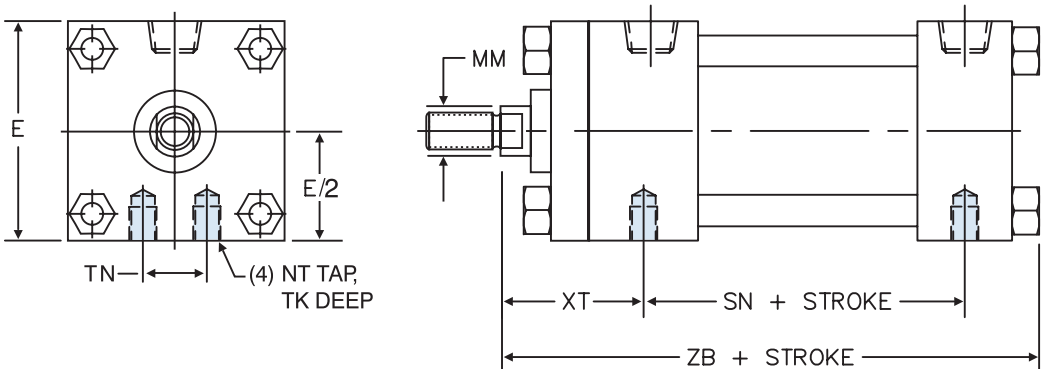
MS2: SIDE LUGS



BORE	ROD DIA. (MM)	E	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE SS	ADD TO STROKE ZB
1.50	0.625	2.000	0.438	0.500	1.125	0.375	2.750	3.500	1.375	2.875	4.875
	1.000								1.750		5.250
2.00	0.625	2.500	0.438	0.500	1.125	0.375	3.250	4.000	1.375	2.875	4.938
	1.000								1.750		5.313
	1.375								2.000		5.563
2.50	0.625	3.000	0.438	0.500	1.125	0.375	3.750	4.500	1.375	3.000	5.063
	1.000								1.750		5.438
	1.375								2.000		5.688
	1.750								2.250		5.938
3.25	1.000	3.750	0.563	0.750	1.250	0.500	4.750	5.750	1.875	3.250	6.000
	1.375								2.125		6.250
	1.750								2.375		6.500
	2.000								2.500		6.625
4.00	1.000	4.500	0.563	0.750	1.250	0.500	5.500	6.500	1.875	3.250	6.000
	1.375								2.125		6.250
	1.750								2.375		6.500
	2.000								2.500		6.625
	2.500								2.750		6.875
5.00	1.000	5.500	0.813	1.000	1.063	0.688	6.875	8.250	2.063	3.125	6.313
	1.375								2.313		6.563
	1.750								2.563		6.813
	2.000								2.688		6.938
	2.500								2.938		7.188
	3.000								2.938		7.188
	3.500								2.938		7.188
6.00	1.375	6.500	0.813	1.000	1.313	0.688	7.875	9.250	2.313	3.625	7.063
	1.750								2.563		7.313
	2.000								2.688		7.438
	2.500								2.938		7.688
	3.000								2.938		7.688
	3.500								2.938		7.688
	4.000								2.938		7.688
8.00	1.375	8.500	0.813	1.000	1.313	0.688	9.875	11.250	2.313	3.750	7.313
	1.750								2.563		7.563
	2.000								2.688		7.688
	2.500								2.938		7.938
	3.000								2.938		7.938
	3.500								2.938		7.938
	4.000								2.938		7.938
	4.500								2.938		7.938
	5.000								2.938		7.938
	5.500								2.938		7.938

SERIES 'TAS' DIMENSIONS: BOTTOM MOUNTS

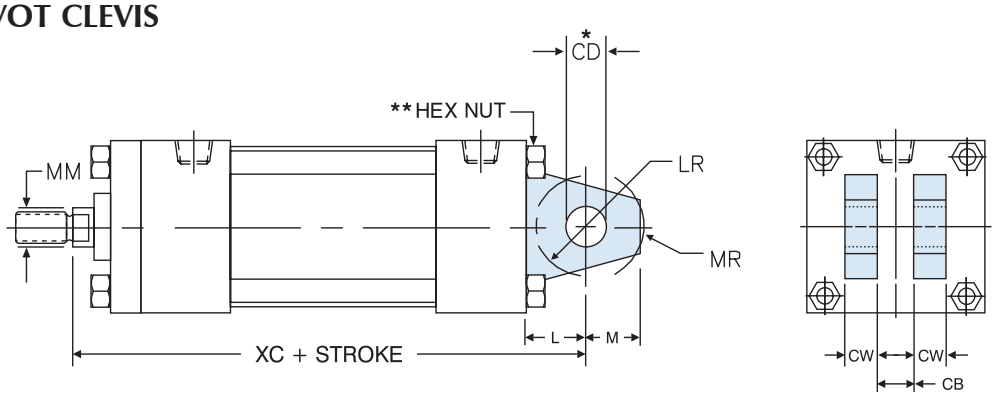
MS4: BOTTOM TAPPED HOLES



BORE	ROD DIA. (MM)	E	NT	TN	TK	XT	ADD TO STROKE	
							SN	ZB
1.50	0.625	2.000	1/4 - 20	0.625	0.375	1.938	2.250	4.875
	1.000					2.313		5.250
2.00	0.625	2.500	5/16 - 18	0.875	0.500	1.938	2.250	4.938
	1.000				0.500	2.313		5.313
	1.375				0.375	2.563		5.563
2.50	0.625	3.000	3/8 - 16	1.250	0.625	1.938	2.375	5.063
	1.000				0.625	2.313		5.438
	1.375				0.438	2.563		5.688
	1.750				0.375	2.813		5.938
3.25	1.000	3.750	1/2 - 13	1.500	0.750	2.438	2.625	6.000
	1.375				0.750	2.688		6.250
	1.750				0.500	2.938		6.500
	2.000				0.500	3.063		6.625
4.00	1.000	4.500	1/2 - 13	2.063	0.750	2.438	2.625	6.000
	1.375				0.750	2.688		6.250
	1.750				0.750	2.938		6.500
	2.000				0.750	3.063		6.625
	2.500				0.625	3.313		6.875
5.00	1.000	5.500	5/8 - 11	2.688	1.000	2.438	2.875	6.313
	1.375				1.000	2.688		6.563
	1.750				1.000	2.938		6.813
	2.000				1.000	3.063		6.938
	2.500				1.000	3.313		7.188
	3.000				0.750	3.313		7.188
	3.500				0.625	3.313		7.188
6.00	1.375	6.500	3/4 - 10	3.250	1.125	2.813	3.125	7.063
	1.750				1.125	3.063		7.313
	2.000				1.125	3.188		7.438
	2.500				1.125	3.438		7.688
	3.000				1.125	3.438		7.688
	3.500				1.125	3.438		7.688
	4.000				1.000	3.438		7.688
8.00	1.375	8.500	3/4 - 10	4.500	1.125	2.813	3.250	7.313
	1.750					3.063		7.563
	2.000					3.188		7.688
	2.500					3.438		7.938
	3.000					3.438		7.938
	3.500					3.438		7.938
	4.000					3.438		7.938
	4.500					3.438		7.938
	5.000					3.438		7.938
	5.500					3.438		7.938

SERIES 'TAS' DIMENSIONS: PIVOT MOUNTS

MP1: REAR PIVOT CLEVIS



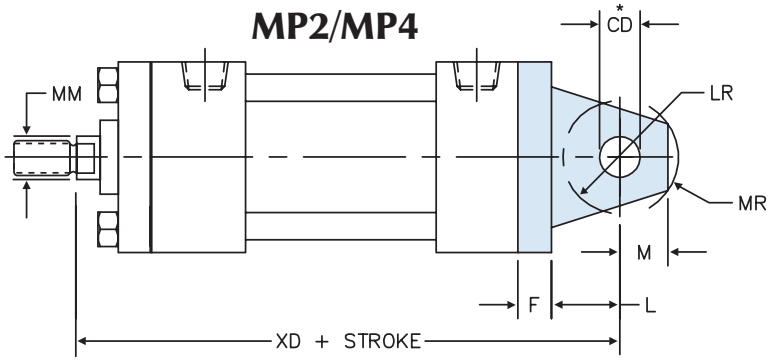
BORE	ROD DIA. (MM)	CB	CD	CW	E	L	LR	M	MR	ADD TO STROKE XC
1.50	0.625	0.750	0.500	0.500	2.000	0.750	0.750	0.500	0.625	5.375
	1.000									5.750
2.00	0.625	0.750	0.500	0.500	2.500	0.750	0.750	0.500	0.625	5.375
	1.000									5.750
	1.375									6.000
2.50	0.625	0.750	0.500	0.500	3.000	0.750	0.750	0.500	0.625	5.500
	1.000									5.875
	1.375									6.125
	1.750									6.375
3.25	1.000	1.250	0.750	0.625	3.750	1.250	1.000	0.750	0.938	6.875
	1.375									7.125
	1.750									7.375
	2.000									7.500
4.00	1.000	1.250	0.750	0.625	4.500	1.250	1.000	0.750	0.938	6.875
	1.375									7.125
	1.750									7.375
	2.000									7.500
	2.500									7.750
5.00	1.000	1.250	0.750	0.625	5.500	1.250	1.000	0.750	0.938	7.125
	1.375									7.375
	1.750									7.625
	2.000									7.750
	2.500									8.000
	3.000									8.000
	3.500									8.000
6.00	1.375	1.500	1.000	0.750	6.500	1.500	1.250	1.000	1.188	8.125
	1.750									8.375
	2.000									8.500
	2.500									8.750
	3.000									8.750
	3.500									8.750
	4.000									8.750
8.00	1.375	1.500	1.000	0.750	8.500	1.500	1.250	1.000	1.188	8.250
	1.750									8.500
	2.000									8.625
	2.500									8.875
	3.000									8.875
	3.500									8.875
	4.000									8.875
	4.500									8.875
	5.000									8.875
	5.500									8.875

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

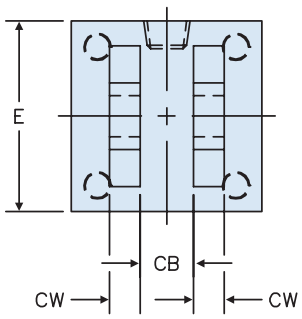
SERIES 'TAS' DIMENSIONS: PIVOT MOUNTS

MP2 & MP4: REAR PIVOT DETACHABLE CLEVIS

MP2/MP4

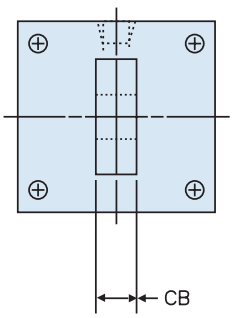


MP2



IRON CASTING:
1.50″-6.00″ BORES

MP4



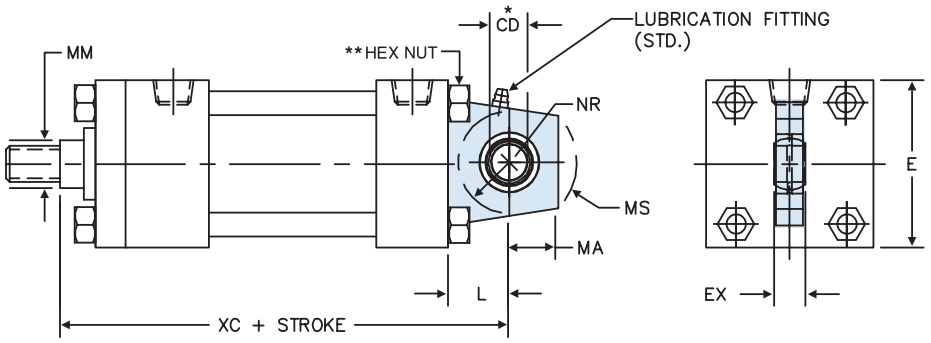
IRON CASTING:
1.50″- 4.00″ BORES
WELDMENT:
5.00″-6.00″ BORES

BORE	ROD DIA. (MM)	CB	CD	CW	E	F	L	LR	M	MR	ADD TO STROKE XD
1.50	0.625	0.750	0.500	0.500	2.000	0.375	0.750	0.750	0.500	0.625	5.750
	1.000										6.125
2.00	0.625	0.750	0.500	0.500	2.500	0.375	0.750	0.750	0.500	0.625	5.750
	1.000										6.125
	1.375										6.375
2.50	0.625	0.750	0.500	0.500	3.000	0.375	0.750	0.750	0.500	0.625	5.875
	1.000										6.250
	1.375										6.500
	1.750										6.750
3.25	1.000	1.250	0.750	0.625	3.750	0.625	1.250	1.000	0.750	0.938	7.500
	1.375										7.750
	1.750										8.000
	2.000										8.125
4.00	1.000	1.250	0.750	0.625	4.500	0.625	1.250	1.000	0.750	0.938	7.500
	1.375										7.750
	1.750										8.000
	2.000										8.125
	2.500										8.375
5.00	1.000	1.250	0.750	0.625	5.500	0.625	1.250	1.000	0.750	0.938	7.750
	1.375										8.000
	1.750										8.250
	2.000										8.375
	2.500										8.625
	3.000										8.625
	3.500										8.625
6.00	1.375	1.500	1.000	0.750	6.500	0.750	1.500	1.250	1.000	1.188	8.875
	1.750										9.125
	2.000										9.250
	2.500										9.500
	3.000										9.500
	3.500										9.500
	4.000										9.500

*Clevis pins are provided with pivot mounts.

SERIES 'TAS' DIMENSIONS: SPHERICAL BEARING MOUNT

SB: SPHERICAL BEARING



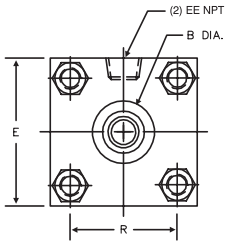
BORE	ROD DIA. (MM)	CD	E	EX	L	MA	MS	NR	ADD TO STROKE XC
1.50	0.625	0.500	2.000	0.437	0.750	0.750	0.938	0.625	5.375
	1.000								5.750
2.00	0.625	0.500	2.500	0.437	0.750	0.750	0.938	0.625	5.375
	1.000								5.750
	1.375								6.000
2.50	0.625	0.500	3.000	0.437	0.750	0.750	0.938	0.625	5.500
	1.000								5.875
	1.375								6.125
	1.750								6.375
3.25	1.000	0.750	3.750	0.656	1.250	1.000	1.375	1.000	6.875
	1.375								7.125
	1.750								7.375
	2.000								7.500
4.00	1.000	0.750	4.500	0.656	1.250	1.000	1.375	1.000	6.875
	1.375								7.125
	1.750								7.375
	2.000								7.500
	2.500								7.750
5.00	1.000	0.750	5.500	0.656	1.250	1.000	1.375	1.000	7.125
	1.375								7.375
	1.750								7.625
	2.000								7.750
	2.500								8.000
	3.000								8.000
	3.500								8.000
6.00	1.375	1.000	6.500	0.875	1.500	1.250	1.688	1.250	8.125
	1.750								8.375
	2.000								8.500
	2.500								8.750
	3.000								8.750
	3.500								8.750
	4.000								8.750
8.00	1.375	1.000	8.500	0.875	1.500	1.250	1.688	1.250	8.250
	1.750								8.500
	2.000								8.625
	2.500								8.875
	3.000								8.875
	3.500								8.875
	4.000								8.875
	4.500								8.875
	5.000								8.875
	5.500								8.875

*Clevis pins are provided with pivot mounts.
**Hex nuts are located on cap end (3.25"-8.00" bores).

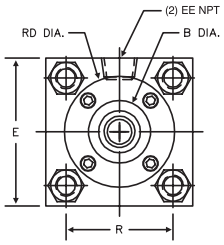
Note: Must specify KK3 rod end if to be used with 'HH-MSRE' series rod eye.

SERIES 'TAS' DIMENSIONS: BASIC DOUBLE ROD END MOUNTS

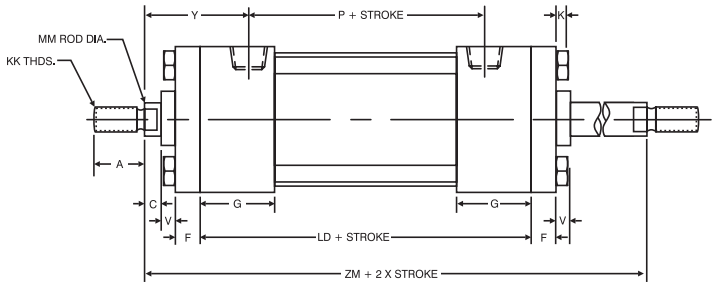
MX0D: NO MOUNT



WITH SQUARE RETAINER



WITH ROUND RETAINER
(8.00" BORE ONLY)

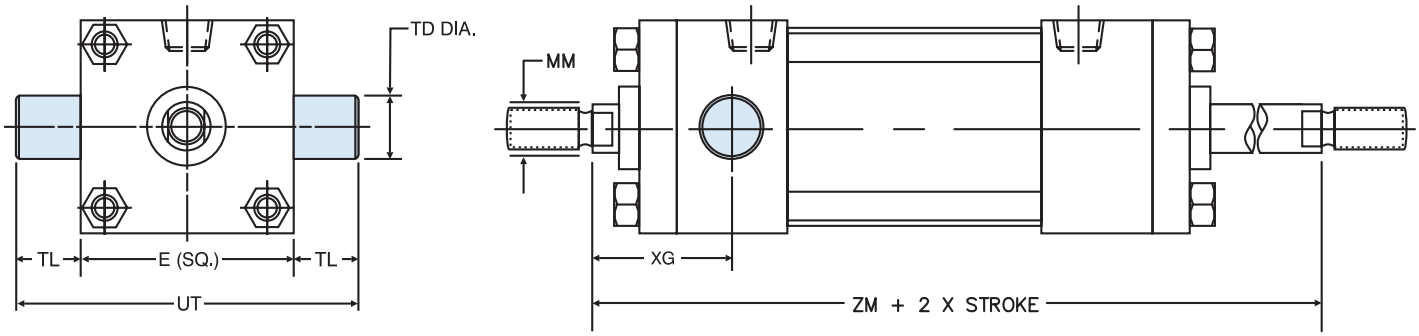


BORE	ROD DIA. (MM)	A	B	C	E	EE NPT	F	G	K	KK	LD	P	R	① RD	V	Y	ZM
1.50	0.625	0.750	1.124	0.375	2.000	3/8	0.375	1.500	0.250	SEE ROD END DETAIL CHART ON PAGE 104	4.125	2.375	1.438	SQ	0.250	1.875	6.125
	1.000	1.125	1.499	0.500											0.500	2.250	6.875
2.00	0.625	0.750	1.124	0.375	2.500	3/8	0.375	1.500	0.313		4.125	2.375	1.844	SQ	0.250	1.875	6.125
	1.000	1.125	1.499	0.500											0.500	2.250	6.875
	1.375	1.625	1.999	0.625											0.625	2.500	7.375
2.50	0.625	0.750	1.124	0.375	3.000	3/8	0.375	1.500	0.313		4.250	2.500	2.188	SQ	0.250	1.875	6.250
	1.000	1.125	1.499	0.500											0.500	2.250	7.000
	1.375	1.625	1.999	0.625											0.625	2.500	7.500
	1.750	2.000	2.374	0.750											0.750	2.750	8.000
3.25	1.000	1.125	1.499	0.500	3.750	1/2	0.625	1.750	0.375		4.750	2.750	2.766	SQ	0.250	2.375	7.500
	1.375	1.625	1.999	0.625											0.375	2.625	8.000
	1.750	2.000	2.374	0.750											0.500	2.875	8.500
	2.000	2.250	2.624	0.875											0.500	3.000	8.750
4.00	1.000	1.125	1.499	0.500	4.500	1/2	0.625	1.750	0.375		4.750	2.750	3.328	SQ	0.250	2.375	7.500
	1.375	1.625	1.999	0.625											0.375	2.625	8.000
	1.750	2.000	2.374	0.750											0.500	2.875	8.500
	2.000	2.250	2.624	0.875											0.500	3.000	8.750
	2.500	3.000	3.124	1.000											0.625	3.250	9.250
5.00	1.000	1.125	1.499	0.500	5.500	1/2	0.625	1.750	0.438		5.000	3.000	4.109	SQ	0.250	2.375	7.750
	1.375	1.625	1.999	0.625											0.375	2.625	8.250
	1.750	2.000	2.374	0.750											0.500	2.875	8.750
	2.000	2.250	2.624	0.875											0.500	3.000	9.000
	2.500	3.000	3.124	1.000											0.625	3.250	9.500
	3.000	3.500	3.749	1.000											0.625	3.250	9.500
	3.500	3.500	4.249	1.000											0.625	3.250	9.500
6.00	1.375	1.625	1.999	0.625	6.500	3/4	0.750	2.000	0.438		5.500	3.250	4.875	SQ	0.250	2.750	8.750
	1.750	2.000	2.374	0.750											0.375	3.000	9.250
	2.000	2.250	2.624	0.875											0.375	3.125	9.500
	2.500	3.000	3.124	1.000											0.500	3.375	10.000
	3.000	3.500	3.749	1.000											0.500	3.375	10.000
	3.500	3.500	4.249	1.000											0.500	3.375	10.000
	4.000	4.000	4.749	1.000											0.500	3.375	10.000
8.00	1.375	1.625	1.999	0.625	8.500	3/4	0.625	2.000	0.563		5.625	3.375	6.438	3.500	0.250	2.750	8.875
	1.750	2.000	2.374	0.750			0.625							3.500	0.375	3.000	9.375
	2.000	2.250	2.624	0.875			0.625							5.000	0.375	3.125	9.625
	2.500	3.000	3.124	1.000			0.750							5.000	0.500	3.375	10.125
	3.000	3.500	3.749	1.000			0.750							5.250	0.500	3.375	10.125
	3.500	3.500	4.249	1.000			0.750							5.625	0.500	3.375	10.125
	4.000	4.000	4.749	1.000			0.750							6.500	0.500	3.375	10.125
	4.500	4.500	5.249	1.000			0.750							7.250	0.500	3.375	10.125
	5.000	5.000	5.749	1.000			0.750							7.500	0.500	3.375	10.125
	5.500	5.500	6.249	1.000			0.750							7.500	0.500	3.375	10.125

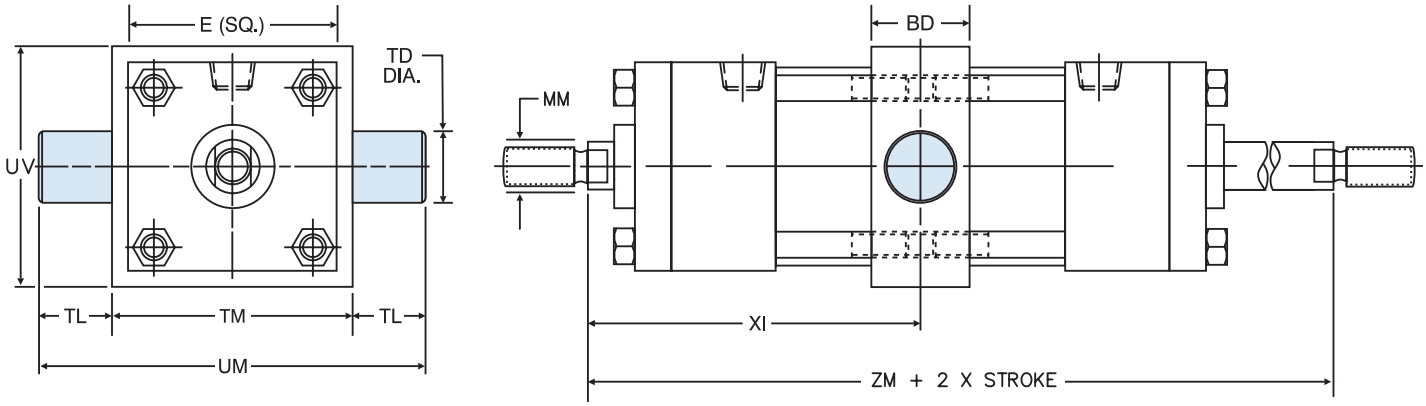
① Where SQ is shown in chart, cylinder utilizes a full square retainer.

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

MT1D: HEAD TRUNNION



MT4D: INTERMEDIATE TRUNNION



Note: 'XI' dimensions to be specified by customer.

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

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

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

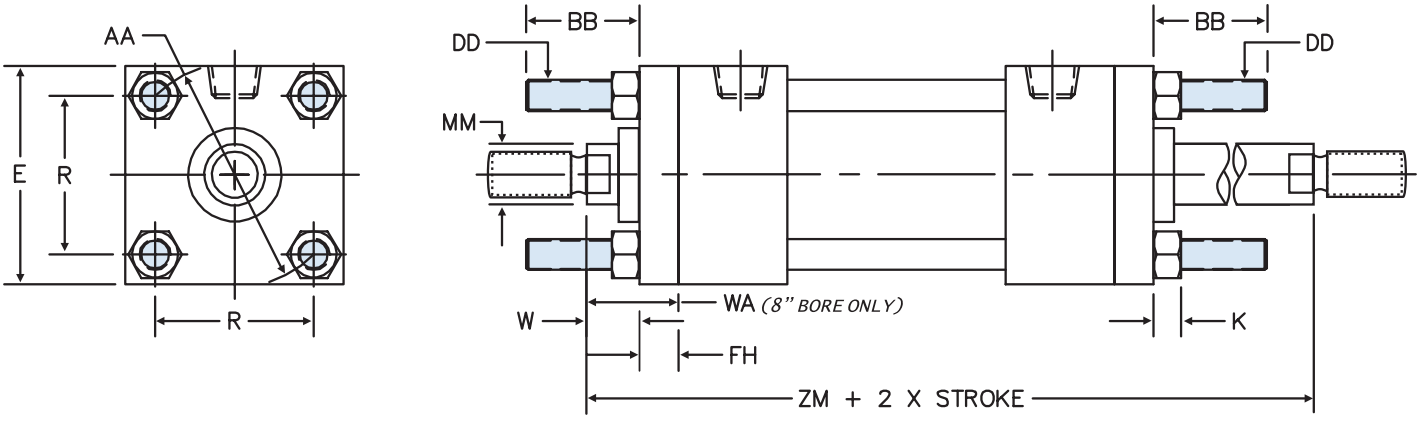
BORE	ROD DIA. (MM)	E	BD	① TD	TL	TM	UM	UT	UV	XG	② XI	MT4D MIN STROKE	ADD 2X STROKE ZM
1.50	0.625	2.000	1.250	1.000	1.000	2.500	4.500	4.000	2.500	1.750	3.250	0.375	6.125
	1.000									2.125	3.625		6.875
2.00	0.625	2.500	1.500	1.000	1.000	3.000	5.000	4.500	3.000	1.750	3.375	0.625	6.125
	1.000									2.125	3.750		6.875
	1.375									2.375	4.000		7.375
2.50	0.625	3.000	1.500	1.000	1.000	3.500	5.500	5.000	3.500	1.750	3.375	0.500	6.250
	1.000									2.125	3.750		7.000
	1.375									2.375	4.000		7.500
	1.750									2.625	4.250		8.000
3.25	1.000	3.750	2.000	1.000	1.000	4.500	6.500	5.750	4.250	2.250	4.250	1.000	7.500
	1.375									2.500	4.500		8.000
	1.750									2.750	4.750		8.500
	2.000									2.875	4.875		8.750
4.00	1.000	4.500	2.000	1.000	1.000	5.250	7.250	6.500	5.000	2.250	4.250	1.000	7.500
	1.375									2.500	4.500		8.000
	1.750									2.750	4.750		8.500
	2.000									2.875	4.875		8.750
	2.500									3.125	5.125		9.250
5.00	1.000	5.500	2.000	1.000	1.000	6.250	8.250	7.500	6.000	2.250	4.250	0.750	7.750
	1.375									2.500	4.500		8.250
	1.750									2.750	4.750		8.750
	2.000									2.875	4.875		9.000
	2.500									3.125	5.125		9.500
	3.000									3.125	5.125		9.500
	3.500									3.125	5.125		9.500
6.00	1.375	6.500	2.000	1.375	1.375	7.625	10.375	9.250	7.000	2.625	4.750	0.750	8.750
	1.750									2.875	5.000		9.250
	2.000									3.000	5.125		9.500
	2.500									3.250	5.375		10.000
	3.000									3.250	5.375		10.000
	3.500									3.250	5.375		10.000
	4.000									3.250	5.375		10.000
8.00	1.375	8.500	2.500	1.375	1.375	9.750	12.500	11.250	9.500	2.625	5.000	1.125	8.875
	1.750									2.875	5.250		9.375
	2.000									3.000	5.375		9.625
	2.500									3.250	5.625		10.125
	3.000									3.250	5.625		10.125
	3.500									3.250	5.625		10.125
	4.000									3.250	5.625		10.125
	4.500									3.250	5.625		10.125
	5.000									3.250	5.625		10.125
	5.500									3.250	5.625		10.125

① 'TD' dimension tolerance is + .000 / - .001

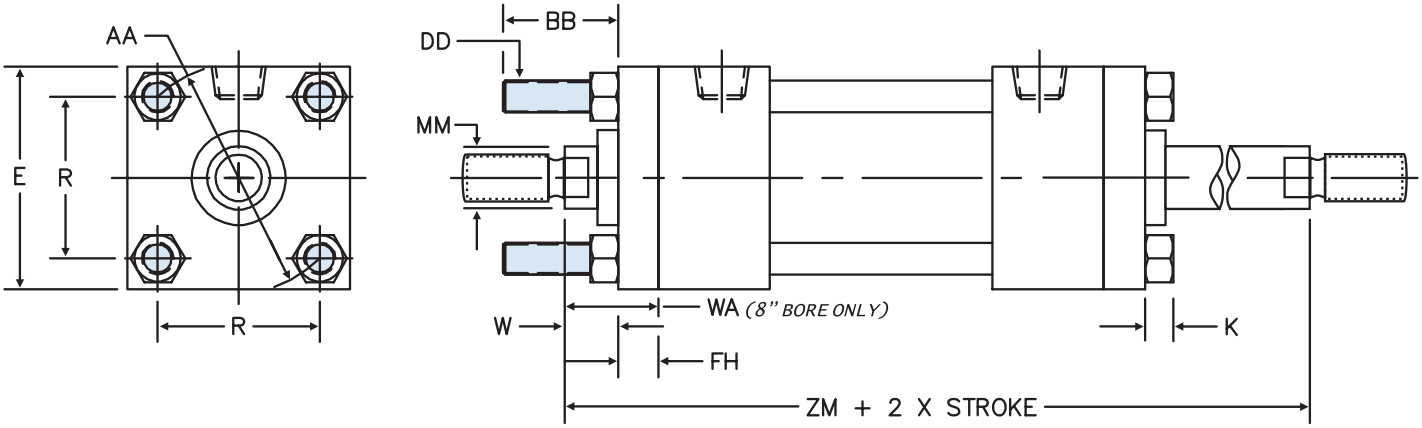
② 'XI' dimension is the minimum that can be supplied and leaves 1/8" gap between head & trunnion block (customer to specify 'XI' dimension).

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

MX1D: EXTENDED TIE RODS - HEAD & CAP



MX3D: EXTENDED TIE RODS - HEAD END



SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

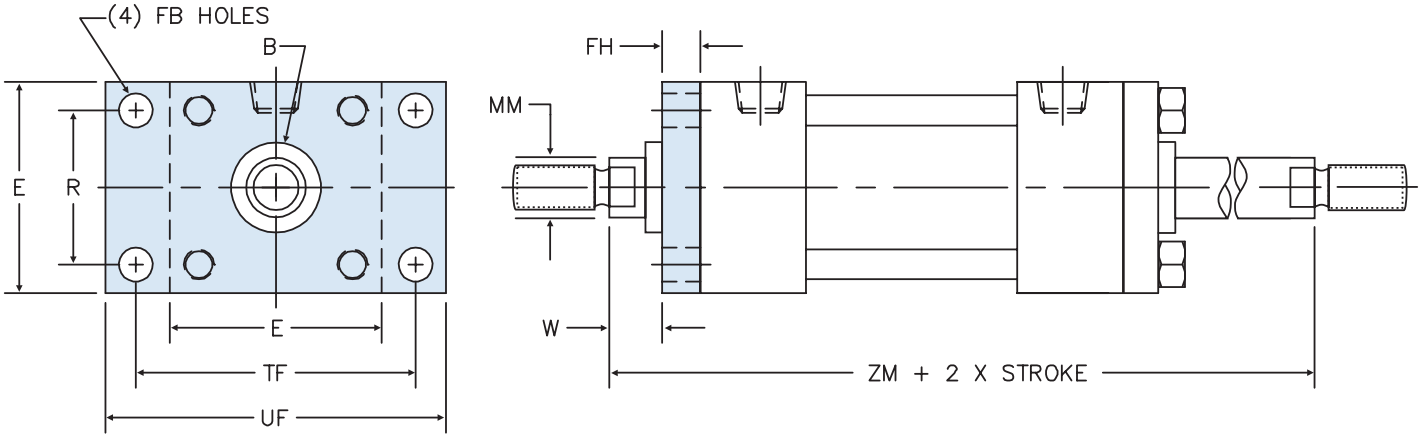
BORE	ROD DIA. (MM)	E	FH	AA	BB	DD	K	R	① RD	W or WA (8")	ADD 2X STROKE ZM
1.50	0.625	2.000	0.375	2.020	1.000	1/4 - 28	0.250	1.430	SQ	0.625	6.125
	1.000									1.000	6.875
2.00	0.625	2.500	0.375	2.600	1.125	5/16 - 24	0.313	1.840	SQ	0.625	6.125
	1.000									1.000	6.875
	1.375									1.250	7.375
2.50	0.625	3.000	0.375	3.100	1.125	5/16 - 24	0.313	2.190	SQ	0.625	6.250
	1.000									1.000	7.000
	1.375									1.250	7.500
	1.750									1.500	8.000
3.25	1.000	3.750	0.625	3.900	1.375	3/8 - 24	0.375	2.760	SQ	0.750	7.500
	1.375									1.000	8.000
	1.750									1.250	8.500
	2.000									1.375	8.750
4.00	1.000	4.500	0.625	4.700	1.375	3/8 - 24	0.375	3.320	SQ	0.750	7.500
	1.375									1.000	8.000
	1.750									1.250	8.500
	2.000									1.375	8.750
	2.500									1.625	9.250
5.00	1.000	5.500	0.625	5.800	1.813	1/2 - 20	0.438	4.100	SQ	0.750	7.750
	1.375									1.000	8.250
	1.750									1.250	8.750
	2.000									1.375	9.000
	2.500									1.625	9.500
	3.000									1.625	9.500
	3.500									1.625	9.500
6.00	1.375	6.500	0.750	6.900	1.813	1/2 - 20	0.438	4.880	SQ	0.875	8.750
	1.750									1.125	9.250
	2.000									1.250	9.500
	2.500									1.500	10.000
	3.000									1.500	10.000
	3.500									1.500	10.000
	4.000									1.500	10.000
8.00	1.375	8.500	0.625	9.100	② 2.313	5/8 - 18	0.563	6.440	3.500	1.500	8.875
	1.750		0.625						3.500	1.750	9.375
	2.000		0.625						5.000	1.875	9.625
	2.500		0.750						5.000	2.125	10.125
	3.000		0.750						5.250	2.125	10.125
	3.500		0.750						5.625	2.125	10.125
	4.000		0.750						6.500	2.125	10.125
	4.500		0.750						7.250	2.125	10.125
	5.000		0.750						7.500	2.125	10.125
	5.500		0.750						7.500	2.125	10.125

① Where SQ is shown in chart, cylinder utilizes a full square retainer.

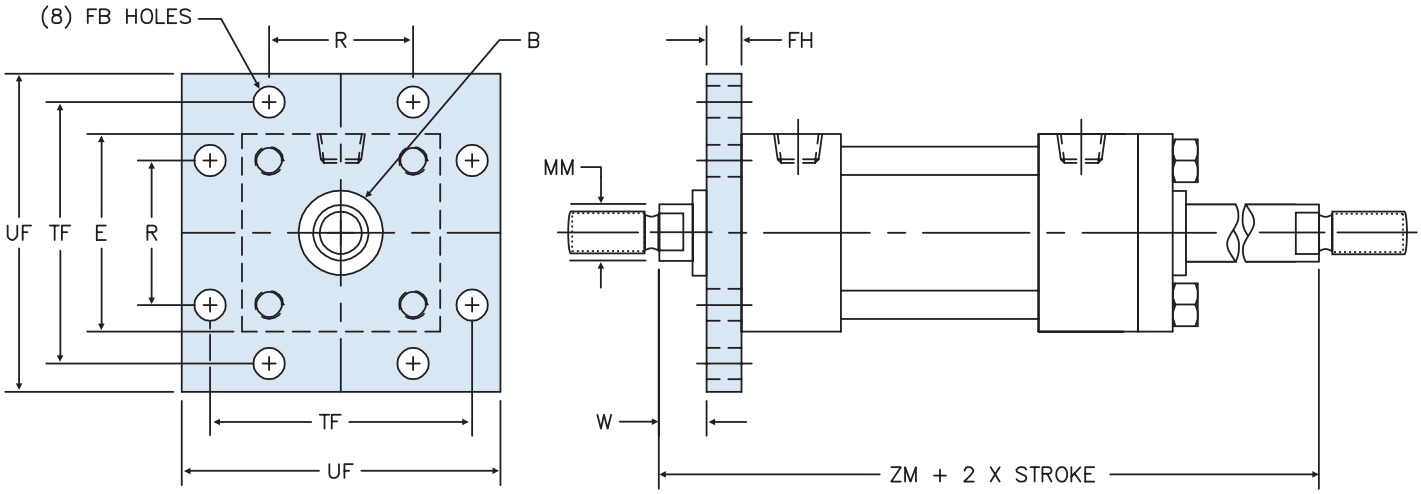
② Round retainer used to retain bushing, not a full front plate as other bores. 'BB' is dimension from head on the 8.00" bore.

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

MF1D: HEAD FLANGE



MF5D: HEAD SQUARE FLANGE

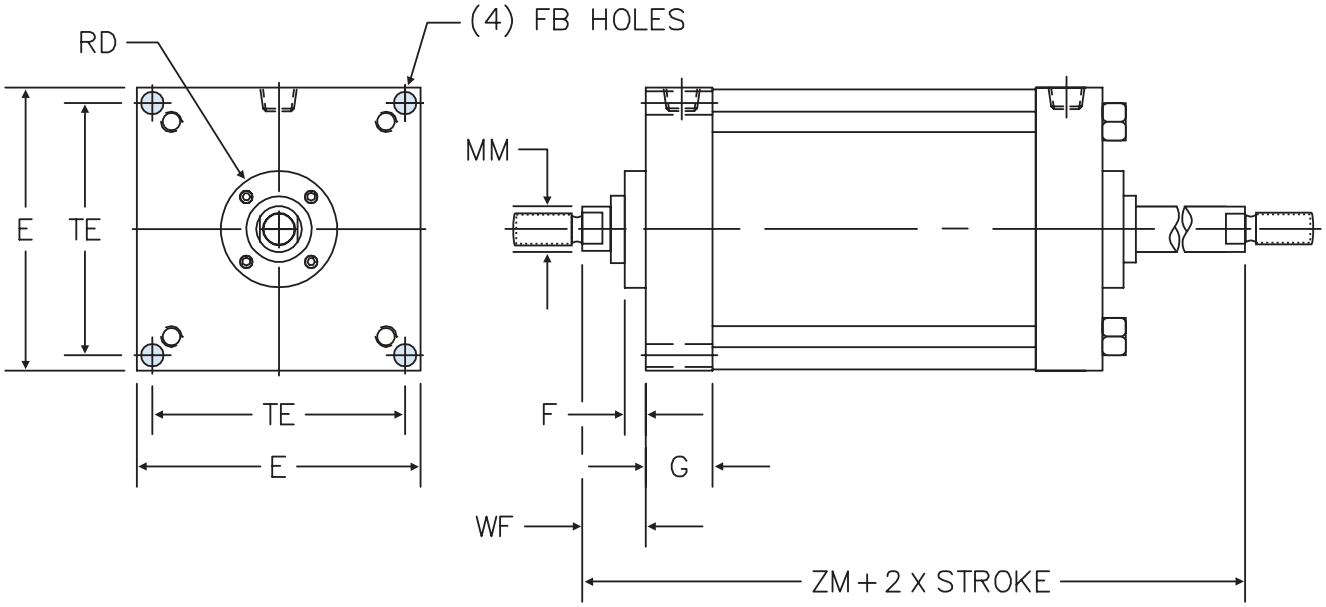


SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

BORE	ROD DIA. (MM)	B	E	FB	FH	R	TF	UF	W	ADD 2X STROKE ZM
1.50	0.625	1.124	2.000	0.313	0.375	1.430	2.750	3.375	0.625	6.125
	1.000	1.499							1.000	6.875
2.00	0.625	1.124	2.500	0.375	0.375	1.840	3.375	4.125	0.625	6.125
	1.000	1.499							1.000	6.875
	1.375	1.999							1.250	7.375
2.50	0.625	1.124	3.000	0.375	0.375	2.190	3.875	4.625	0.625	6.250
	1.000	1.499							1.000	7.000
	1.375	1.999							1.250	7.500
	1.750	2.374							1.500	8.000
3.25	1.000	1.499	3.750	0.438	0.625	2.760	4.688	5.500	0.750	7.500
	1.375	1.999							1.000	8.000
	1.750	2.374							1.250	8.500
	2.000	2.624							1.375	8.750
4.00	1.000	1.499	4.500	0.438	0.625	3.320	5.438	6.250	0.750	7.500
	1.375	1.999							1.000	8.000
	1.750	2.374							1.250	8.500
	2.000	2.624							1.375	8.750
	2.500	3.124							1.625	9.250
5.00	1.000	1.499	5.500	0.563	0.625	4.100	6.625	7.625	0.750	7.750
	1.375	1.999							1.000	8.250
	1.750	2.374							1.250	8.750
	2.000	2.624							1.375	9.000
	2.500	3.124							1.625	9.500
	3.000	3.749							1.625	9.500
	3.500	4.249							1.625	9.500
6.00	1.375	1.999	6.500	0.563	0.750	4.880	7.625	8.625	0.875	8.750
	1.750	2.374							1.125	9.250
	2.000	2.624							1.250	9.500
	2.500	3.124							1.500	10.000
	3.000	3.749							1.500	10.000
	3.500	4.249							1.500	10.000
	4.000	4.749							1.500	10.000

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

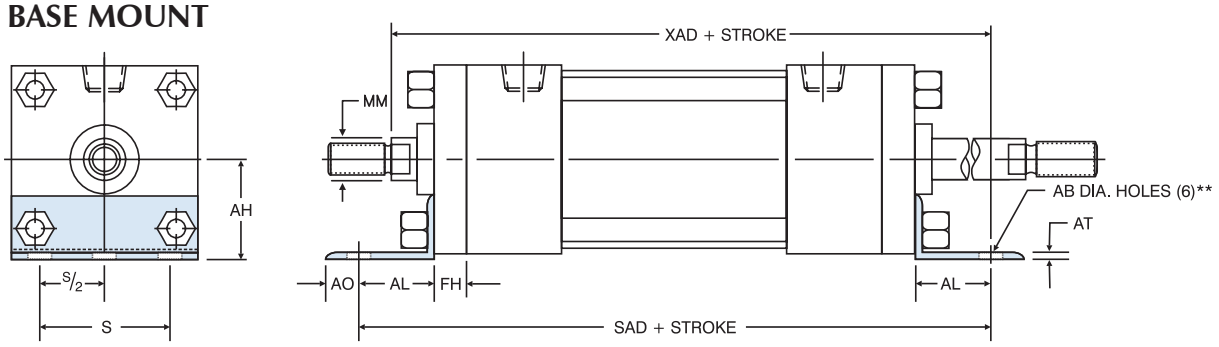
ME3D: HEAD SQUARE MOUNTING HOLES



BORE	ROD DIA. (MM)	E	F	FB	G	TE	RD	WF	ADD 2X STROKE ZM
8.00	1.375	8.500	0.625	0.688	2.000	7.570	3.500	1.625	8.875
	1.750		0.625				3.500	1.875	9.375
	2.000		0.625				5.000	2.000	9.625
	2.500		0.750				5.000	2.250	10.125
	3.000		0.750				5.250	2.250	10.125
	3.500		0.750				5.625	2.250	10.125
	4.000		0.750				6.500	2.250	10.125
	4.500		0.750				7.250	2.250	10.125
	5.000		0.750				7.500	2.250	10.125
	5.500		0.750				7.500	2.250	10.125

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

MS1D: BASE MOUNT

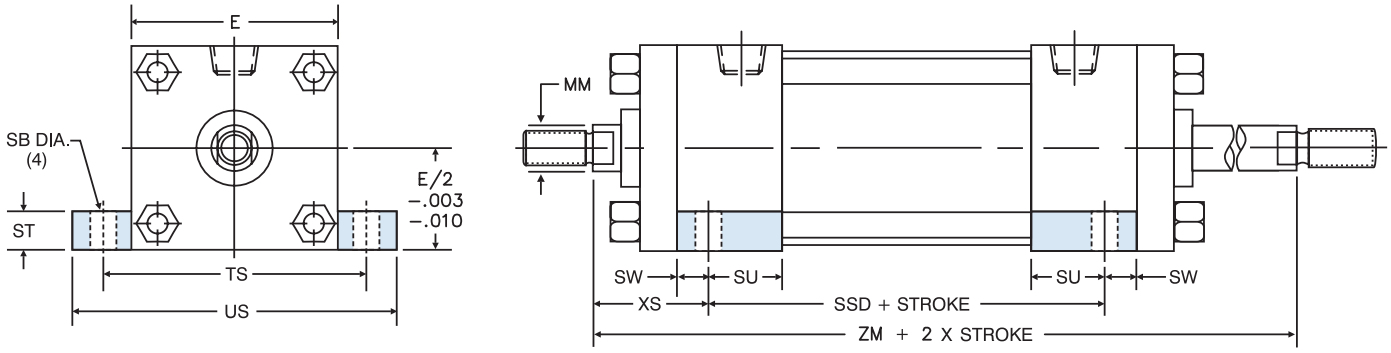


'MS1D' ANGLE MOUNT DIMENSIONS										
									ADD TO STROKE	
BORE	ROD DIA. (MM)	AB	AH	AL	AO	AT	FH	S	SAD	XAD
1.50	0.625	0.438	1.188	1.000	0.375	0.188	0.375	1.250	6.875	6.500
	1.000									6.875
2.00	0.625	0.438	1.438	1.000	0.375	0.188	0.375	1.750	6.875	6.500
	1.000									6.875
	1.375									7.125
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
	1.375									7.250
	1.750									7.500
3.25	1.000	0.563	1.938	1.250	0.500	0.125	0.625	2.750	8.500	8.000
	1.375									8.250
	1.750									8.500
	2.000									8.625
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
	1.750									8.500
	2.000									8.625
	2.500									8.875
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
	1.750									8.875
	2.000									9.000
	2.500									9.250
	3.000									9.250
	3.500									9.250
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
	2.000									9.625
	2.500									9.875
	3.000									9.875
	3.500									9.875
	4.000									9.875
8.00*	1.375	0.813	4.250	1.813	0.688	0.250	0.625	7.125	9.250	9.063
	1.750						0.625			9.313
	2.000						0.625			9.438
	2.500						0.750			9.688
	3.000						0.750			9.688
	3.500						0.750			9.688
	4.000						0.750			9.688
	4.500						0.750			9.688
	5.000						0.750			9.688
	5.500						0.750			9.688

*8.00" bore utilizes round retainer.
**1.50" bore uses (4) "AB" holes.

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

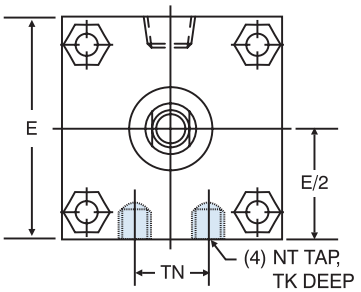
MS2D: SIDE LUGS

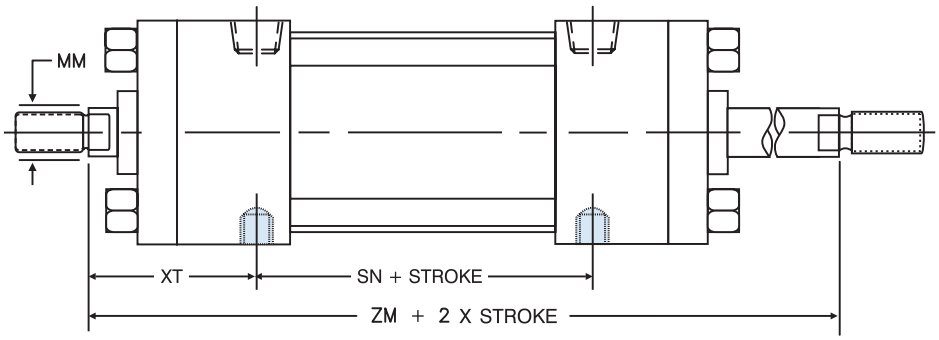


BORE	ROD DIA. (MM)	E	SB	ST	SU	SW	TS	US	XS	ADD TO STROKE SSD	ADD 2X STROKE ZM
1.50	0.625	2.000	0.438	0.500	1.125	0.375	2.750	3.500	1.375	3.375	6.125
	1.000								1.750		6.875
2.00	0.625	2.500	0.438	0.500	1.125	0.375	3.250	4.000	1.375	3.375	6.125
	1.000								1.750		6.875
	1.375								2.000		7.375
2.50	0.625	3.000	0.438	0.500	1.125	0.375	3.750	4.500	1.375	3.500	6.250
	1.000								1.750		7.000
	1.375								2.000		7.500
	1.750								2.250		8.000
3.25	1.000	3.750	0.563	0.750	1.250	0.500	4.75	5.750	1.875	3.750	7.500
	1.375								2.125		8.000
	1.750								2.375		8.500
	2.000								2.500		8.750
4.00	1.000	4.500	0.563	0.750	1.250	0.500	5.500	6.500	1.875	3.750	7.500
	1.375								2.125		8.000
	1.750								2.375		8.500
	2.000								2.500		8.750
	2.500								2.750		9.250
5.00	1.000	5.500	0.813	1.000	1.063	0.688	6.875	8.250	2.063	3.625	7.750
	1.375								2.313		8.250
	1.750								2.563		8.750
	2.000								2.688		9.000
	2.500								2.938		9.500
	3.000								2.938		9.500
	3.500								2.938		9.500
6.00	1.375	6.500	0.813	1.000	1.313	0.688	7.875	9.250	2.313	4.125	8.750
	1.750								2.563		9.250
	2.000								2.688		9.500
	2.500								2.938		10.000
	3.000								2.938		10.000
	3.500								2.938		10.000
	4.000								2.938		10.000
8.00	1.375	8.500	0.813	1.000	1.313	0.688	9.875	11.250	2.313	4.250	8.875
	1.750								2.563		9.375
	2.000								2.688		9.625
	2.500								2.938		10.125
	3.000								2.938		10.125
	3.500								2.938		10.125
	4.000								2.938		10.125
	4.500								2.938		10.125
	5.000								2.938		10.125
	5.500								2.938		10.125

SERIES 'TAS' DIMENSIONS: DOUBLE ROD END MOUNTS

MS4D: BOTTOM TAPPED HOLES





BORE	ROD DIA. (MM)	E	NT	TN	TK	XT	ADD TO STROKE SN	ADD 2X STROKE ZM
1.50	0.625	2.000	1/4 - 20	0.625	0.375	1.938	2.250	6.125
	1.000					2.313		6.875
2.00	0.625	2.500	5/16 - 18	0.875	0.500	1.938	2.250	6.125
	1.000				0.500	2.313		6.875
	1.375				0.375	2.563		7.375
2.50	0.625	3.000	3/8 - 16	1.250	0.625	1.938	2.375	6.250
	1.000				0.625	2.313		7.000
	1.375				0.438	2.563		7.500
	1.750				0.375	2.813		8.000
3.25	1.000	3.750	1/2 - 13	1.500	0.750	2.438	2.625	7.500
	1.375				0.750	2.688		8.000
	1.750				0.500	2.938		8.500
	2.000				0.500	3.063		8.750
4.00	1.000	4.500	1/2 - 13	2.063	0.750	2.438	2.625	7.500
	1.375				0.750	2.688		8.000
	1.750				0.750	2.938		8.500
	2.000				0.750	3.063		8.750
	2.500				0.625	3.313		9.250
5.00	1.000	5.500	5/8 - 11	2.688	1.000	2.438	2.875	7.750
	1.375				1.000	2.688		8.250
	1.750				1.000	2.938		8.750
	2.000				1.000	3.063		9.000
	2.500				1.000	3.313		9.500
	3.000				0.750	3.313		9.500
	3.500				0.625	3.313		9.500
6.00	1.375	6.500	3/4 - 10	3.250	1.125	2.813	3.125	8.750
	1.750				1.125	3.063		9.250
	2.000				1.125	3.188		9.500
	2.500				1.125	3.438		10.000
	3.000				1.125	3.438		10.000
	3.500				1.125	3.438		10.000
	4.000				1.000	3.438		10.000
8.00	1.375	8.500	3/4 - 10	4.500	1.125	2.813	3.250	8.875
	1.750					3.063		9.375
	2.000					3.188		9.625
	2.500					3.438		10.125
	3.000					3.438		10.125
	3.500					3.438		10.125
	4.000					3.438		10.125
	4.500					3.438		10.125
	5.000					3.438		10.125
	5.500					3.438		10.125

SERIES 'TAS' BASIC OPTIONS

Index to Options:

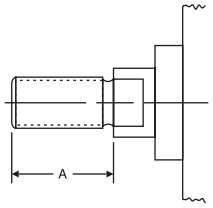
A= Extended Piston Rod Thread

"A=" refers to the length of piston rod thread.

Shorter than standard lengths can be furnished at no charge. Longer than standard lengths can be furnished at a nominal price adder.

Special length threads do not delay orders!

Note: Maximum thread length is double the standard "A" length.

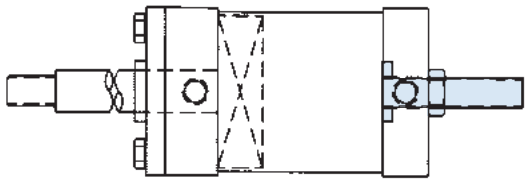


AS Adjustable Stroke (Retract)

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

To order, specify "AS" and length of adjustment.

(Example: AS=3")



Note: Offered on standard through 2x oversized rods.

Consult factory for adjustable strokes over 12"

A/O Air/Oil Piston

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

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

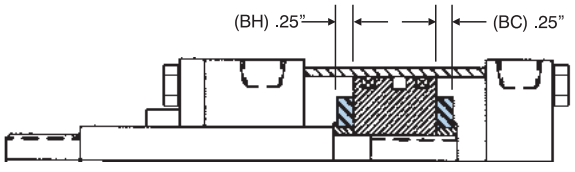
For applications that require the oil to be on the cylinder rod end, specify the "TH" option.

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

B BC BH Bumpers

Urethane impact dampening bumpers are 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).

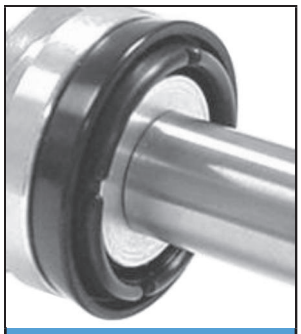


Note: Offered on standard and 1x oversized rods.

Consult factory for other offerings.

SERIES 'TAS' BASIC OPTIONS

BP *Bumper Piston Seals*



1.50" Bore Shown

Available on 1.50" to 8" Bore

TRD's bumper piston seal, when used with our advanced cushion design, decelerates the cylinder at end of stroke, reducing noise and extending cylinder life.

Standard Material: Nitrile
Operating Temp: -20°F to 200°F (-29°C to 93°C)

Optional Material: Fluorocarbon
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

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.

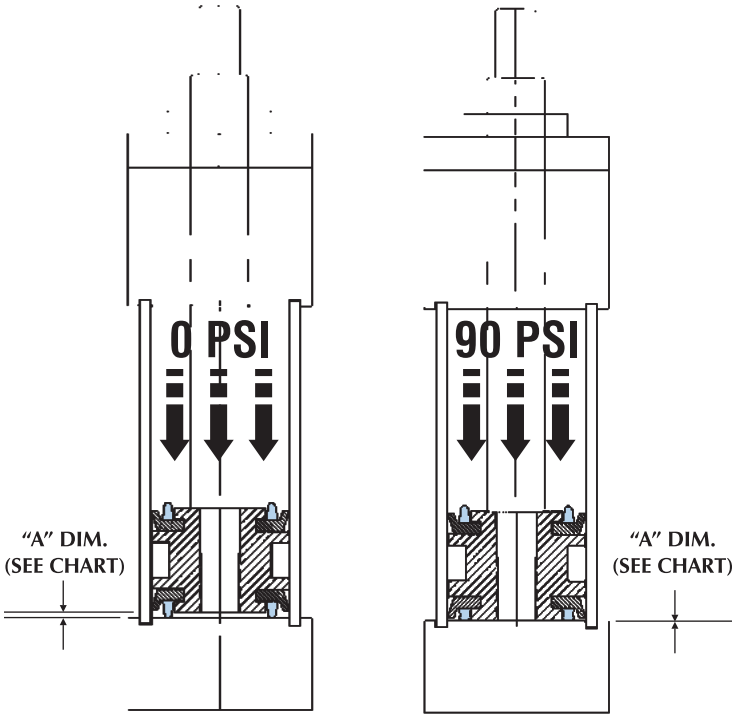
Bumper piston seals will shorten the cylinder stroke when operated at less than 90 PSI supply air. The charts below show the approximate (average) stroke reduction at various pressure (for new cylinders). As the cylinders are cycled, the seals will take a slight set. Tests have shown that after 1,500,000 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



SERIES 'TAS' 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).

Example: BSPT=.25″

BSPP British Standard Pipe Parallel

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

Example: BSPP=.25″

H C LH LC FC FCH FCC Cushions

TRD's advanced cushion design features a unique, one piece seal that is allowed to float in a precision machined groove. This type of seal design provides consistent cushion performance and maximum seal life. Oversized flow paths molded in the periphery of the seal provide full flow on the return stroke without the use of ball checks. *Note: Cylinders with a short stroke (value varies with bore/rod diameter and cushion combinations) may result in improper cylinder operation. Consult factory for availability.*

HEAD CUSHIONS

- **H** Standard Length Head Cushion
- **LH** Long Head Cushion
- **FCH** Fixed Head Cushion[1]

CAP CUSHIONS

- **C** Standard Length Cap Cushion
- **LC** Long Cap Cushion
- **FCC** Fixed Cap Cushion[1]

[1] *This is a non-adjustable cushion.*
Note: Designate FC for both fixed head and cap cushions.

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. You can choose a larger bore size to increase cushion capacities.

CUSHION SIZING FORMULA:

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

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

SIZING EXAMPLE:

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

P=80 PSI W=26.25 lbs. V=6 FPS. K=.17

Energy = (26.25/64) X (6^2) or (36) + (80 X .17)
Energy = 28.36 ft/lbs.

The Maximum Energy Data Chart indicates that the long cushion at 38.6 max. energy value would be correct for this application.

MAXIMUM ENERGY DATA CHART

BORE	K	H or C STANDARD CUSHION SERIES MAX ENERGY (FT-LBS)	LH or LC LONG CUSHION SERIES MAX ENERGY (FT-LBS)
1.50	.06	8.2	12.8
2.00	.11	13.8	21.7
2.50	.17	24.6	38.6
3.25	.25	45.7	83.6
4.00	.38	57.3	137.1
5.00	.59	94.6	226.0
6.00	1.37	225.5	334.4
8.00	2.43	411.3	609.8

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
3.000	20.0 lb. + 2.01 lb./in. of stroke
3.500	28.7 lb. + 2.73 lb./in. of stroke
4.000	39.2 lb. + 3.57 lb./in. of stroke
4.500	50.0 lb. + 4.52 lb./in. of stroke
5.000	60.4 lb. + 5.58 lb./in. of stroke
5.500	78.5 lb. + 6.75 lb./in. of stroke

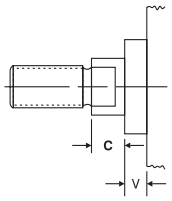
*Double weight for double rod end cylinders.

SERIES 'TAS' BASIC OPTIONS

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. Extended piston rod lengths do not delay delivery.

Example: If C=0.50" then 1" rod extension is C=1.50"



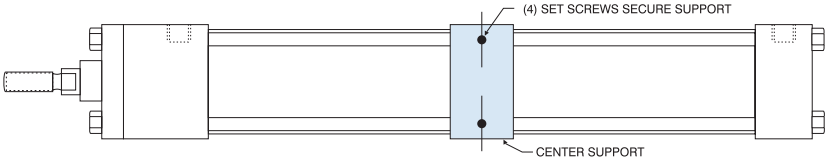
CS Center Supports

Center supports are recommended for long stroke cylinders to support tube and prevent the tie rods from sagging. Properly supported cylinders will eliminate premature cylinder wear and eliminate tie rod vibration.

Center supports can include MS2 mounts.

Contact TRD for more information.

MAXIMUM STROKE RECOMMENDATIONS			
BORE	NO CENTER SUPPORT	WITH CENTER SUPPORTS (CS OPTION)	
		ONE SUPPORT	TWO SUPPORTS
1.50", 2.00" & 2.50"	48 INCHES	OVER 48 INCHES	OVER 72 INCHES
3.25", 4.00" & 5.00"	65 INCHES	OVER 65 INCHES	OVER 92 INCHES
6.00"	72 INCHES	OVER 72 INCHES	NOT REQUIRED



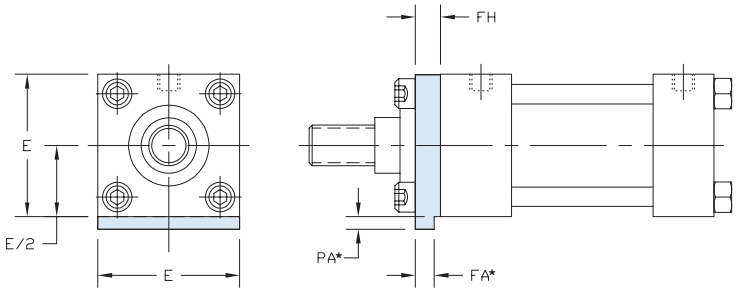
EK Extended Key Plate

Extended key plate or thrust key is made from a full square bushing retainer plate. The key is designed to fit in a milled slot on the equipment to prevent the cylinder from shifting. An additional mount needs to be specified to secure cylinder.

Available bore sizes: TAS - 1.50" to 6.00" Bore

'TAS' DIMENSIONS FOR EXTENDED KEY PLATE				
BORE	E	FA*	FH	PA*
1.50	2.000	0.312 / 0.310	0.375	0.188
2.00	2.500	0.312 / 0.310	0.375	0.188
2.50	3.000	0.312 / 0.310	0.375	0.188
3.25	3.750	0.562 / 0.560	0.625	0.313
4.00	4.500	0.562 / 0.560	0.625	0.313
5.00	5.500	0.562 / 0.560	0.625	0.313
6.00	6.500	0.687 / 0.685	0.750	0.375

*FA & PA dimensions will have a black oxide finish and will not be painted.



KK10 Rod Coupler End

The KK10 rod end was made popular in 3,000 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. Refer to page 148 for KK10 accessories.

Example: TAS-MX0-2x6-KK10

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 KK3X Special Rod Thread

TRD can machine virtually any diameter and type of rod thread on the piston rod end. Standard NFPA rod threads are UNF (fine), class 2 threads. Common alternative choices are UNC (course) threads. Some uncommon thread choices are threads larger than the rod diameter. This is only possible by providing a KK3 (female) rod end and making a stud with the larger rod thread.

Example: TAS-MX0-2x6-KKX=1/2-13 UNC

Note: Unless otherwise specified, the rod thread will be standard catalog "A" dimension lengths.

Female special rod thread is also available; please specify KK3X.

KKM KK3M Metric Rod Thread

ISO 6431 is a very popular European tie rod cylinder design. Equipment that is imported from outside the U.S. will typically 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.

Example: TAS-MX0-2x6-KKM=M10X1

TRD can provide cylinders with metric piston rod end threads to assist customers in mating replacement cylinders to existing equipment.

Female metric rod thread is also available; please specify KK3M.

SERIES 'TAS' BASIC OPTIONS

L001 Magnalube-G Grease

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

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

See www.magnalube.com for more information.

Color: Green

Recommended temperature range: -20°F to 200°F (-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 TRD for assistance.

Color: White-Gray

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

L008 RS Series Standard Grease

USDA Food Grade grease. Synthetic based fluid with aluminum complex soap thickener type grease that is ideal for freezer applications. USDA approved for incidental food contact.

Color: White

Recommended temperature range: -60°F to 300°F (-51°C to 149°C)

L011 EPDM Seal Lube

A silicone (Dimethyl Siloxane Polymer) based, tacky-stiff lubricant used specifically with EPDM type special seal materials. Note: this lube is not compatible with Nitrile seals.

Color: Clear

Recommended temperature range: -40°F to 300°F (-40°C to 149°C)

L012 Water Hydraulic Grease

A polymer-fortified petroleum grease, PTFE additives, and high molecular weight polymers formulated to resist water washout. Used specifically for water hydraulic cylinders. NLGI #2

Color: Green

Recommended temperature range: 0°F to 300°F (-18°C to 149°C)

L013 Low Friction Oil

A low friction, synthetic oil offering superior extreme pressure (EP), anti-wear properties and extremely low wear rates. Designed specifically for low friction applications such as counterbalance cylinders.

Color: White-Gray Liquid

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

SERIES 'TAS' BASIC OPTIONS

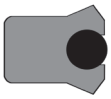
LF Low Friction Seals

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

MATERIAL: Carboxilated Nitrile
OPERATING TEMPERATURE: -20°F to 200°F (-29°C to 93°C)
OPERATING PRESSURE: 250 PSI AIR (17 BAR)

LT Low Temperature Seals

TEMP RATING: -30°F to 200°F (-34°C to 93°C)
PRESSURE RATING: 0-250 PSI Air (17 Bar); 0-400 PSI Hyd. (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.

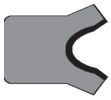
Seal Type: U-Cup, urethane seals with O-ring energizer, which functions as a spring to maintain sealing contact under low temperature applications. Unidirectional seal.

Must also specify LTG (Low Temperature Grease L003) option.

How to order LT seal kit: SK100-325-LT-LTG (1" Rod, 3.25" Bore)

LTE Low Temperature Extreme Seals

TEMP RATING: -65°F to 200°F (-54°C to 93°C)
PRESSURE RATING: 0-250 PSI Air (17 Bar); 0-400 PSI Hyd. (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.

Must also specify LTG (Low Temperature Grease L003) option.

How to order LTE seal kit: SK100-325-LTE-LTG (1" Rod, 3.25" Bore)

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.

MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1.50	1.000	1.875	3.719	1/2 - 20	0.050
2.00	1.000	1.875	3.719	1/2 - 20	0.050
2.50	1.000	1.875	3.719	1/2 - 20	0.050
3.25	1.000	2.813	3.719	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

Notes: Offered on standard through 2x oversized rods.
See double rod end cylinder drawings for dimensions not shown.

MICRO-ADJUST SET-UP INSTRUCTIONS:

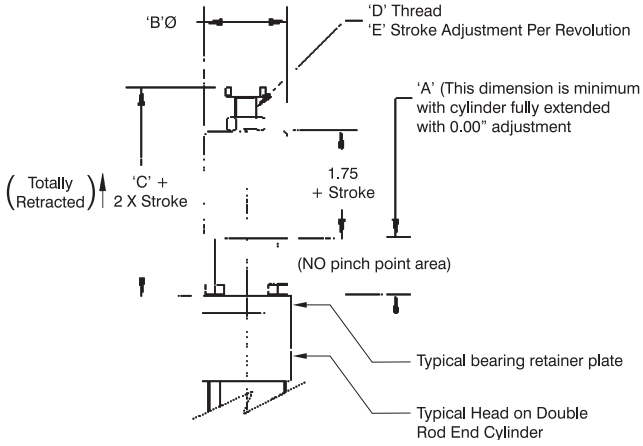
1) Set actuator to desired stroke
2) Turn stop collar until it makes contact with stop
3) Tighten set screw
4) Tighten jam nut for positive lock of stop collar

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

Hold stop collar by hand to tighten jam nut.

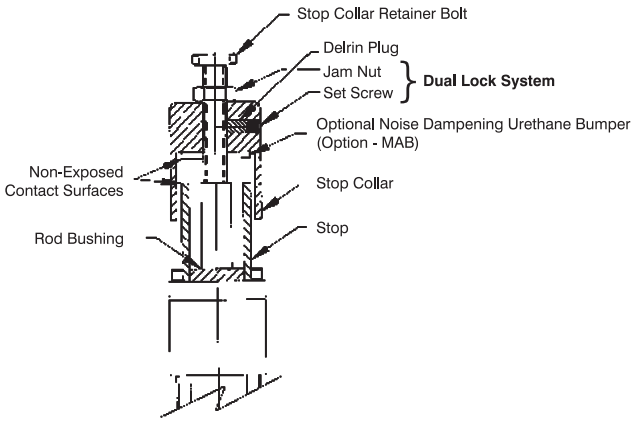
Stroke adjustments to be made while cylinder is in the retract position only.

SKETCH A



Construction: Anodized Aluminum

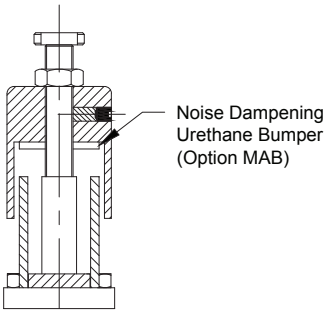
SKETCH B



SERIES 'TAS' BASIC OPTIONS

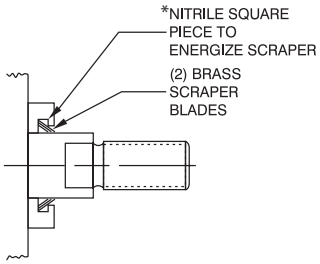
MAB *Micro-Adjust with Urethane Bumper*

A noise dampening urethane bumper is added between the metal contact points, minimizing noise.



MS *Metallic Rod Scraper*

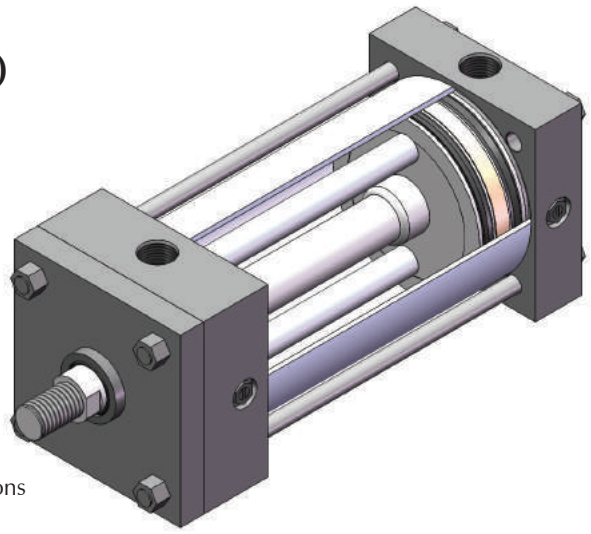
Aggressively scrapes the piston rod, removing foreign material such as spatter, sprays and powders *(brass construction)*.



*Standard energizer will match cylinder seals.

NR *Non-Rotating (NFPA) Cylinders*

2.00" through 8.00" Bore
250 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 and not subjected to harsh cleaners
- Compact design saves space; no larger than standard NFPA cylinders!
- Durable, self-contained construction

Force Chart
Refer to page 164

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

'NR' GUIDE ROD SIZES AND MAX STROKE				
BORE	ROD DIA. (MM)	CUSHIONS	GUIDE ROD DIAMETERS	MAXIMUM STROKE
2.00	0.625	Cap Only	0.250	10"
2.50	0.625	Cap Only	0.312	12"
	1.000			
3.25	1.000	Available	0.375	18"
	1.375	Cap Only		
4.00	1.000	Available	0.625	30"
	1.375			
5.00	1.000	Available	0.625	30"
	1.375			
	1.750			
	2.000			

'NR' GUIDE ROD SIZES AND MAX STROKE				
BORE	ROD DIA. (MM)	CUSHIONS	GUIDE ROD DIAMETERS	MAXIMUM STROKE
6.00	1.375	Available	0.625	30"
	1.750			
	2.000			
	2.500			
8.00	1.375	Available	1.000	40"
	1.750	Available		
	2.000	Available		
	2.500	Available		
	3.000	Available		
	3.500	Cap Only		

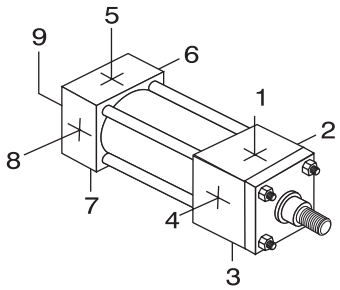
OP *Optional Port Location*

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

Example: TAS-MS4-2X10-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 at 1 & 5
- Standard Cushion Positions at 2 & 6
- Please specify non-standard locations when ordering.



SERIES 'TAS' BASIC OPTIONS

*Optional Port and Cushion at Same Location**

Specify ports and cushions on the same cylinder side!

Ordering Examples:

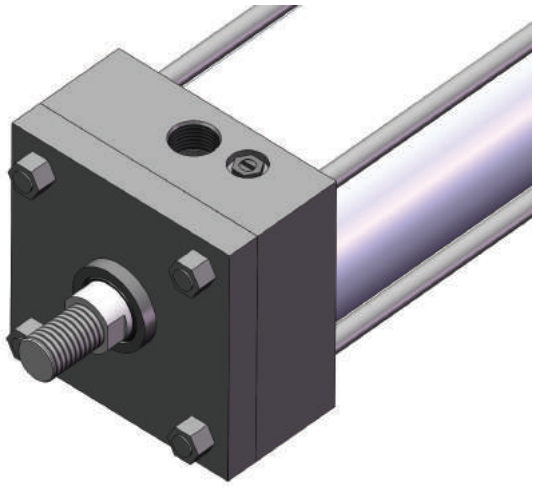
TAS - MS4 - 2 X 10 - H1C5 - OP= 1 & 5
(Ports and Cushions @ 1 & 5)

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

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

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

*Please consult factory for availability on other rod sizes.



BASIC DIMENSIONS:

HEAD VIEWS

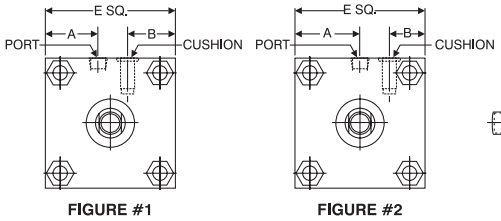
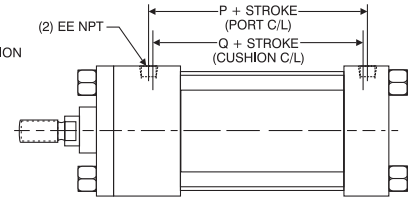


FIGURE #1 FIGURE #2



CAP VIEWS

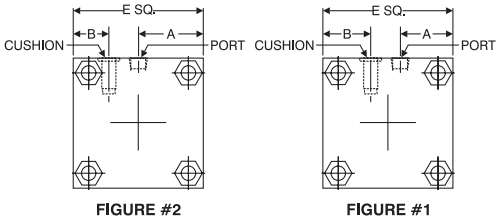


FIGURE #2 FIGURE #1

BORE	ROD DIA. (MM)	FIGURE	A	B	E	P	Q	EE NPT
1.50	0.625	1	0.750	0.625	2.000	2.375	2.125	1/4
	1.000	N/A	N/A	N/A	N/A			
2.00	0.625	1	0.875	0.938	2.500	2.375	2.125	3/8
	1.000	1	1.000	0.750	2.500			
2.50	0.625	1	1.125	1.125	3.000	2.500	2.250	3/8
	1.000	1	1.125	1.000	3.000			
3.25	1.000	1	1.500	1.375	3.750	2.750	2.500	1/2
	1.375	2	1.875	1.000	3.750			
4.00	1.000	2	2.250	1.250	4.500	2.750	2.500	1/2
	1.375	2	2.250	1.125	4.500			
5.00	1.000	2	2.750	1.750	5.500	3.000	3.000	1/2
	1.375	2	2.750	1.625	5.500			
6.00	1.375	2	3.250	1.875	6.500	3.250	3.000	3/4
	1.750	2	3.250	1.875	6.500			
8.00	1.375	2	4.250	2.750	8.500	3.375	3.125	3/4
	1.750	2	4.250	2.750	8.500			

OS *Oversize Rod*

Applications requiring long strokes may require oversize piston rod diameters to prevent sagging or buckling. To determine the recommended rod diameter, refer to Chart 3 on page 142.

Example: TAS-MS4-2X10-OS=1.375

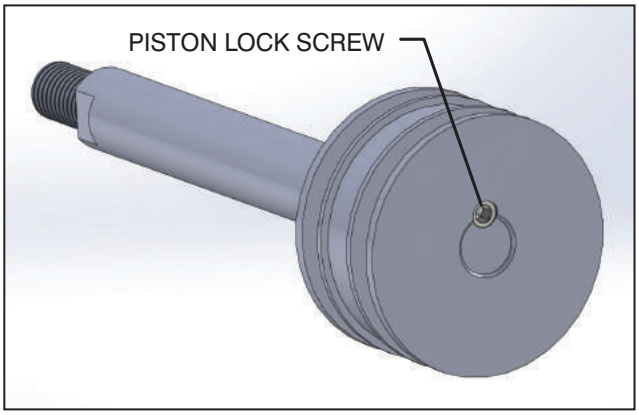
OVERSIZED PISTON ROD STANDARD PISTON ROD

SERIES 'TAS' BASIC OPTIONS

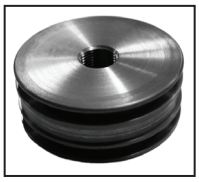
PLS *Piston Lock Screw* *(For higher shock load applications)*

Cylinders are able to develop high forces and can also be subjected to severe shock loads in demanding applications due to piston-to-end cap impact. The Piston Lock Screw (PLS) acts as a shear pin between the piston and rod threads, eliminating any chance of a piston coming loose from the rod.

All TRD cylinders use a specified torque with a permanent anaerobic thread lock/sealant to secure pistons to the piston rod; threads are then staked. This standard connection method has proven to be very effective in almost all applications. However, in severe shock load applications, the PLS option provides a 100% positive connection that cannot come apart.



PMC *Solid Cast Iron Pistons*



Solid cast iron pistons are standard in the 'HH' and 'MH' series. They can be ordered as an option for any other TRD series. Not suitable for use with an aluminum tube; we recommend that cast iron pistons are only used with a steel tube.

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.

RBB *Solid Bronze Rod Bushing*

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 uses are in water hydraulic applications.

Note: Since the mechanical properties of bronze is much lower than cast iron, bronze rod bushings typically do not provide the same long life that our standard PTFE coated cast iron rod bushings provide.

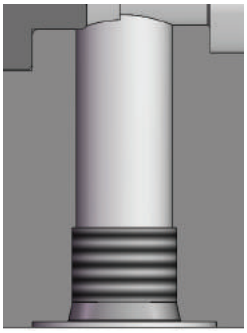
Specials: TRD can provide special length rod bushings; contact your local distributor for details

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

SAE ports can be ordered in place of NPT ports.

Order by SAE number.

Example: SAE=6



RECOMMENDED SAE PORT SIZE BY CYLINDER BORE			
BORE	SAE PORT WITH CUSHION	BORE	SAE PORT WITHOUT CUSHION
1.50	#6 (9/16-18)	1.50	#6 (9/16-18)
2.00	#6 (9/16-18)	2.00	#6 (9/16-18)
2.50	#6 (9/16-18)	2.50	#6 (9/16-18)
3.25	#8 (3/4-16)	3.25	#10 (7/8-14)
4.00	#8 (3/4-16)	4.00	#10 (7/8-14)
5.00	#8 (3/4-16)	5.00	#10 (7/8-14)
6.00	#10 (7/8-14)	6.00	#10 (7/8-14)
8.00	#12 (1 1/16-12)	8.00	#12 (1 1/16-12)

SERIES 'TAS' BASIC OPTIONS

SE *Spring Extend (1.50" - 2.50" Bore)*

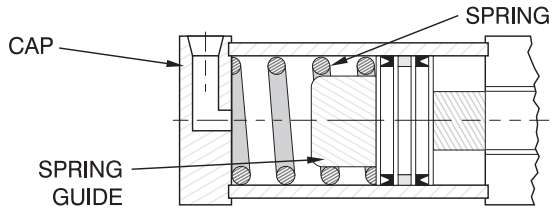
"SE" Option is designed to provide a spring bias to extend cylinder in the event of air pressure loss.

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 (IN.)	OVERALL LENGTH ADDER FOR "SE" OPTION (IN.)	SPRING RATE (LBS. PER IN.)	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

***Only available on 0.625" and 1.000" rods. Consult factory for other bores, rods and forces.**
Note: Spring rates are for reference only; actual rates may vary from spring to spring.



SR *Spring Retract (1.50" - 2.50" Bore)*

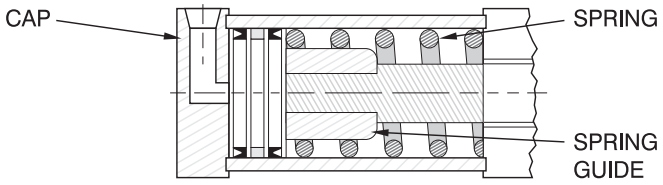
"SR" Option is designed to provide a spring bias to retract cylinder in the event of air pressure loss.

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 (IN.)	OVERALL LENGTH ADDER FOR "SR" OPTION (IN.)	SPRING RATE (LBS. PER IN.)	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

***Only available on 0.625" and 1.000" rods. Consult factory for other bores, rods and forces.**
Note: Spring rates are for reference only; actual rates may vary from spring to spring.



Stainless steel components provide corrosion resistance. Customize your cylinder by choosing from stainless steel fasteners, piston rod or tie rods and nuts. Refer to Series 'SS' for a complete stainless steel solution.

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

SSF **Stainless Steel Fasteners (Bushing Retainer Screws)**

SSR **Stainless Steel Piston Rod (Hard-Chrome Plated)**

SST **Stainless Steel Tie Rods and Nuts**

SSC **Stainless Steel Cushion Needle (External Adjustment Components)**

SSN **Stainless Steel Tie Rod Nuts**

TH *400 PSI Hydraulic (Non-Shock)*

Rating: 400 PSI Hydraulic, Non-Shock

Seals:
Piston Seals - (1) Poly-Pak, (1) Square-lip
Rod Seal - Poly-Pak

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

VS *Fluorocarbon Seals*

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 TRD for proper seal material selection in tough applications or environments.

SERIES 'TAS' BASIC OPTIONS

ST *Stop Tube and Rod Size Selection*

Stop tubes are designed to reduce the piston rod bushing stress to within the designed range of the bearing material. This will ensure proper cylinder performance in any given application. Stop tubes lower the cylinder bearing stress by adding length to the piston, which increases the overall length of the cylinder (note: TRD uses a double piston design when possible).

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 has 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 stop tube length to the cylinder model number.
- Add "ES" after the cylinder stroke to indicate that the stroke is the effective stroke.

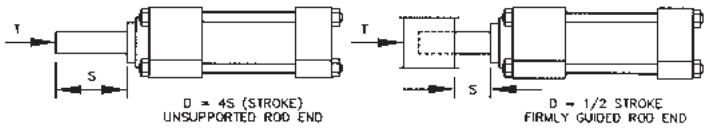
EXAMPLE

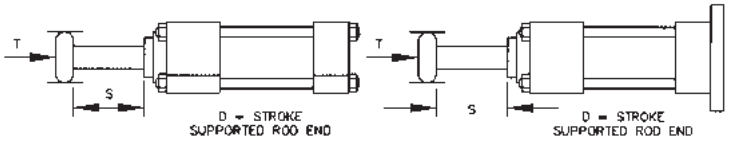
TAS - MP1 - 3.25 x 40 ES - ST = 2

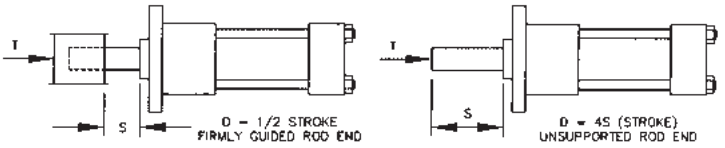
Chart 1

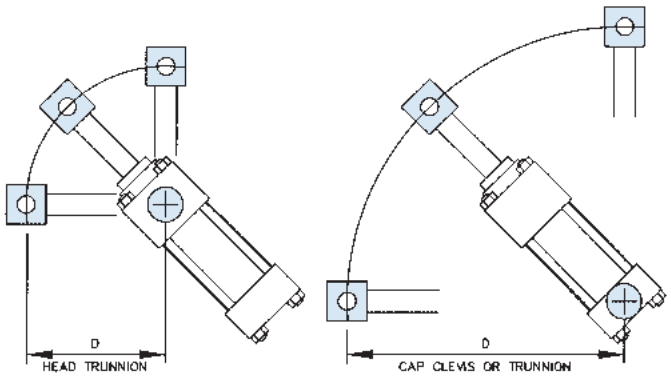
Find the value of "D" for your application

"D" = Stroke, adjusted for mounting condition
"S" = Actual cylinder stroke
"T" = Axial thrust (refer to Chart 3)





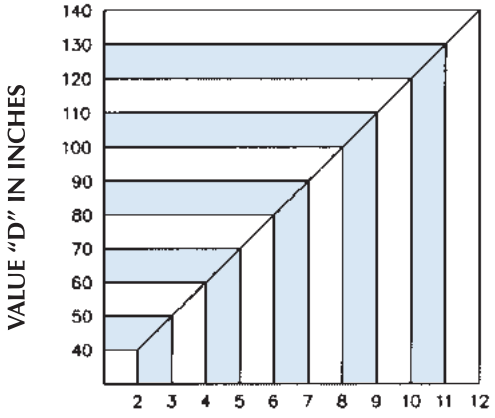




Note: Measure "D" when cylinder is fully extended.

Chart 2

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

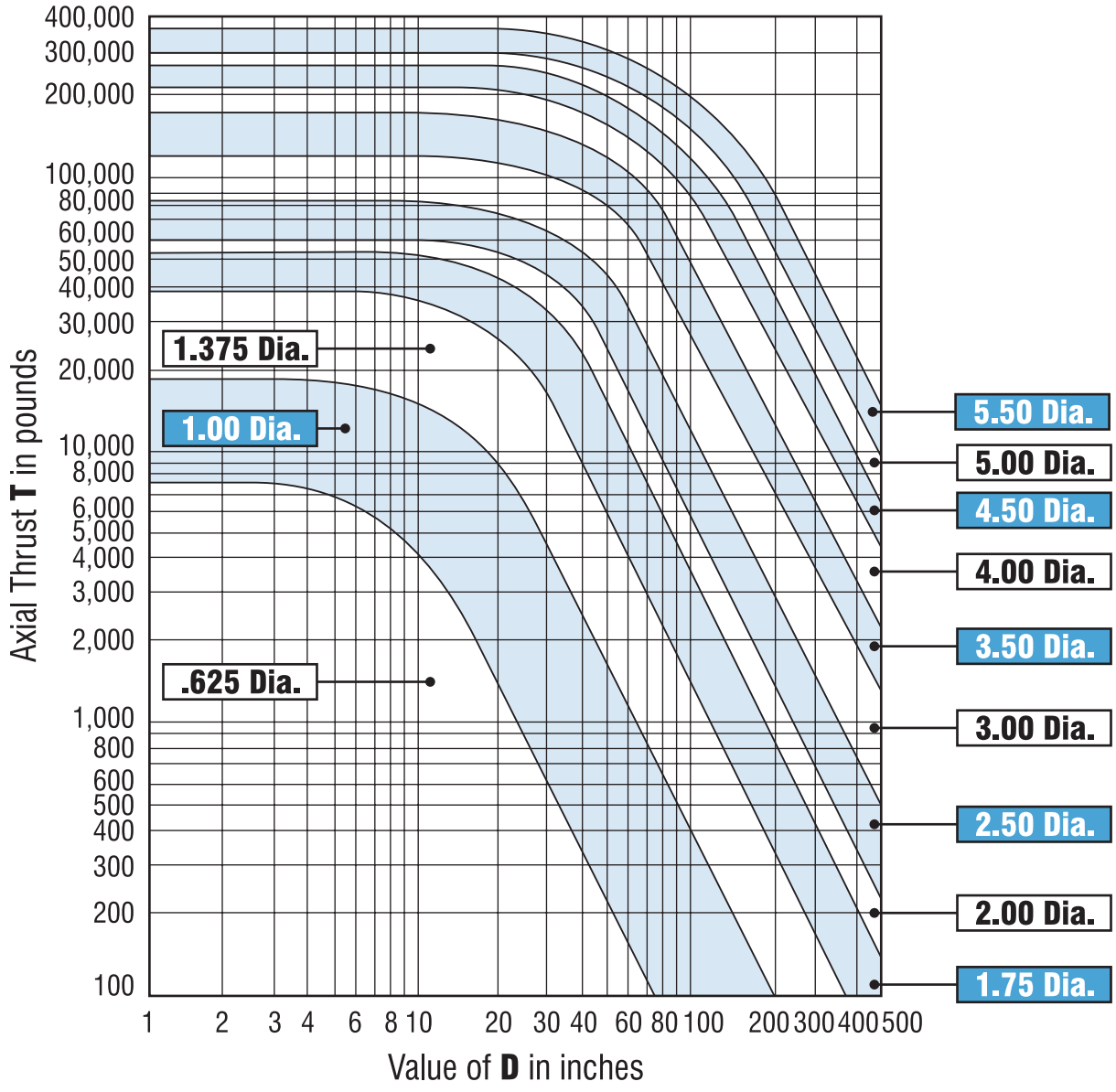


Piston Rod Size Selection

Standard rod sizes are usually suitable for shorter stroke applications at lower air pressures. With high thrust force or long stroke applications, you must check the column strength of the rod in the mounting style to determine the proper rod diameter size.

1. Determine the total axial thrust by multiplying the bore area size (in inches) by the operating pressure (in PSI).
2. Determine the value of "D" for the application.
3. Find the value of "D" in the chart below. Follow the value of "D" vertically on the graph until it intersects with the axial thrust value of the cylinder. The intersection of these two values will fall within one of the shaded areas representing the piston rod diameter size required for the application.

Chart 3 (Piston Rod Diameter Selection)

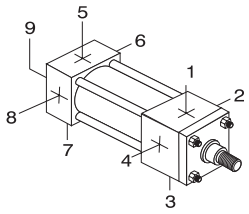


SERIES 'TAS' UNCOMMON OPTIONS

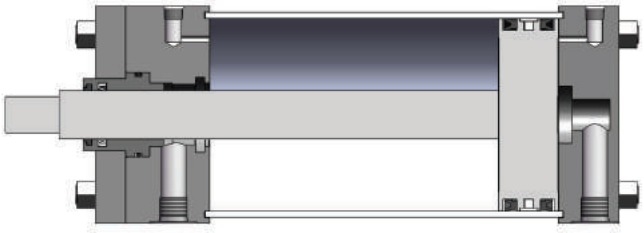
ABP= Air Bleed Ports

Air bleeds can be provided at either or both ends of the cylinder. Air bleeds should be located at the highest point in the cylinder for maximum effectiveness. The location needs to be specified, similar to port locations. Plugged from factory.

Example: ABP=15



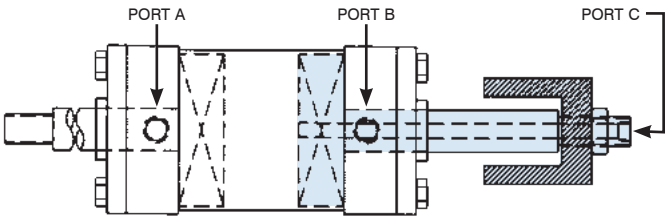
Location 9 is center of cap face.



AS3POS Adjustable Mid Stroke (3-Position)

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.

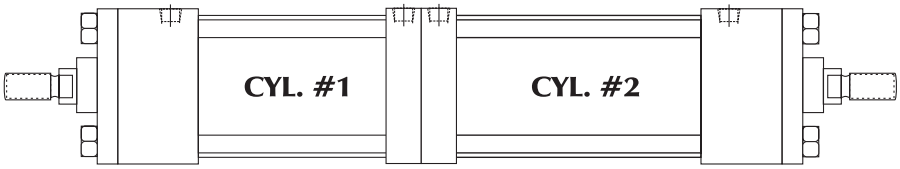
Example: AS3POS=4″



BTB Back-To-Back Cylinders

Back-to-Back cylinders consist of two individual cylinders built as one unit. These cylinders can act as a four position cylinder.

Contact TRD for more information.

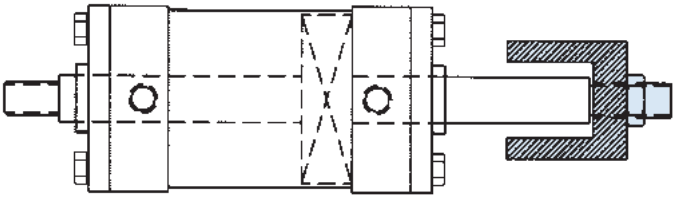


DAS Double Rod Adjustable Stroke (Extend)

Consists of a double rod end cylinder and an adjustable stop collar. Used to adjust the extend cylinder stroke.

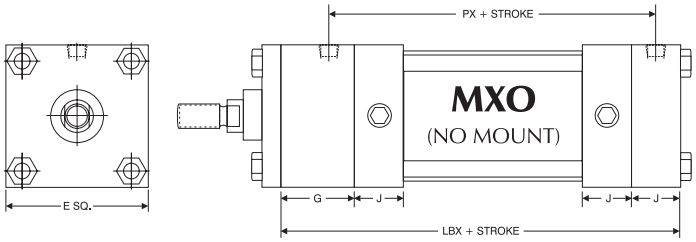
Example: DAS=4″

Contact TRD with your specifications.

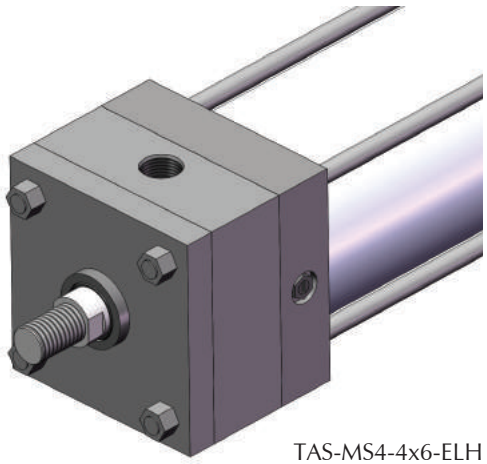


ELH ELC Extra-Long Head Cushions (ELH) and Extra-Long Cap Cushions (ELC)

ELH and ELC add length to the cylinder. Refer to the chart below for dimensions.



DIMENSIONS "MX0' STANDARD & OVERSIZE RODS					
BORE	E	G	J	LBX	PX
1.50	2.000	1.500	1.000	5.625	4.375
2.00	2.500	1.500	1.000	5.625	4.375
2.50	3.000	1.500	1.000	5.750	4.500
3.25	3.750	1.750	1.250	6.750	5.250
4.00	4.500	1.750	1.250	6.750	5.250
5.00	5.500	1.750	1.250	7.000	5.500
6.00	6.500	2.000	1.500	8.000	6.250
8.00	8.500	2.000	1.500	8.125	6.375


TAS-MS4-4x6-ELH

SERIES 'TAS' UNCOMMON OPTIONS

EN *Electroless Nickel*

Electroless Nickel (EN) plating is often used within aircraft landing gear, automotive brake cylinder and components, fuel injector parts, gas turbine parts, spray nozzles for chemical applications and many electronic devises including hard drives.

The properties of EN contribute to the multitude of uses. The coating provides an attractive finish while exhibiting high abrasion and corrosion resistance. Its 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 EN plating as a base to braze broken blades.

EN CYLINDER SPECIFICATIONS:

EN PLATED PARTS:

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

OTHER COMPONENTS:

300 Series Stainless Steel: Tube, 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 EN plating available)

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

HARDNESS: Rc 46-48

THICKNESS: .0005"-.0007"

LUBRICITY: Excellent (Similar to chrome)

COEFFICIENT OF FRICTION: Low

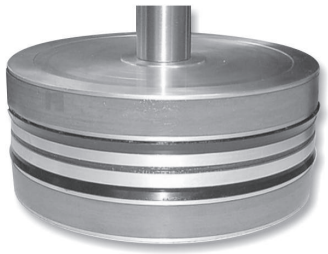
FINISH: Bright and very smooth

PART NUMBER EXAMPLE: TAS - MS4 - 2 x 10 - EN

EXTRA WIDE MULTIPLE WEAR BANDS

TRD can provide special wear band designs for higher side load applications. Piston widths can be increased to accommodate wider wear bands or multiple wear bands for increased performance. Note: Special wear band widths will increase the overall cylinder length.

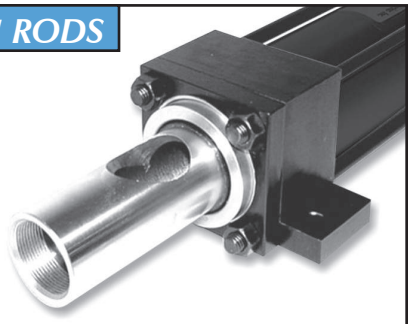
8" Piston with two 1" wide wear bands shown.
(Special piston thickness shown; adds length to cylinder)



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.

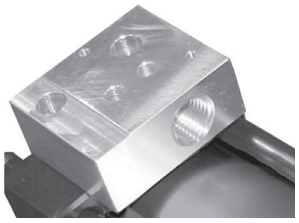


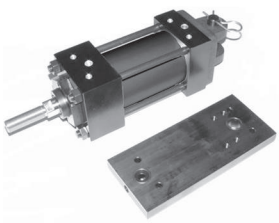
Contact TRD for rod column strength limitations and more information.

MANIFOLD BLOCK OR PLATE

For OEM's, TRD can design and provide custom made manifolds in high quantity.

Contact TRD with your specifications.



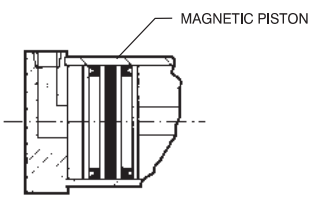


MPR MPH *Magnetic Piston*

Magnetic Pistons (MPR) are used in conjunction with TRD R10, R10P, RHT, RAC Reed and MSS Solid State Switches.

Magnetic Pistons (MPH) are used with TRD old style HE011, HE03SK and HE04SC Hall Effect Switches **Only**.

Note: Must be used with Aluminum (TMA) or Stainless Steel (TMSS) tube material.



PAINT & OTHER SPECIAL FINISHES

Standard Finish: Black Urethane Paint (indoor/outdoor use)

Optional Paint: Black Epoxy Paint (indoor use only)

Additional Paint Choices: TRD can provide paint in any color or type.

Additional Finishes: TRD can provide special finishes, i.e., Nutride Plate

Heavy Chrome Plated Piston Rods.

Contact TRD with your specifications for a quote.

SERIES 'TAS' UNCOMMON OPTIONS

ROD BOOTS

Rod Boots are common in dirty environments, which is a standard specification for many applications.

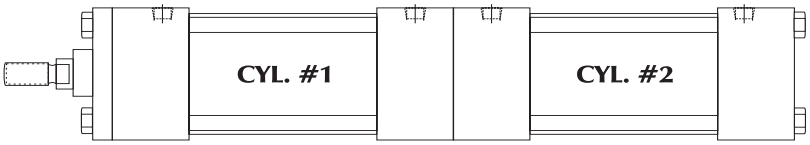
Note: Rod boots add length to cylinder rod extension; contact TRD for specifications.

TM Tandem Cylinders

You can tandem two different cylinders together to create unlimited design possibilities.

Note: Piston rods are connected.

Contact TRD for more information.



3P Three-Position Cylinder

You can create a Three-Position (3P) cylinder from two of the same bore size cylinders.

3P cylinders consist of multiple cylinders built as one unit having one exposed working rod end, capable of delivering three rod positions.

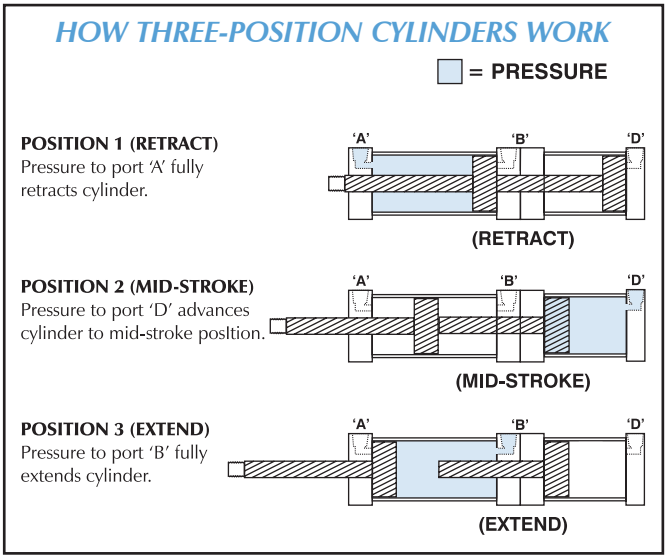
THREE-POSITION BENEFITS:

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

Note: Piston rods are not connected.

Contact TRD for more information.

HOW THREE-POSITION CYLINDERS WORK



TMA TMSS Tube Materials - Aluminum & Stainless Steel

Since TRD uses the exact same design for our basic TA, FM, TD, SS and TAS Series, cylinder component materials can be easily substituted from series to series. The TMA and TMSS options can be ordered on any series for increased corrosion resistance or to be used with our magnetic piston options (MPR/MPH).

Stainless steel cylinder tubes have the same wall thickness as the aluminum tubes in TRD's standard product lines. The stainless steel tubing I.D. is stainless steel (not hard chrome plated) and is honed to close tolerances. The aluminum tubing I.D. is hard coated for wear resistance and extended cycle life.

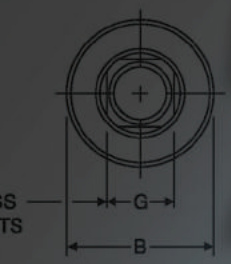
rge thread sizes can be "pinned" in tough duty applications, eliminating unwanted loosening of upler from rod. Always use the smallest pin possible to avoid weakening the piston rod thread.

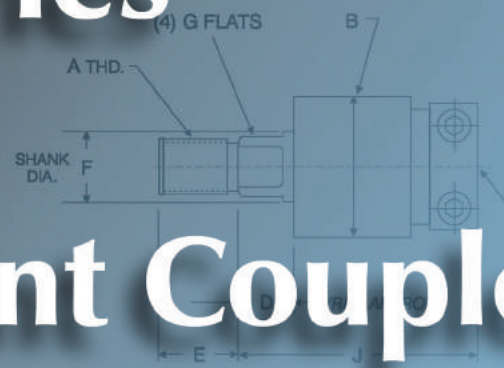
ACH Coupler
ACH250 - ACH12

ACH SERIES

Accessories
Mounts
Alignment Couplers

AC SERIES





ALIGNMENT COUPLER DIMENSIONS

NO.	A	B	C	D	E	F	G	H	H HEX	J	MAX PULL AT YIELD
750	3/4 -16	1.750	2.313	0.438	1.125	0.968	0.813	1.125	1.750	2.500	34,000
875	7/8 -14	1.750	2.313	0.438	1.125	0.968	0.813	1.125	1.750	2.500	39,000
2000	2 -12	3.750	5.625	1.000	3.000	2.468	2.125	2.750	—	—	195,000
2250	2 1/4 -12	4.500	6.375	1.000	3.500	2.968	2.625	3.375	—	—	240,000

horizontal applications

BORE	MAXIMUM STRO
1.50	27
2.00	43
2.50	50
3.25	50

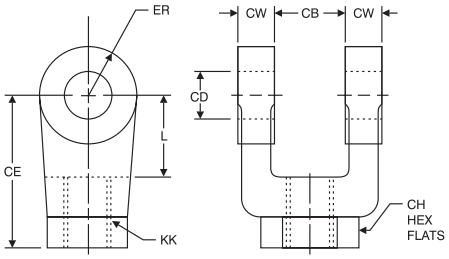
95% OF OUR CYLINDERS SHIP IN 2-3 DAYS!
ONE DAY RUSH SERVICE AVAILABLE ON ALL CATALOGED CYLINDER MODELS!

ACCESSORIES: CLEVIS, PINS & MOUNTS

ROD CLEVIS

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE

PART NO.	MAX LOAD IN LBS (TENSION)	CB	CD (DIA.)	CE	CH	CW	ER (RADIUS)	KK	L
RC437	5667	0.750	0.500	1.500	1.000	0.500	0.500	7/16 - 20	0.750
RC500	6533	0.750	0.500	1.500	1.000	0.500	0.500	1/2 - 20	0.750
RC750	14933	1.250	0.750	2.375	1.250	0.625	0.750	3/4 - 16	1.250
RC1000	26000	1.500	1.000	3.125	1.500	0.750	1.000	1 - 14	1.500
RC1250	44667	2.000	1.375	4.125	2.000	1.000	1.375	1 1/4 - 12	2.125
RC1375	44667	2.000	1.375	4.125	2.000	1.000	1.375	1 3/8 - 12	2.125
RC1500	60800	2.500	1.750	4.500	2.375	1.250	1.750	1 1/2 - 12	2.250
RC1750	60800	2.500	1.750	4.500	2.375	1.250	1.750	1 3/4 - 12	2.250
RC1875	87467	2.500	2.000	5.500	3.000	1.250	2.000	1 7/8 - 12	2.500
RC2250	130933	3.031	2.500	6.500	3.500	1.500	2.500	2 1/4 - 12	3.000
RC2500	130933	3.031	3.000	6.750	3.875	1.500	2.750	2 1/2 - 12	3.250
RC3250	208933	4.031	3.500	8.500	5.000	2.000	3.500	3 1/4 - 12	4.000
RC4000	294933	4.531	4.000	10.000	6.125	2.250	4.000	4 - 12	4.500



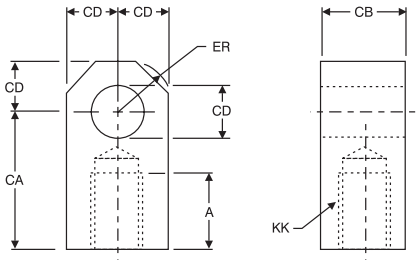
(Clevis Pins sold separately from Rod Clevises)

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

MATERIAL: 1018 CRS
FINISH: BLACK OXIDE

PART NO.	MAX LOAD IN LBS (TENSION)	A	CA	CB	CD (DIA.)	ER (RADIUS)	KK
RE437	6667	0.750	1.500	0.750	0.500	0.625	7/16 - 20
RE500	7600	0.750	1.500	0.750	0.500	0.625	1/2 - 20
RE750	16133	1.125	2.063	1.250	0.750	0.875	3/4 - 16
RE875	16133	1.125	2.063	1.250	0.750	0.875	7/8-14
RE1000	28933	1.625	2.813	1.500	1.000	1.187	1 - 14
RE1250	44667	2.000	3.438	2.000	1.375	1.563	1 1/4 - 12
RE1500	60000	2.250	4.000	2.500	1.750	2.000	1 1/2 - 12
RE1875	71333	3.000	5.000	2.500	2.000	2.500	1 7/8 - 12
RE2250	131600	3.500	5.812	3.000	2.500	2.813	2 1/4 - 12
RE2500	146667	3.500	6.125	3.000	3.000	3.250	2 1/2 - 12
RE3250	215067	4.500	7.625	4.000	3.500	3.875	3 1/4 - 12
RE3500	289733	5.000	7.625	4.000	3.500	3.875	3 1/2 - 12
RE4000	365067	5.500	9.125	4.500	4.000	4.438	4 - 12



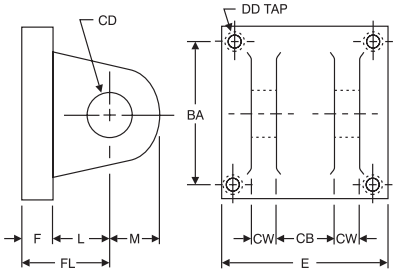
(Clevis Pins sold separately from Rod Eyes)

Note: When using a rod eye in combination with a clevis bracket, the operating angle is +/-90° from the bracket center line.

CLEVIS BRACKET

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE

PART NO.	MAX LOAD IN LBS (TENSION)	BA	CB	CD (DIA.)	CW	DD	E	F	FL	L	M
CB500	9733	1.625	0.750	0.500	0.500	3/8 - 24	2.500	0.375	1.125	0.750	0.500
CB750	18667	2.563	1.250	0.750	0.625	1/2 - 20	3.500	0.625	1.875	1.250	0.750
CB1000	25600	3.250	1.500	1.000	0.750	5/8 - 18	4.500	0.750	2.250	1.500	1.000
CB1375	49200	3.813	2.000	1.375	1.000	5/8 - 18	5.000	0.875	3.000	2.125	1.375
CB1750	45333	4.938	2.500	1.750	1.250	7/8 - 14	6.500	0.875	3.125	2.250	1.750
CB2000	44000	5.750	2.500	2.000	1.250	1 - 14	7.500	1.000	3.500	2.500	2.000
CB2500	46533	6.594	3.000	2.500	1.500	1 1/8 - 12	8.500	1.000	4.000	3.000	2.500
CB3000	45067	7.500	3.000	3.000	1.500	1 1/4 - 12	9.500	1.000	4.250	3.250	2.750
CB3500	111333	9.625	4.000	3.500	2.000	1 3/4 - 12	12.625	1.688	5.688	4.000	3.500
CB4000	136800	11.500	4.500	4.000	2.250	2 - 12	14.875	1.840	6.440	4.500	4.000

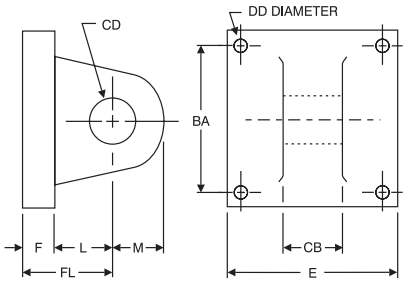


(Clevis Pins sold separately from Clevis Brackets)

EYE BRACKET

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE

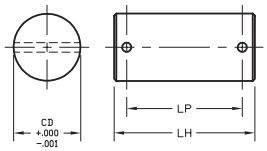
PART NO.	MAX LOAD IN LBS (TENSION)	BA	CB	CD (DIA.)	DD	E	F	FL	L	M
EB500	5467	1.625	0.750	0.500	0.406	2.500	0.375	1.125	0.750	0.500
EB750	14000	2.563	1.250	0.750	0.531	3.500	0.625	1.875	1.250	0.750
EB1000	27200	3.250	1.500	1.000	0.656	4.500	0.750	2.250	1.500	1.000
EB1375	28267	3.813	2.000	1.375	0.656	5.000	0.875	3.000	2.125	1.375
EB1750	65973	4.938	2.500	1.750	0.906	6.500	0.875	3.125	2.250	1.750
EB2000	93333	5.750	2.500	2.000	1.063	7.500	1.000	3.500	2.500	2.000
EB2500	125600	6.594	3.000	2.500	1.188	8.500	1.000	4.000	3.000	2.500
EB3000	162533	7.500	3.000	3.000	1.313	9.500	1.000	4.250	3.250	2.750
EB3500	76533	9.625	4.000	3.500	1.813	12.625	1.688	5.688	4.000	3.500
EB4000	100000	11.500	4.500	4.000	2.063	14.875	1.938	6.440	4.500	4.000



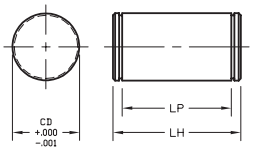
(Clevis Pins sold separately from Eye Brackets)

ACCESSORIES: CLEVIS, PINS & MOUNTS

PIVOT PIN
(INCLUDES COTTER PINS)

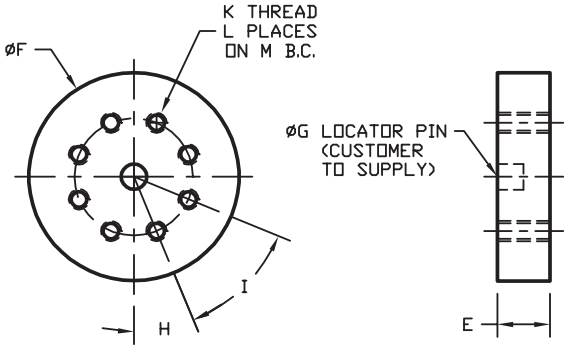


PIVOT PIN
(INCLUDES E-CLIPS)



PIVOT PIN (INCLUDES COTTER PINS)					PIVOT PIN (INCLUDES E-CLIPS)				
PART NO.	MAX LOAD IN LBS (TENSION)	CD	LP	LH	PART NO.	MAX LOAD IN LBS (TENSION)	CD	LP	LH
CP500C	5800	0.500	1.97	2.33	CP500E	5800	0.500	1.88	2.13
CP750C	13250	0.750	2.75	3.15	CP750E	13250	0.750	2.63	2.88
CP1000C	23500	1.000	3.25	3.60	CP1000E	23500	1.000	3.13	3.38
CP1375C	44500	1.375	4.28	4.63	CP1375E	44500	1.375	4.13	4.50
CP1750C	72000	1.750	5.53	6.09	CP1750E	72000	1.750	5.19	5.55
CP2000C	94000	2.000	5.53	6.09	CP2000E	94000	2.000	5.19	5.55
CP2500C	145000	2.500	6.31	6.78	CP2500E	145000	2.500	6.19	6.63
CP3000C	210000	3.000	6.35	6.84	CP3000E	210000	3.000	6.25	6.78
CP3500C	285000	3.500	8.41	8.97	CP3500E	285000	3.500	8.13	8.85
CP4000C	375000	4.000	9.41	9.97	CP4000E	375000	4.000	9.19	9.86

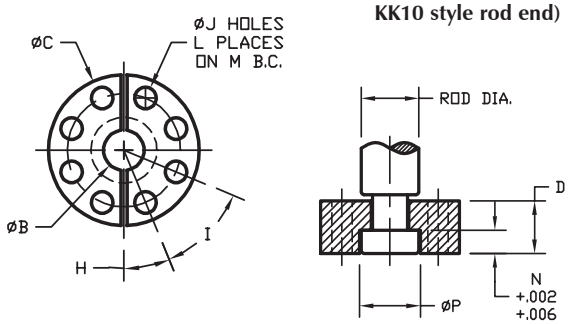
WELD PLATE



WELD PLATE DIMENSIONS									
PART NO.	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 - 24	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

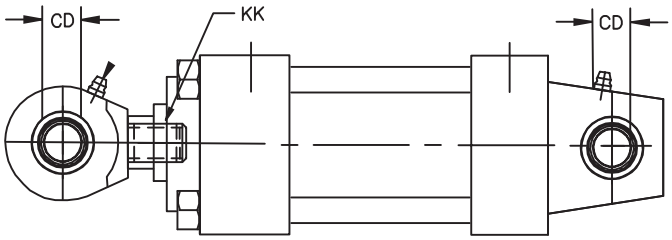
FLANGE END COUPLER

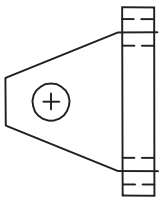
(To be used with KK10 style rod end)



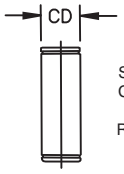
FLANGE END COUPLER DIMENSIONS											
PART NO.	ROD DIA.	B	C	D	H	I	J	L	M	N	P
FEC625	0.625	0.406	1.500	0.563	45.0°	90.0°	0.219	4	1.125	0.250	0.656
FEC1000	1.000	0.750	2.000	0.875	30.0°	60.0°	0.281	6	1.500	0.375	1.063
FEC1375	1.375	0.938	2.500	1.000	30.0°	60.0°	0.344	6	2.000	0.375	1.438
FEC1750	1.750	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

ACCESSORIES: 'HH' & 'MH' SERIES SPHERICAL BEARING





Spherical Brg.
Clevis Bracket



Spherical Brg.
Clevis Bracket
Pivot Pin &
Retaining Ring

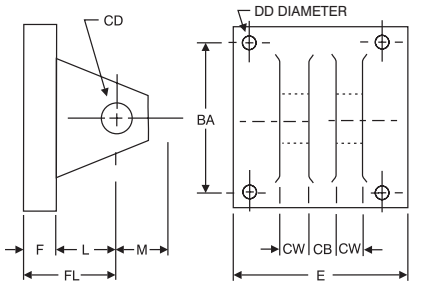
BORE	ROD DIAMETER (MM)	KK	CD	SPHERICAL BEARING ROD EYE PART NUMBER	SPHERICAL BEARING CLEVIS BRACKET PART NUMBER	SPHERICAL BEARING CLEVIS BRACKET PIVOT PIN PART NUMBER	SPHERICAL BEARING PIVOT PIN RETAINING RING PART NUMBER
1.50	0.625 1.000	7/16 - 20	0.500	HH-MSRE-500	CB500-SB	CP500-SB	SH-50 STPA
2.00	1.000 1.375	3/4 - 16	0.750	HH-MSRE-750	CB750-SB	CP750-SB	SH-75 STPA
2.50	1.000 1.375 1.750	3/4 - 16	0.750	HH-MSRE-750	CD750-SB	CP750-SB	SH-75 STPA
3.25	1.375 1.750 2.000	1- 14	1.000	HH-MSRE-1000	CB1000-SB	CP1000-SB	SH-100 STPA
4.00	1.750 2.000 2.500	1 1/4 - 12	1.375	HH-MSRE-1375	CB1375-SB	CP1375-SB	SH-137 STPA
5.00	2.000 2.500 3.000 3.500	1 1/2 - 12	1.750	HH-MSRE-1750	CB1750-SB	CP1750-SB	SH-175 STPA
6.00	2.500 3.000 3.500 4.000	1 7/8 - 12	2.000	HH-MSRE-2000	CB2000-SB	CP2000-SB	SH-200 STPA

SPHERICAL BEARING CLEVIS BRACKET DIMENSIONS

PART NO.	MAX LOAD IN LBS (TENSION)	BA	CB	CD (DIA.)	CW	DD (DIA.)	E	F	FL	L	M
CB500-SB	5770	2.050	0.440	0.500	0.500	0.410	3.000	0.500	1.500	1.000	0.500
CB750-SB	9450	2.760	0.660	0.750	0.620	0.530	3.750	0.625	2.000	1.375	0.875
CB1000-SB	14300	4.100	0.880	1.000	0.750	0.530	5.500	0.750	2.500	1.750	1.000
CB1375-SB	20300	4.950	1.190	1.375	1.000	0.660	6.500	0.875	3.500	2.625	1.380
CB1750-SB	37800	6.580	1.530	1.750	1.250	0.910	8.500	1.250	4.500	3.250	1.750
CB2000-SB	50375	7.920	1.750	2.000	1.500	0.910	10.620	1.500	5.000	3.500	2.000

CLEVIS BRACKET

MATERIAL: CAST STEEL
FINISH: BLACK OXIDE

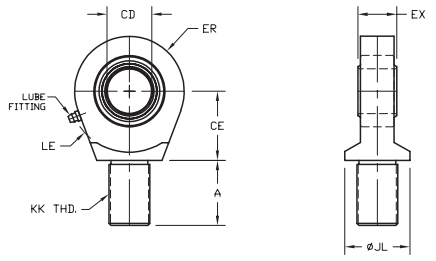


Clevis Pins sold separately from Clevis Brackets)

MALE SPHERICAL ROD EYE DIMENSIONS

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

MALE SPHERICAL ROD EYE



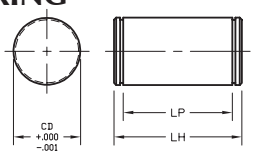
PIVOT PIN (INCLUDES E-CLIPS)

PART NO.	MAX LOAD IN LBS (TENSION)	CD	LP	LH
CP500-SB	8600	0.499	1.56	1.78
CP750-SB	19300	0.749	2.03	2.28
CP1000-SB	34300	0.999	2.50	2.75

PIVOT PIN (INCLUDES E-CLIPS)

PART NO.	MAX LOAD IN LBS (TENSION)	CD	LP	LH
CP1375-SB	65000	1.374	3.31	3.61
CP1750-SB	105200	1.749	4.22	4.58
CP2000-SB	137400	1.999	4.94	5.30

SPHERICAL BEARING PIVOT PIN *(INCLUDES E-CLIPS)*



ACCESSORIES: ALIGNMENT COUPLERS

Solid Steel Self-Aligning Piston Rod Couplers

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

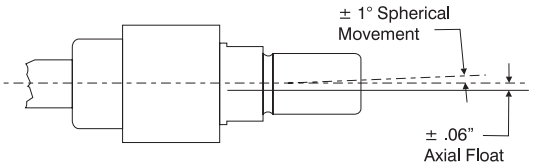
Standard AC Coupler
AC250 - AC5000

ACH Coupler
ACH250 - ACH1250

Benefits

- Rod alignment couplers eliminate expensive machining for mounting fixed or rigid cylinders on guided or slide applications.
- Simplifies alignment problems in the field.

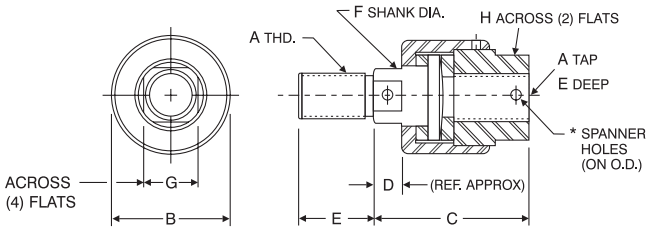
MATERIAL: 100,000 MIN. YIELD *STRESS-PROOF™*



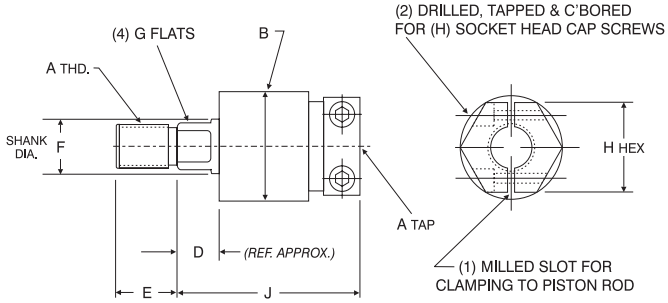
Design Tips

- Alignment couplers can be exposed to high stresses that are not apparent in an application. Always use the largest thread size practical in your application (see chart for maximum pull yields).
- Use jam nut to lock coupler to rod when used with full diameter threads (example: 1.00″ thread on 1.00″ rod).
- Large thread sizes can be pinned in tough duty applications, eliminating unwanted loosening of coupler from rod. Always use the smallest pin possible to avoid weakening the piston rod thread.

AC SERIES



ACH SERIES

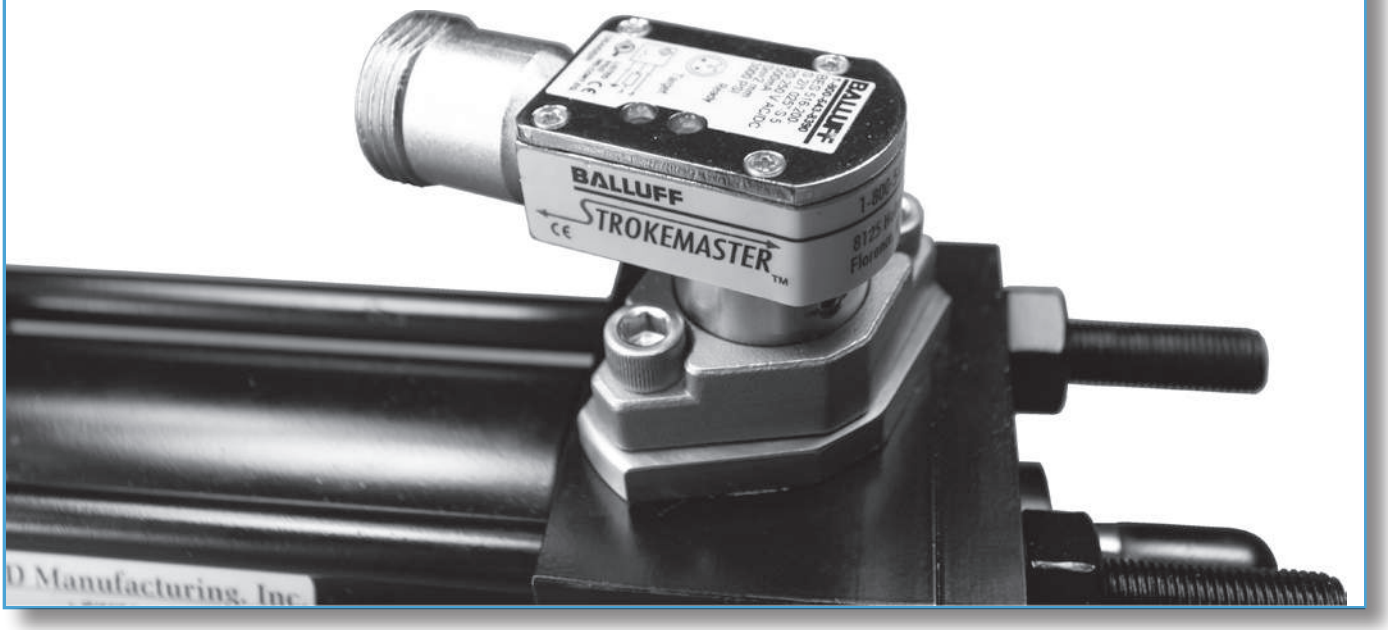


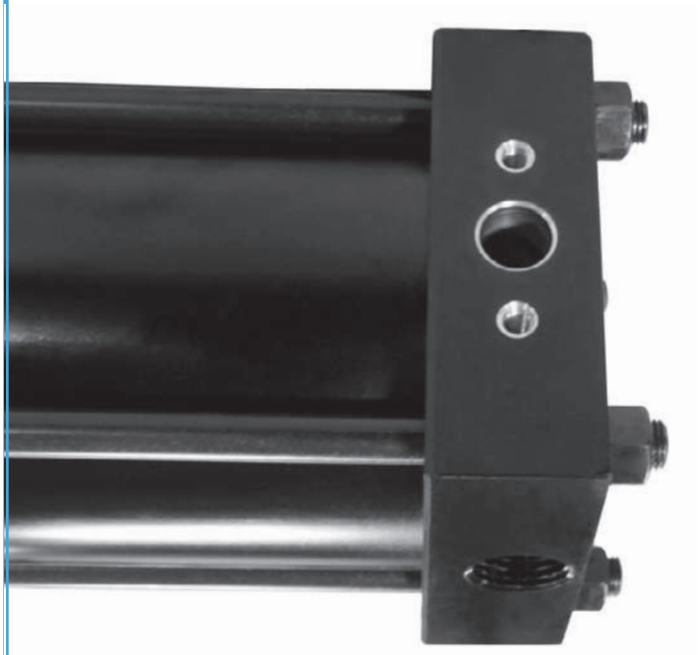
ALIGNMENT COUPLER DIMENSIONS											
PART NO.	A	B	C	D	E	F	G	H	H HEX	J	MAX PULL POUNDS (3:1 SAFETY FACTOR)
AC250	1/4 -28	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	886
AC312	5/16 -24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	1,623
AC375	3/8 -24	1.125	1.750	0.375	0.500	0.500	0.375	0.688	1.250	2.000	2,532
AC437	7/16 -20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.250	2.156	3,526
AC500	1/2 -20	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.125	2.156	4,841
AC625	5/8 -18	1.250	2.000	0.438	0.750	0.625	0.500	0.813	1.250	2.156	7,862
AC750	3/4 -16	1.750	2.313	0.438	1.125	0.968	0.813	1.125	1.750	2.500	11,543
AC875	7/8 -14	1.750	2.313	0.438	1.125	0.968	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	1.968	1.750	2.375	—	—	49,857
AC1750	1 3/4-12	3.250	4.375	0.875	2.250	1.968	1.750	2.375	—	—	69,558
AC1875	1 7/8-12	3.750	5.625	1.000	3.000	2.468	2.125	2.750	—	—	79,354
AC2000	2-12	3.750	5.625	1.000	3.000	2.468	2.125	2.750	—	—	92,531
AC2250	2 1/4-12	4.500	6.375	1.000	3.500	2.968	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

Notes: Please specify AC or ACH coupler when ordering: i.e.: AC750 (Std. Coupler) or ACH750 (Hex Coupler).
Spanner holes are used on AC2500 and larger, (2) 1/2″ dia. holes, 1/2″ deep, 180° apart (each end).

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

TRD stocks Strokemaster®® sensors for quick delivery. The correct combination of sensor and spacer will be provided for proper operation.





TRD can also machine cylinders to accept other types of end of stroke sensing switches or ready for Strokemaster®® sensors.

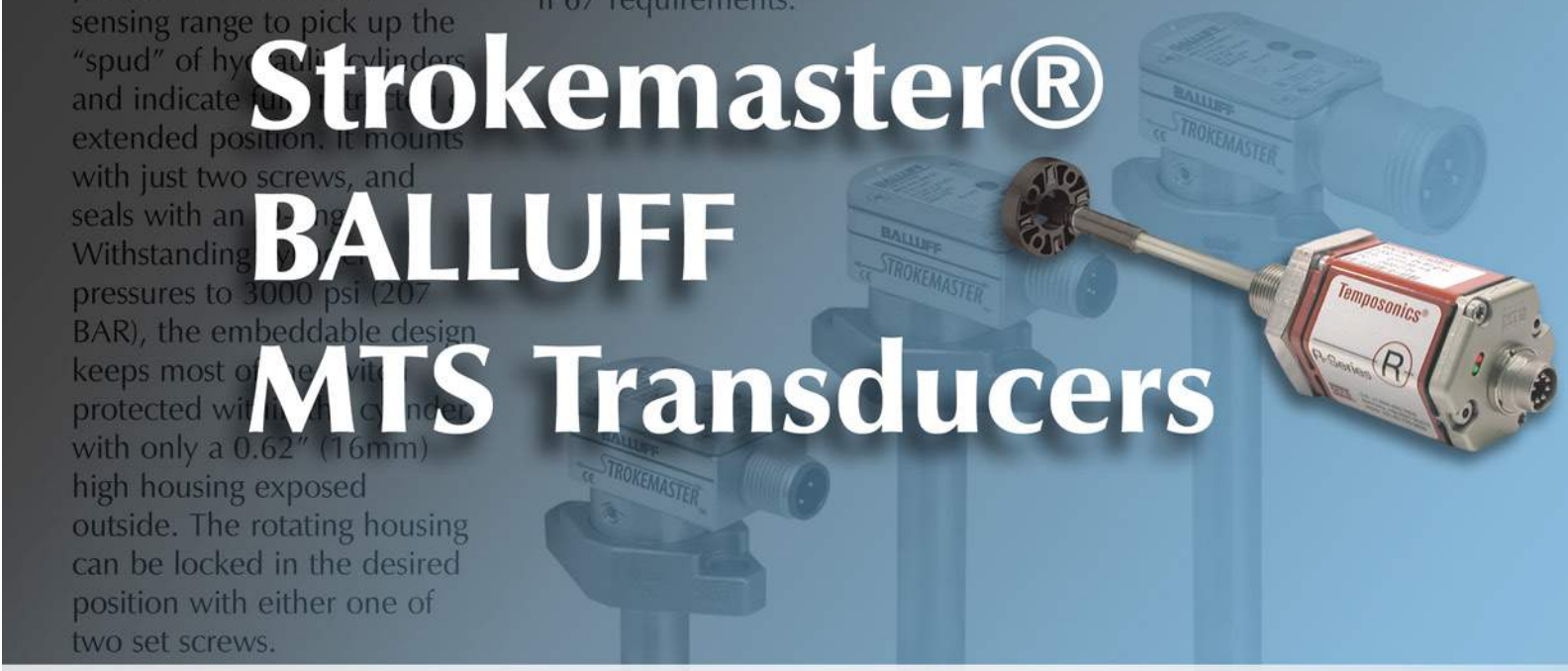
TRD's extensive inventory allows customers to specify the ports you want, where you want them, made-to-order strokes and customize your rod end.

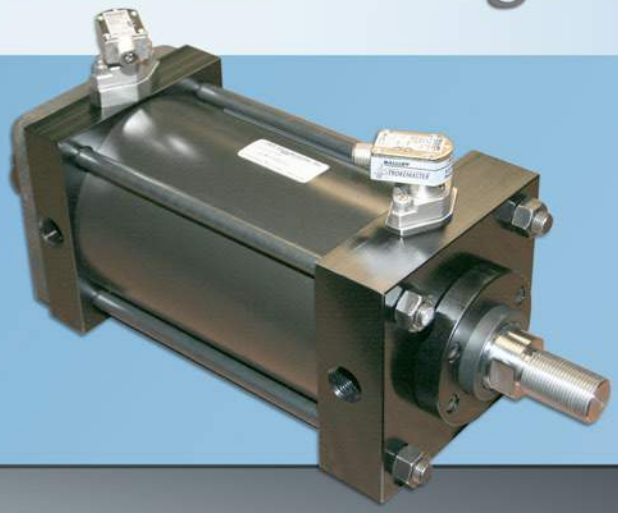
Most catalog options ship in 2-3 days!

Strokemaster® sensor provides a 2mm (0.8") sensing range to pick up the "spud" of hydraulic cylinders and indicate full stroke extended position. It mounts with just two screws, and seals with an O-ring. Withstanding 0-3000 psi pressures to 3000 psi (207 BAR), the embeddable design keeps most of the unit protected within the cylinder with only a 0.62" (16mm) high housing exposed outside. The rotating housing can be locked in the desired position with either one of two set screws.

Strokemaster® is CE-certified, and its housing is sealed to IP67 requirements.

Strokemaster® BALLUFF MTS Transducers





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

BALLUFF INDUCTIVE SENSORS

BALLUFF STROKEMASTER™ Inductive Sensors

Flexible Solutions for an Often Inflexible World

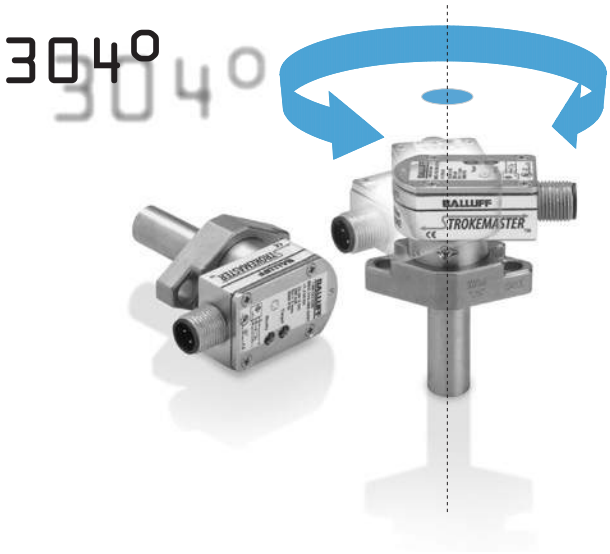
Balluff's Strokemaster® cylinder-piston sensors provide precision end-of-stroke sensing for hydraulic cylinders. It also eliminates post-installation cable management problems with 304° of rotational freedom on the connector.

Strokemaster® sensors allow infinitely adjustable and lockable cable positioning anytime after mounting to the cylinder. Without breaking the seal, Strokemaster® enables quicker installation of the sensor *and* neat cable runs.

A high-pressure, inductive proximity switch, the Strokemaster® sensor provides a 2mm (0.8") sensing range to pick up the spud of hydraulic cylinders and indicate fully retracted or extended position. It mounts with just two screws, and seals with an O-ring. Withstanding cylinder pressures to 3000 PSI (207 Bar), the embeddable design keeps most of the switch protected within the cylinder, with only a 0.62" (16mm) high housing exposed outside. The rotating housing can be locked in the desired position with either one of two set screws.

Strokemaster® sensors are available in 3-wire or 4-wire DC and 3-wire AC/DC versions, mini or micro connectors. Switching frequency is 50 Hz in the AC/DC versions. All units are weld-field immune and short-circuit and reverse polarity protected. They fit all popular cylinder designs, with standard probe lengths of 0.912" - 4.560" (23.165mm - 115.8mm), along with available custom probe lengths and spacers. Probes are made of stainless steel with a ceramic face. Both DC and AC/DC sensors have all metal housings.

Strokemaster® is CE-certified, and its housing is sealed to IP67 requirements.



BALLUFF INDUCTION SENSORS

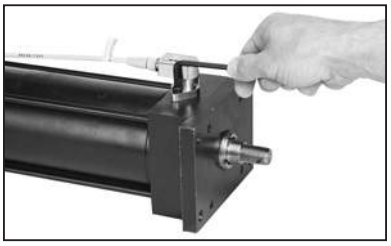
DC INDUCTIVE SENSORS

BALLUFF STROKEMASTER™

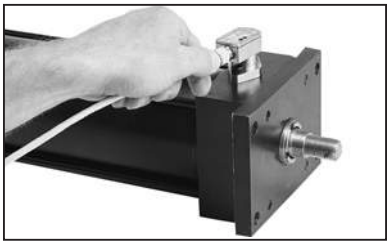
Features/Advantages

Inductive cylinder switch for piston position feedback in cylinders.

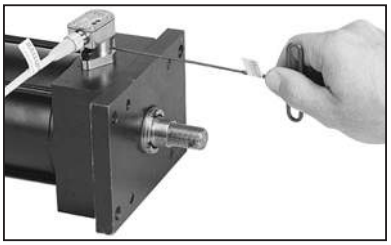
- Magnetic field immune, for use with welding equipment
- Available in DC or all current (AC/DC) versions
- Easy installation - sensor mounts to cylinder with two fasteners
- Sealed directly at flange, connector can be oriented after installation
- Various lengths available for different cylinder sizes



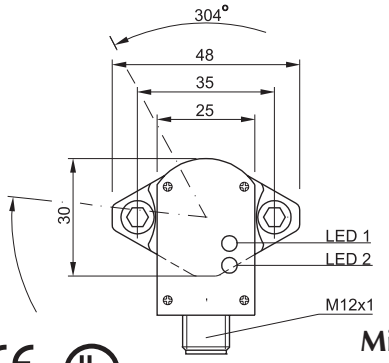
Bolt sensor to cylinder.

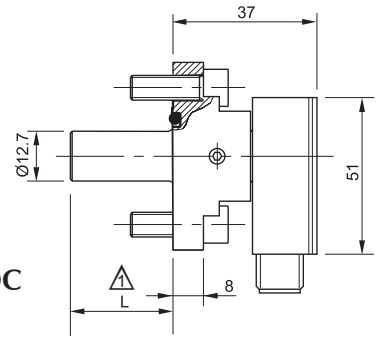


Position cable to desired orientation (even over mounting bolts).



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



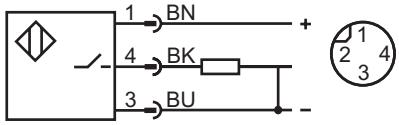


CE cULus

Micro M12DC Connector

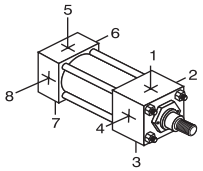
PNP Normally-open	BES 516-300-S 295-S 4
Rated operational voltage U_e	24 VDC
Supply voltage U_B	10-30 VDC
Voltage drop U_d at I_e	≤ 2.5 V
Rated insulation voltage U_i	75 VDC
Rated operational current I_e	200 mA
No-load supply current I_v d./und.	≤ 18 mA/≤ 10 mA
Off-state current I_r	≤ 80 µA
Protected against polarity reversal	Yes
Short circuit/overload protected	Yes/Yes
Load capacitance	≤ 1.0 µF
Repeat accuracy R	≤ 5 %
Ambient temperature range T	-25...+70°C
Frequency of operating cycles f	10 Hz
Utilization categories	DC 13
Function/Operating voltage indication	Yes/Yes
Degree of protection per IEC 529	IP 67/connector IP 65
Housing material	Stainless steel/aluminum
Material of sensing face	Ceramic
Connection	Micro connector
Approvals	cULus
High pressure rated up to	207 bar (3000 PSI)
Recommended connector	**C04 AEL-00-VY-050M**

Wiring **PNP Normally Open** Pinout



⚠ TRD will supply the correct length probe and spacer combination (if required) for each cylinder. Using the combination of standard probe lengths & spacers will give the appropriate .030" gap between sensor and cylinder spud. The spacers supplied have the same base profile as the sensor (material: stainless steel).

HOW TO ORDER CYLINDERS WITH BALLUFF SENSORS:



STANDARD LOCATIONS:

- **Ports at 1 and 5**
- **Cushions at 2 and 6**
- **Sensors at 4 and 8**

(Specify non-standard locations)

How To Order:

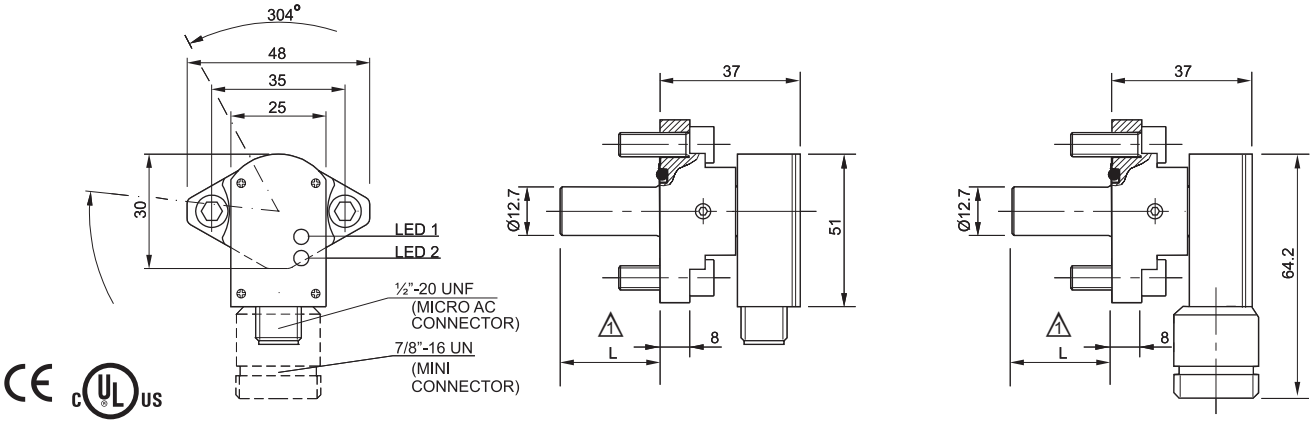
Cylinder Model Number ➡	**HH-MS4-325-100-KK1-N500**
SENSOR MODEL (HEAD) ➡	**-BES 516-300-S 295-S4 (Head)**
SENSOR MODEL (CAP) ➡	**-BES 516-300-S 295-S4 (Cap)**
(Include ALL Sensor positions) ➡	**-Sensors at 4 & 8**

NOTE: TRD will include the Strokemaster® probe length on your order and any sensor spacers required (example: HH-MS4-325-100-KK1-N500- BES 516-300-S4 /1.025-S21 (Head) -BES 516-300-S4 /1.75-S21 (Cap) - Sensors at 4 & 8.

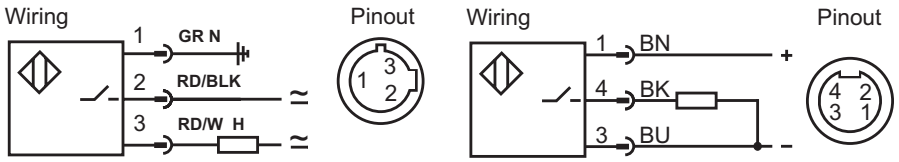
BALLUFF INDUCTION SENSORS

AC/DC INDUCTIVE SENSORS

BALLUFF STROKEMASTER™

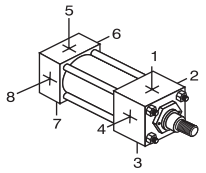


Normally-open	BES 516-200-S 2-S21	BES 516-200-S 2-S5
Rated operational voltage U_e	110 VAC	110 VAC
Supply voltage U_e	20-250 V AC/DC	20-250 V AC/DC
Voltage drop U_d at I_e	≤ 6 V	≤ 6 V
Rated insulation voltage U_i	250 VAC	250 VAC
Rated operational current I_e	500 mA	500 mA
Minimum operational current I_m	5 mA	5 mA
Off-state current I_r	≤ 1.7 mA @ 110 VAC	≤ 1.7 mA @ 110 VAC
Inrush current I_k (t_f = 20 ms)	3 A max./1 Hz	3 A max./1 Hz
Protected against polarity reversal	Yes	Yes
Short circuit protected	Yes	Yes
Repeat accuracy R	≤ 5 %	≤ 5 %
Ambient temperature range T	-25...+70°C	-25...+70°C
Frequency of operating cycles f	≤ 50 Hz	≤ 50 Hz
Utilization categories	AC 140/DC 13	AC 140/DC 13
Function/Operating voltage indication	Yes/Yes	Yes/Yes
Degree of protection per IEC 529	IP 67	IP 67
Insulation class	1	1
Housing material	Stainless steel/aluminum	Stainless steel/aluminum
Material of sensing face	Ceramic	Ceramic
Connection	Micro connector	Mini connector
Approvals	cULus	cULus
High pressure rated up to	207 bar (3000 PSI)	207 bar (3000 PSI)
Recommended connector	**C21 AE3-00-VY-150F**	**C05 AE1-00-VY-150F**



⚠ TRD will supply the correct length probe and spacer combination (if required) for each cylinder. Using the combination of standard probe lengths & spacers will give the appropriate .030" gap between sensor and cylinder spud. The spacers supplied have the same base profile as the sensor (material: stainless steel).

HOW TO ORDER CYLINDERS WITH BALLUFF SENSORS:



STANDARD LOCATIONS:

- **Ports at 1 and 5**
- **Cushions at 2 and 6**
- **Sensors at 4 and 8**

(Specify non-standard locations)

How To Order:

Cylinder Model Number ➡	**HH-MS4-325-100-KK1-N500**
SENSOR MODEL (HEAD) ➡	**-BES 516-200-S 2-S21 (Head)**
SENSOR MODEL (CAP) ➡	**-BES 516-200-S 2-S21 (Cap)**
(Include ALL Sensor positions) ➡	**-Sensors at 4 & 8**

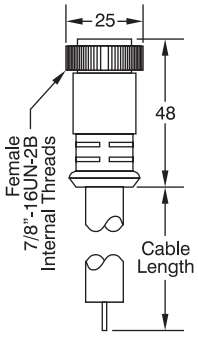
NOTE: TRD will include the Strokemaster® probe length on your order, and any sensor spacers required (example: HH-MS4-325-100-KK1-N500- BES 516-200-S 2 /1.025-S21 (Head) -BES 516-200-S 2 /1.75-S21 (Cap) - Sensors at 4 & 8.

BALLUFF INDUCTION SENSORS
CABLE CONNECTORS

BALLUFF STROKEMASTER™

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

Connector	3-5 Pole Mini
Style	Mini Size A
Configuration	Straight Female
Recommended Connector	**C05 AE1-00-VY-150F**

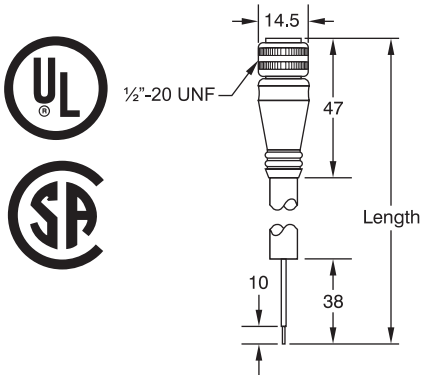


	ORDER NUMBER
3 Pole	C05 AE1 00 * Y 150
Voltage Rating	300 V AC/DC
Current	10 A
Wire Gauge	16 AWG
Jacket	PVC
Coupling Nut	Black Epoxy Coated Zinc
Protection	IP68 / NEMA 6P
Ambient Operating Temp.	-4°F - 221°F (-21°C - 105°C)
UL Listed	Yes
CSA Certified	Yes

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

S21 - Micro Connectors (½"-20 UNF Threads)

Connector	Micro AC 1/2" x 20 UNF
Style	3 Pin Dual Keyway
Configuration	Straight Female
Recommended Connector	**C21 AE3-00-VY-150F**



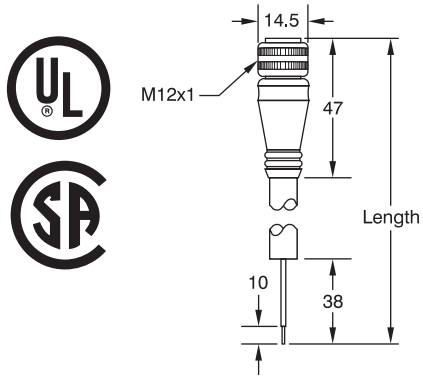
	ORDER NUMBER
Ordering Code	
3 Pin Dual Keyway	C21 AE3 00 * Y 150F
Voltage Rating	250 V AC/DC
Current	4 A
Wire Gauge	22 AWG
Jacket	Yellow PVC or TPE
Coupling Nut	Black Epoxy Coated Zinc
O-Ring	Viton
Overmold Head	TPE
Protection	IP68 / NEMA 6P
Ambient Operating Temp.	-4°F - 221°F (-21°C - 105°C)
UL Listed	Yes
CSA Certified	Yes

NOTE: 15 ft (5 m) cable is standard (other lengths available - consult factory)

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

S4 - Micro Connectors (M12x1 Metric Threads)

Connector	Micro
Style	M12 DC Single Keyway
Configuration	Straight Female
Recommended Connector	**C04 AEL-00-VY-050M**



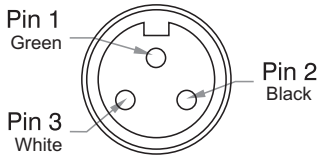
	Note	ORDER NUMBER
3 Wire DC		
3 Wire Normally Open, non-LED	**1,2,3**	C04 AEC 00 * Y 050M
3 Wire Normally Open PNP w/ LED		C04 AEH 00 * Y 050M
4 Wire DC (NO/NC)		
4 Wire (Universal), non-LED	**1,2,3**	C04 AEL 00 * Y 050M
4 Wire PNP w/LED	**1,3**	C04 AEM 00 * Y 050M
Voltage Rating		10 - 30 VDC
Current		4 A
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°F - 221°F (-21°C - 105°C)
UL Listed		Yes
CSA Certified		Yes

NOTE: 15 ft (5 m) cable is standard (other lengths available - consult factory)

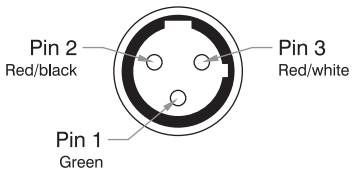
* Insert **V** = PVC Cable
T = TPE Cable
For 3 pole versions only

NOTE: 1 Add **B** = Braided 80% Metallic Braid, i.e. 050 M**B**
2 Add **S** = S-Shielded 360 Degree Shield through Coupling Nut, i.e. 050 M**S**
3 Stainless Steel Couple Nut: Change **E** to **S**, i.e. C04A**S**C00TY050M

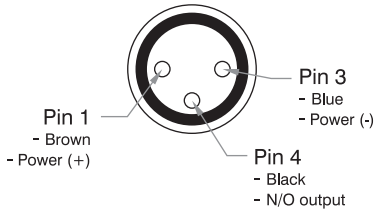
Female 3-pin - Face view



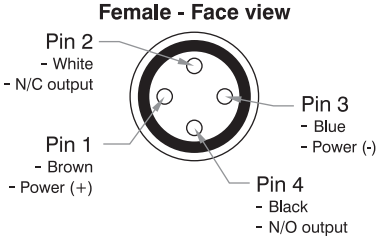
Female - Face view



Female - Face view



Female - Face view



Refer to Balluff Catalog for additional cable connectors.

BALLUFF TRANSDUCERS

BALLUFF

MICROPULSE Linear Position Transducers

Enhanced Magnetostrictive Technology

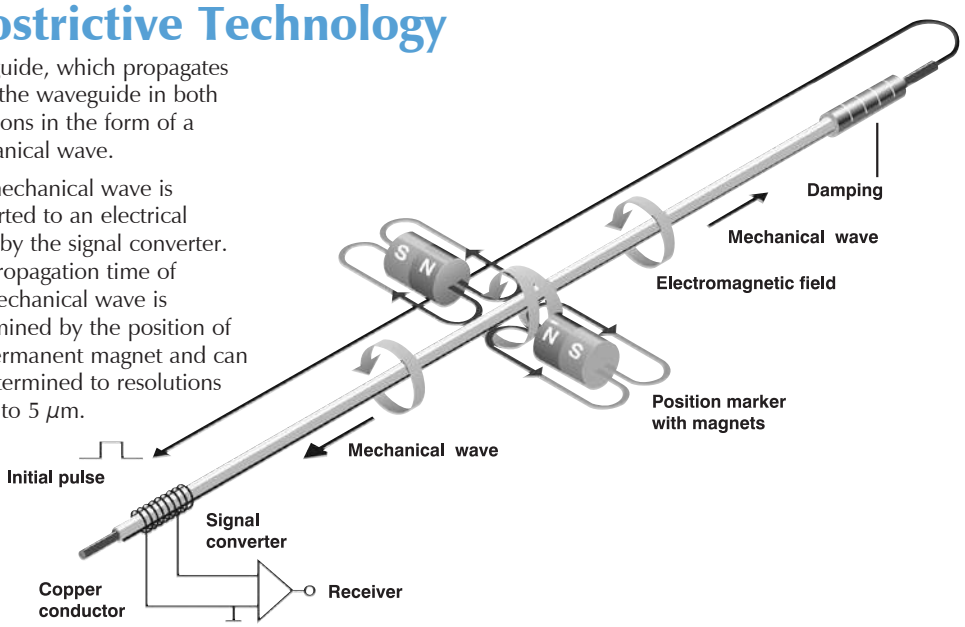
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

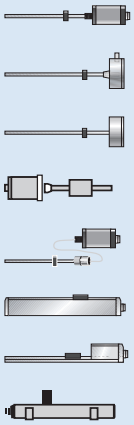
A copper conductor is introduced through the length of this tube. The start of measurement is initiated by a short current pulse. This current generates a circular magnetic field which rotates around the waveguide.

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

In the area on the waveguide where the two fields intersect, a magnetostrictive effect causes an elastic deformation of the waveguide, which propagates along the waveguide in both directions in the form of a mechanical wave.

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





Balluff has the right transducer for any application!

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

Rod Style

Z

- 3/4" x 16 UNF threads
- Pressure rated to 8700 PSI for use in hydraulic cylinders
- Replaceable electronics head
- Analog signal adjustable in field

Rugged, Compact Rod Style

W

- Rugged all stainless steel housing
- Eliminates the need for protective cover
- Designed for demanding applications
- 3/4" - 16 UNF threads
- Pressure rated to 8700 PSI

Compact, Bolt-in Rod Style

K

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

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

*(24 or 25 bit binary or gray code)

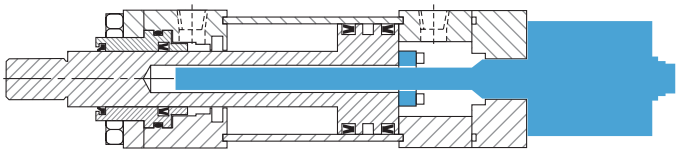
BALLUFF TRANSDUCERS

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

INTERNAL MODELS (BALLUFF Z, W, K SERIES)

- Not available on MP1 and MP2 Mounts. Consult factory for special application.
- 1.50″ to 8.00″ Bores
- May require additional cap length
- Gun-drilled piston rod (Requires 1″ piston rod or larger)
- Balluff Magnet (Installed on piston)

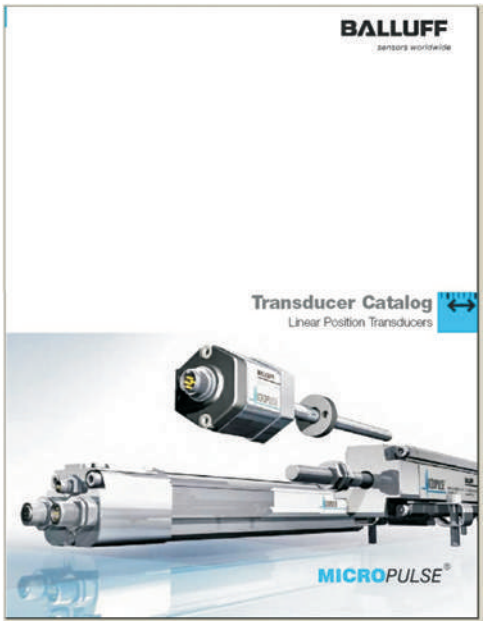
SERIES "Z" SHOWN

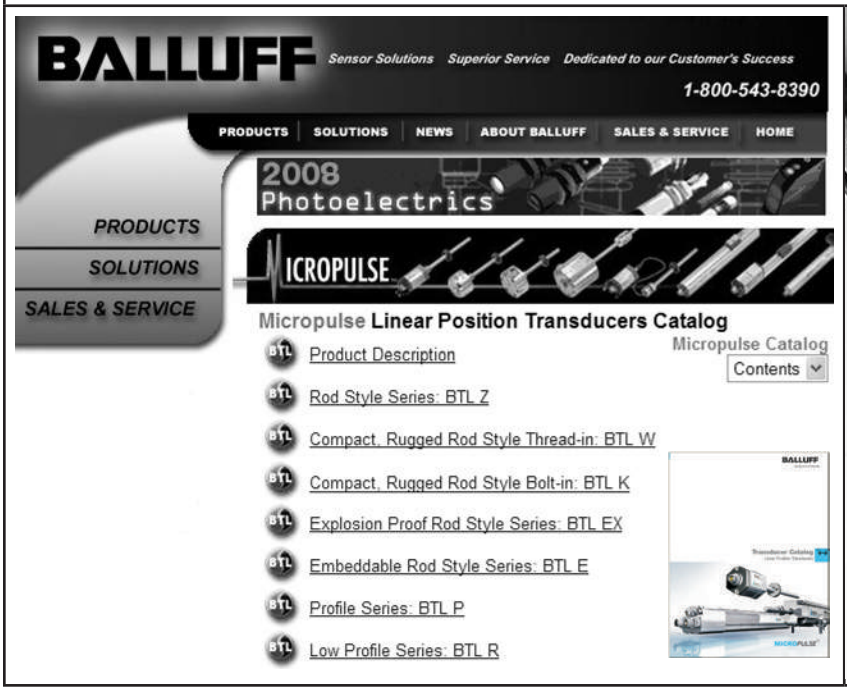


- Complete Balluff MICROPULSE™ Transducer information is available in catalog form or electronic PDF downloads.

  Visit www.balluff.com

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





SERIES "Z" SHOWN

MTS Temposonics® TRANSDUCERS

TRD will provide hydraulic cylinders built to your specifications and can incorporate MTS Temposonics® Transducers in a wide variety of models.

Visit www.mtssensors.com for detailed product information or call TRD for more information.

	R-SERIES A smart sensor for fast, high precision and synchronized position control applications.	G-SERIES Programmable sensors with built in diagnostics.
MTS® SENSORS		
	H STYLE Hydraulic/pneumatic sensor housing with integral electronics	
DIRECT SENSOR OUTPUTS	Voltage 0 to +10V, +10 to 0V -10 to +10V, +10 to -10V (1)	Voltage 0 to +10V, +10 to 0V -10 to +10V, +10 to -10V (1)
	Current 0 or 4 to 20 mA, 20 to 4 or 0 mA	Current 0 or 4 to 20 mA, 20 to 4 or 0 mA
	SSI, Synchronous Serial Interface, (absolute encoder format)	
	Fieldbus - CANbus (2), DeviceNet, Profibus DP	
		Digital Pulse Start/Stop or PWM
STROKE LENGTH	50 to 7,620 mm (2 to 300 in.)	Voltage or Current 50 to 2,540 mm (2 to 100 in.) Digital Pulse 50 to 7,620 mm (2 to 300 in.)
RESOLUTION	16 bit, as low as 0.01 mm (0.0004 in.) (Analog)	Infinite (6)
	as low as 0.002mm (0.00008 in.) (Digital) (5)	Controller Dependent (Digital Pulse)
MEASUREMENT FEATURES	Position / Displacement	Position / Displacement
	Velocity	
	Multiple magnets to 15	Multiple magnets to 15
	Analog Zero and Span Scale Adjustment	Analog Zero and Span Scale Adjustment
EXTERNAL INTERFACES		TDU-200 Digital Display (for digital pulse outputs)
		MK-292 (Parallel 24 Bit Binary, BCD or Gray Code)

Hydraulic/Pneumatic "H Style"

- Sensing element pressure housing threads into standard size port on cylinder end cap.
- Industry standard for position feedback in fluid power cylinders.
- Convenient sensor cartridge field replacement without need to break oil seal.
- High pressure flange and isolation tube (5000 PSI static, 10,000 PSI spike).

(1) Additional output ranges available.

(2) Includes CANOpen and MTS multiple-magnet position, velocity and programmable limit switch output.

(3) R-Series SSI available with 0.001mm (0.00004 in.) resolution.

(4) Analog (Voltage or Current) resolution restricted by output ripple.

Technical Data

MS4 MXO	MX1 MX2 MX3	MF1	MF2	MF5	MF6	MP1	MP2	MS2 MS3 MS7	MT1 MT2	MT4	ME3 ME4	SB	ADD PER INCH OF STROKE
3.9		4.3	4.6	4.6	5.0	4.2	4.8	4.4	4.4	5.8		4.1	0.6
4.7		5.0	5.4	5.4	5.8	5.0	5.6	5.2	5.2	6.6		4.9	0.8
6.4		6.9	7.3	7.4	8.0	6.7	7.3	6.9	7.0	8.7		6.6	1.0
												7.1	1.3
												8.6	1.5

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

'HH' SEAL KITS: HOW TO ORDER

NOTE: To ensure proper seals are supplied for all models, ALWAYS supply TRD serial number.

HH - SK 137 - 250 - S S S S

SEAL KIT SERIES	
HH-SK	HH SERIES SEAL KIT
HH-SKD	DOUBLE ROD

ROD SIZE	
062	0.625" ROD DIA.
100	1.000" ROD DIA.
137	1.375" ROD DIA.
175	1.750" ROD DIA.
200	2.000" ROD DIA.
250	2.500" ROD DIA.
300	3.000" ROD DIA.
350	3.500" ROD DIA.
400	4.000" ROD DIA.
450	4.500" ROD DIA.
500	5.000" ROD DIA.
550	5.500" ROD DIA.

BORE	
150	1.50" BORE
200	2.00" BORE
250	2.50" BORE
325	3.25" BORE
400	4.00" BORE
500	5.00" BORE
600	6.00" BORE
700	7.00" BORE
800	8.00" BORE

PISTON SEAL	
C	CAST-RING
E	EP
S	STANDARD (CARBOXILATED)
T	PTFE
V	FLUOROCARBON

ROD SEAL	
E	EP
S	STANDARD (POLYURETHANE)
V	FLUOROCARBON

TUBE SEAL	
E	EP
S	STANDARD (BUNA)
V	FLUOROCARBON

ROD WIPER*	
M	METALLIC SCRAPPER
S	STANDARD (FLOCKED NITRILE)
T	PTFE
V	FLUOROCARBON

*When cylinder design calls for all EP seals, use PTFE rod wiper.

All seal kits come with proper backup rings when required. To order replacement seal kits, call out the rod size, bore size and the seal selection from the original order.

Examples:
HH-SK175-400-SSSS
HH-SK100-250-VVVT

'MH' SEAL KITS: HOW TO ORDER

NOTE: To ensure proper seals are supplied for all models, ALWAYS supply TRD serial number.

MH - SK 137 - 250 - S S S S

SEAL KIT SERIES	
MH-SK	MH SERIES SEAL KIT
MH-SKD	DOUBLE ROD

ROD SIZE	
062	0.625" ROD DIA.
100	1.000" ROD DIA.
137	1.375" ROD DIA.
175	1.750" ROD DIA.
200	2.000" ROD DIA.
250	2.500" ROD DIA.
300	3.000" ROD DIA.
350	3.500" ROD DIA.
400	4.000" ROD DIA.
450	4.500" ROD DIA.
500	5.000" ROD DIA.
550	5.500" ROD DIA.

BORE	
150	1.50" BORE
200	2.00" BORE
250	2.50" BORE
325	3.25" BORE
400	4.00" BORE
500	5.00" BORE
600	6.00" BORE
800	8.00" BORE

PISTON SEAL	
C	CAST-RING
E	EP
S	STANDARD (CARBOXILATED)
T	PTFE
V	FLUOROCARBON

ROD SEAL	
E	EP
S	STANDARD (POLYURETHANE)
V	FLUOROCARBON

TUBE SEAL	
E	EP
S	STANDARD (BUNA)
V	FLUOROCARBON

ROD WIPER*	
M	METALLIC SCRAPPER
S	STANDARD (FLOCKED NITRILE)
T	PTFE
V	FLUOROCARBON

*When cylinder design calls for all EP seals, use PTFE rod wiper.

All seal kits come with proper backup rings when required. To order replacement seal kits, call out the rod size, bore size and the seal selection from the original order.

Examples:
MH-SK137-400-SSSS
MH-SK100-250-VVVT

'TAS' SEAL KITS: HOW TO ORDER

NOTE: To ensure proper seals are supplied for all models, ALWAYS supply TRD serial number.

SK 137 - 250 - _____ - OTS

STYLE	
(BLANK)	SINGLE ROD
D	DOUBLE ROD

ROD SIZE	
062	0.625" ROD DIA.
100	1.000" ROD DIA.
137	1.375" ROD DIA.
175	1.750" ROD DIA.
200	2.000" ROD DIA.
250	2.500" ROD DIA.
300	3.000" ROD DIA.
350	3.500" ROD DIA.
400	4.000" ROD DIA.
450	4.500" ROD DIA.
500	5.000" ROD DIA.
550	5.500" ROD DIA.

BORE	
150	1.50" BORE
200	2.00" BORE
250	2.50" BORE
325	3.25" BORE
400	4.00" BORE
500	5.00" BORE
600	6.00" BORE
800	8.00" BORE

PISTON SEALS	
	STANDARD CARBOXILATED NITRILE SEALS
BP	BUMPER PISTON SEALS
C	CAP CUSHION SEAL
H	HEAD CUSHION SEAL
LF	LOW FRICTION
MS	METALLIC ROD SCRAPER
NR	NON-ROTATING
TH	400 PSI HYDRAULIC SEALS
VS	FLUOROCARBON SEALS

O-RING TUBE SEAL

All seal kits come with proper backup rings when required. To order replacement seal kits, call out the rod size, bore size and the seal selection from the original order.

Examples:
SK137-400-OTS
SK100-250-HC-OTS

'HH' SERIES HYDRAULIC TECHNICAL DATA

BORE	ROD DIA. (MM)	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI										DISPLACEMENT PER INCH OF STROKE (GALLONS)
			100	150	200	250	500	1000	1500	2000	2500	3000	
1.50	EXTEND	1.77	177	265	353	442	884	1767	2651	3534	4418	5301	.00765
	0.625	1.46	146	219	292	365	730	1460	2191	2921	3651	4381	.00635
	1.000	0.98	98	147	196	245	491	982	1473	1964	2454	2945	.00425
2.00	EXTEND	3.14	314	471	628	785	1571	3142	4712	6283	7854	9425	.0136
	1.000	2.36	236	353	471	589	1178	2356	3534	4712	5891	7069	.0102
	1.375	1.66	166	249	331	414	828	1657	2485	3313	4142	4970	.0071
2.50	EXTEND	4.91	491	736	982	1227	2454	4909	7363	9818	12272	14726	.0213
	1.000	4.12	412	619	825	1031	2062	4123	6185	8247	10308	12370	.0179
	1.375	3.42	342	514	685	856	1712	3424	5136	6848	8560	10272	.0148
	1.750	2.50	250	376	501	626	1252	2503	3755	5007	6259	7510	.0109
3.25	EXTEND	8.30	830	1244	1659	2074	4148	8296	12444	16592	20739	24887	.0359
	1.375	6.81	681	1022	1362	1703	3405	6811	10216	13622	17027	20433	.0294
	1.750	5.89	589	884	1178	1473	2945	5891	8836	11781	14726	17672	.0255
	2.000	5.15	515	773	1031	1289	2577	5154	7731	10308	12885	15463	.0223
4.00	EXTEND	12.57	1257	1885	2513	3142	6283	12566	18850	25133	31416	37699	.0544
	1.750	10.16	1016	1524	2032	2540	5081	10161	15242	20322	25403	30483	.0440
	2.000	9.42	942	1414	1885	2356	4712	9425	14137	18850	23562	28274	.0408
	2.500	7.66	766	1149	1532	1914	3829	7658	11486	15315	19144	22973	.0331
5.00	EXTEND	19.64	1964	2945	3927	4909	9818	19635	29453	39270	49088	58905	.0850
	2.000	16.49	1649	2474	3299	4123	8247	16493	24740	32987	41234	49480	.0714
	2.500	14.73	1473	2209	2945	3682	7363	14726	22089	29453	36816	44179	.0637
	3.000	12.57	1257	1885	2513	3142	6283	12566	18850	25133	31416	37699	.0544
	3.500	10.02	1002	1503	2004	2505	5009	10019	15028	20038	25047	30056	.0434
6.00	EXTEND	28.27	2827	4241	5655	7069	14137	28274	42412	56549	70686	84823	.1224
	2.500	23.37	2337	3505	4673	5841	11683	23366	35048	46731	58414	70097	.1011
	3.000	21.21	2121	3181	4241	5301	10603	21206	31809	42412	53015	63617	.0918
	3.500	18.65	1865	2798	3730	4663	9325	18650	27975	37300	46625	55950	.0808
	4.000	15.70	1570	2355	3140	3925	7850	15700	23550	31400	39250	47100	.0680
7.00	EXTEND	38.48	3848	5773	7697	9621	19242	38485	57727	76969	96211	115454	.1666
	3.000	31.42	3142	4712	6283	7854	15708	31416	47124	62832	78540	94248	.1360
	3.500	28.86	2886	4330	5773	7216	14432	28863	43295	57727	72158	86590	.1249
	4.000	25.92	2592	3888	5184	6480	12959	25918	38877	51836	64795	77754	.1122
	4.500	22.58	2258	3387	4516	5645	11290	22580	33870	45160	56450	67741	.0977
	5.000	18.85	1885	2827	3770	4712	9425	18850	28274	37699	47124	56549	.0816
8.00	NONE	50.27	5027	7540	10053	12566	25133	50266	75398	100531	125664	150797	.2176
	3.500	40.64	4064	6097	8129	10161	20322	40644	60967	81289	101611	121933	.1760
	4.000	37.70	3770	5655	7540	9425	18850	37699	56549	75398	94248	113098	.1632
	4.500	34.36	3436	5154	6872	8590	17181	34361	51542	68723	85903	103084	.1488
	5.000	30.63	3063	4595	6126	7658	15315	30631	45946	61261	76577	91892	.1326
	5.500	26.51	2651	3976	5301	6627	13254	26507	39761	53015	66268	79522	.1148

*Theoretical force. Actual force will be reduced by friction.

CYLINDER TORQUE CHARTS

TIE ROD TORQUE SPECS		
BORE	TIE ROD SIZE	TORQUE (FT-LBS)
1.50	.375 DIA.	25 FT-LBS
2.00	.500 DIA.	50 FT-LBS
2.50	.500 DIA.	50 FT-LBS
3.25	.625 DIA.	120 FT-LBS
4.00	.625 DIA.	130 FT-LBS
5.00	.875 DIA.	300 FT-LBS
6.00	1.000 DIA.	450 FT-LBS
7.00	1.125 DIA.	675 FT-LBS
8.00	1.250 DIA.	900 FT-LBS

All Torque Specs are based upon using anti-seize thread lubricant.

TRD SPEC: LPS Premium Copper Anti-Seize
Temperature Rating: -65°F to 1800°F
Military Spec: MIL-PRF-907-E
Torque Tolerance: -0% to +5%

BUSHING RETAINER SCREWS TORQUE SPECS	
SHCS SIZE	TORQUE (FT-LBS)
1/4-28	15 FT-LBS
5/16-24	20 FT-LBS
3/8-24	30 FT-LBS
7/16-20	40 FT-LBS

BUSHING RETAINER HEX HEAD SCREWS TORQUE SPECS	
HEX HEAD SCREW SIZE	TORQUE (FT-LBS)
3/8-24	30 FT-LBS
1/2-20	40 FT-LBS
5/8-18	50 FT-LBS
7/8-14	90 FT-LBS
1-14	125 FT-LBS

'MH' SERIES HYDRAULIC TECHNICAL DATA

BORE	ROD DIA. (MM)	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI													DISPLACEMENT PER INCH OF STROKE (GALLONS)
			250	350	440	500	550	630	675	750	830	980	1000	1300	1500	
1.50	EXTEND	1.767	442	618	777	884	972	1113	1193	1325	1467	1732	1767	2297	2651	0.00765
	0.625	1.460	365	511	642	730	803	920	986	1095	1212	1431	1460	1898	2190	0.00635
	1.000	0.982	246	344	432	491	540	619	663	737	815	962	982	1277	1473	0.00425
2.00	EXTEND	3.142	786	1100	1382	1571	1728	1979	2121	2357	2608	3079	3142	4085	4713	0.0136
	0.625	2.835	709	992	1247	1418	1559	1786	1914	2126	2353	2778	2835	3686	4253	0.0123
	1.000	2.357	589	825	1037	1179	1296	1485	1591	1768	1956	2310	2357	3064	3536	0.0102
	1.375	1.657	414	580	729	829	911	1044	1118	1243	1375	1624	1657	2154	2486	0.0071
2.50	EXTEND	4.909	1227	1718	2160	2455	2700	3093	3314	3682	4074	4811	4909	6382	7364	0.0213
	0.625	4.602	1151	1611	2025	2301	2531	2899	3106	3452	3820	4510	4602	5983	6903	0.0200
	1.000	4.124	1031	1443	1815	2062	2268	2598	2784	3093	3423	4042	4124	5361	6186	0.0179
	1.375	3.424	856	1198	1507	1712	1883	2157	2311	2568	2842	3356	3424	4451	5136	0.0148
	1.750	2.504	626	876	1102	1252	1377	1578	1690	1878	2078	2454	2504	3255	3756	0.0109
3.25	EXTEND	8.296	2074	2904	3650	4148	4563	5226	5600	6222	6886	8130	8296	10785	12444	0.0359
	1.000	7.511	1878	2629	3305	3756	4131	4732	5070	5633	6234	7361	7511	9764	11267	0.0325
	1.375	6.811	1703	2384	2997	3406	3746	4291	4597	5108	5653	6675	6811	8854	10217	0.0294
	1.750	5.891	1473	2062	2592	2946	3240	3711	3976	4418	4890	5773	5891	7658	8837	0.0255
	2.000	5.154	1289	1804	2268	2577	2835	3247	3479	3866	4278	5051	5154	6700	7731	0.0223
4.00	EXTEND	12.566	3142	4398	5529	6283	6911	7917	8482	9425	10430	12315	12566	16336	18849	0.0544
	1.000	11.781	2945	4123	5184	5891	6480	7422	7952	8836	9778	11545	11781	15315	17672	0.0510
	1.375	11.081	2770	3878	4876	5541	6095	6981	7480	8311	9197	10859	11081	14405	16622	0.0479
	1.750	10.161	2540	3556	4471	5081	5589	6401	6859	7621	8434	9958	10161	13209	15242	0.0440
	2.000	9.424	2356	3298	4147	4712	5183	5937	6361	7068	7822	9236	9424	12251	14136	0.0408
	2.500	7.657	1914	2680	3369	3829	4211	4824	5168	5743	6355	7504	7657	9954	11486	0.0331
5.00	EXTEND	19.635	4909	6872	8639	9818	10799	12370	13254	14726	16297	19242	19635	25526	29453	0.0850
	1.000	18.850	4713	6598	8294	9425	10368	11876	12724	14138	15646	18473	18850	24505	28275	0.0816
	1.375	18.150	4538	6353	7986	9075	9983	11435	12251	13613	15065	17787	18150	23595	27225	0.0785
	1.750	17.230	4308	6031	7581	8615	9477	10855	11630	12923	14301	16885	17230	22399	25845	0.0746
	2.000	16.493	4123	5773	7257	8247	9071	10391	11133	12370	13689	16163	16493	21441	24740	0.0714
	2.500	14.726	3682	5154	6479	7363	8099	9277	9940	11045	12223	14431	14726	19144	22089	0.0637
	3.000	12.566	3142	4398	5529	6283	6911	7917	8482	9425	10430	12315	12566	16336	18849	0.0544
	3.500	10.014	2504	3505	4406	5007	5508	6309	6759	7511	8312	9814	10014	13018	15021	0.0434
6.00	EXTEND	28.274	7069	9896	12441	14137	15551	17813	19085	21206	23467	27709	28274	36756	42411	0.1224
	1.375	26.789	6697	9376	11787	13395	14734	16877	18083	20092	22235	26253	26789	34826	40184	0.1159
	1.750	25.869	6467	9054	11382	12935	14228	16297	17462	19402	21471	25352	25869	33630	38804	0.0112
	2.000	25.132	6283	8796	11058	12566	13823	15833	16964	18849	20860	24629	25132	32672	37698	0.1088
	2.500	23.365	5841	8178	10281	11683	12851	14720	15771	17524	19393	22898	23365	30375	35048	0.1011
	3.000	21.205	5301	7422	9330	10603	11663	13359	14313	15904	17600	20781	21205	27567	31808	0.0918
	3.500	18.653	4663	6529	8207	9327	10259	11751	12591	13990	15482	18280	18653	24249	27980	0.0808
	4.000	15.708	3927	5498	6912	7854	8639	9896	10603	11781	13038	15394	15708	20420	23562	0.0680
8.00	EXTEND	50.265	12566	17593	22117	25133	27646	31667	33929	37699	41720	49260	50265	65345	75398	0.2176
	1.375	48.780	12195	17073	21463	24390	26829	30731	32927	36585	40487	47804	48780	63414	73170	0.2111
	1.750	47.860	11965	16751	21058	23930	26323	30152	32306	35895	39724	46903	47860	62218	71790	0.2072
	2.000	47.123	11781	16493	20734	23562	25918	29687	31808	35342	39112	46181	47123	61260	70685	0.2040
	2.500	45.356	11339	15875	19957	22678	24946	28574	30615	34017	37645	44449	45356	58963	68034	0.1963
	3.000	43.196	10799	15119	19006	21598	23758	27213	29157	32397	35853	42332	43196	56155	64794	0.1870
	3.500	40.644	10161	14225	17883	20322	22354	25606	27435	30483	33735	39831	40644	52837	60966	0.1760
	4.000	37.699	9425	13195	16588	18850	20734	23750	25447	28274	31290	36945	37699	49009	56549	0.1632
	4.500	34.361	8590	12026	15119	17181	18899	21647	23194	25771	28520	33674	34361	44669	51542	0.1488
	5.000	30.630	7658	10721	13477	15315	16847	19297	20675	22973	25423	30017	30630	39819	45945	0.1326
	5.500	26.507	6627	9277	11663	13254	14579	16699	17892	19880	22001	25977	26507	34459	39761	0.1148

*Theoretical force. Actual force will be reduced by friction.

CYLINDER TORQUE CHARTS

'MH' MEDIUM DUTY HYDRAULIC TIE ROD TORQUE SPECS	
BORE	TORQUE (FT-LBS)
1.50	8 FT-LBS
2.00	15 FT-LBS
2.50	15 FT-LBS
3.25	30 FT-LBS
4.00	30 FT-LBS
5.00	55 FT-LBS
6.00	60 FT-LBS
8.00	140 FT-LBS

'MH' MEDIUM DUTY HYDRAULIC SQUARE RETAINER PLATE TORQUE SPECS	
HEX HEAD SCREW SIZE	TORQUE (FT-LBS)
1/4 - 28	7 FT-LBS
5/16 - 24	12 FT-LBS
3/8 - 24	30 FT-LBS
1/2 - 20	50 FT-LBS
5/8 - 18	50 FT-LBS

'MH' MEDIUM DUTY HYDRAULIC ROUND RETAINER PLATE TORQUE SPECS	
SOCKET HEAD CAP SCREW SIZE	TORQUE (FT-LBS)
#10 - 32	5 FT-LBS
1/4 - 28	15 FT-LBS
5/16 - 24	20 FT-LBS

All Torque Specs are based upon using anti-seize thread lubricant. Tighten cylinders using an "X" tightening pattern on tie rods.

TRD SPEC: LPS Premium Copper Anti-Seize
Temperature Rating: -65°F to 1800°F
Military Spec: MIL-PRF-907-E
Torque Tolerance: -0% to +5%

'TAS' SERIES TECHNICAL DATA

BORE	ROD DIA. (MM)	EFFECTIVE PISTON AREA	POUNDS OF FORCE AT PSI						DISPLACEMENT PER INCH OF STROKE (GALLONS)
			60	80	100	200	250	400	
1.50	EXTEND	1.767	106	142	177	353	442	706	0.008
	0.625	1.460	88	117	146	292	365	584	0.006
	1.000	0.982	59	79	98	196	246	392	0.004
2.00	EXTEND	3.142	188	251	314	628	785	1256	0.014
	0.625	2.835	170	227	284	567	708	1134	0.012
	1.000	2.357	141	189	236	471	589	942	0.010
	1.375	1.657	99	133	166	331	414	663	0.007
2.50	EXTEND	4.909	295	393	491	981	1227	1962	0.021
	0.625	4.602	276	368	460	920	1150	1840	0.020
	1.000	4.124	247	330	412	825	1031	1650	0.018
	1.375	3.424	205	274	342	685	856	1370	0.015
	1.750	2.503	150	200	250	501	626	1001	0.011
3.25	EXTEND	8.296	498	664	830	1659	2074	3318	0.036
	1.000	7.511	451	601	751	1502	1877	3004	0.033
	1.375	6.811	409	545	681	1362	1702	2724	0.029
	1.750	5.890	353	471	589	1178	1473	2356	0.025
	2.000	5.154	309	412	515	1031	1289	2062	0.022
4.00	EXTEND	12.566	754	1005	1257	2513	3141	5026	0.054
	1.000	11.781	707	942	1178	2356	2945	4712	0.051
	1.375	11.081	665	886	1108	2216	2770	4432	0.048
	1.750	10.161	610	813	1016	2032	2540	4064	0.044
	2.000	9.425	565	754	942	1885	2356	3770	0.041
	2.500	7.658	459	613	766	1532	1914	3063	0.033
5.00	EXTEND	19.635	1178	1571	1964	3927	4908	7854	0.085
	1.000	18.850	1131	1508	1885	3770	4712	7540	0.082
	1.375	18.150	1089	1452	1815	3630	4537	7260	0.079
	1.750	17.230	1034	1378	1723	3446	4307	6892	0.075
	2.000	16.493	990	1319	1649	3299	4123	6597	0.071
	2.500	14.726	884	1178	1473	2945	3682	5890	0.064
	3.000	12.566	754	1005	1257	2513	3142	5027	0.054
	3.500	10.014	601	801	1001	2003	2503	4006	0.043
6.00	EXTEND	28.274	1696	2262	2827	5655	7068	11310	0.122
	1.375	26.789	1607	2144	2679	5358	6697	10716	0.116
	1.750	25.869	1552	2070	2587	5174	6467	10348	0.112
	2.000	25.133	1508	2011	2513	5027	6283	10053	0.109
	2.500	23.366	1402	1869	2337	4673	5841	9346	0.101
	3.000	21.206	1272	1696	2121	4241	5301	8482	0.092
	3.500	18.653	1119	1492	1865	3731	4663	7461	0.081
	4.000	15.708	942	1257	1571	3142	3927	6283	0.068
8.00	EXTEND	50.265	3016	4021	5026	10053	12566	20106	0.218
	1.375	48.780	2927	3902	4878	9756	12195	19512	0.211
	1.750	47.860	2872	3829	4786	9572	11965	19144	0.207
	2.000	47.124	2827	3770	4712	9425	11781	18850	0.204
	2.500	45.357	2721	3629	4536	9071	11339	18143	0.196
	3.000	43.197	2592	3456	4320	8639	10799	17279	0.187
	3.500	40.644	2439	3252	4064	8129	10161	16258	0.176
	4.000	37.699	2262	3016	3770	7540	9425	15080	0.163
	4.500	34.361	2062	2749	3436	6872	8590	13744	0.149
	5.000	30.631	1838	2450	3063	6126	7658	12252	0.133
	5.500	26.507	1590	2121	2651	5301	6627	10603	0.115

Note: Theoretical force; actual force will be reduced by friction.

CYLINDER TORQUE CHARTS

'TAS' PNEUMATIC TIE ROD TORQUE SPECS		
BORE	TIE ROD THREAD SIZE	TORQUE (FT-LBS)
1.50	1/4 - 28	7 FT-LBS
2.00	5/16 - 24	12 FT-LBS
2.50	5/16 - 24	14 FT-LBS
3.25	3/8 - 24	30 FT-LBS
4.00	3/8 - 24	35 FT-LBS
5.00	1/2 - 20	45 FT-LBS
6.00	1/2 - 20	50 FT-LBS
8.00	5/8 - 18	125 FT-LBS

'TAS' PNEUMATIC RETAINER PLATE TORQUE SPECS		
BORE	SOCKET HEAD CAP SCREW SIZE	TORQUE (FT-LBS)
8	1/4 - 28	12 FT-LBS
8	5/16 - 24	20 FT-LBS

Note: All Torque Specs are based upon using anti-seize thread lubricant. Tighten cylinders using an "X" tightening pattern on tie rods.

TRD SPEC: LPS Premium Copper Anti-Seize
Temperature Rating: -65°F to 1800°F
Military Spec: MIL-PRF-907-E
Torque Tolerance: -0% to +5%

TECHNICAL DATA

HYDRAULIC CYLINDER SPEEDS

BORE	ROD DIA. (MM)	1 GPM	3 GPM	5 GPM	8 GPM	12 GPM	15 GPM	20 GPM	25 GPM	30 GPM	40 GPM	50 GPM	75 GPM
1.50	NONE	130	392	654	1034	—	—	—	—	—	—	—	—
	0.625	158	476	792	1265	—	—	—	—	—	—	—	—
	1.000	235	706	1176	1880	—	—	—	—	—	—	—	—
2.00	NONE	73	221	368	588	883	1120	—	—	—	—	—	—
	1.000	97	294	490	782	1175	1465	—	—	—	—	—	—
	1.375	139	418	697	1115	1673	2090	—	—	—	—	—	—
2.50	NONE	47	131	235	376	565	675	940	1175	—	—	—	—
	1.000	56	168	280	448	672	840	1120	1400	—	—	—	—
	1.375	67	203	339	542	813	1015	1355	1695	—	—	—	—
	1.750	92	277	463	740	1110	1385	1850	2310	—	—	—	—
3.25	NONE	28	83	139	223	334	417	557	696	836	1115	—	—
	1.375	34	102	170	271	407	510	680	850	1020	1360	—	—
	1.750	39	118	196	313	472	588	784	980	1176	1568	—	—
	2.000	44	134	224	358	537	672	896	1120	1344	1792	—	—
4.00	NONE	18	55	92	147	220	276	368	460	552	736	920	—
	1.750	22	68	113	182	273	339	452	565	678	904	1130	—
	2.000	24	73	122	196	294	366	488	610	732	976	1220	—
	2.500	30	90	150	241	362	450	600	750	900	1200	1500	—
5.00	NONE	12	35	58	94	141	174	232	290	348	464	580	870
	2.000	14	42	70	112	168	210	280	350	420	560	700	1050
	2.500	16	47	78	125	188	235	315	390	470	630	780	1170
	3.000	18	55	92	147	220	275	365	460	550	730	920	1380
	3.500	22	66	111	178	266	333	444	555	665	888	1110	1665
6.00	NONE	8	24	41	65	98	123	162	202	245	320	405	606
	2.500	10	30	50	79	118	150	200	250	300	400	495	750
	3.000	11	33	54	87	130	165	206	270	325	435	545	810
	3.500	12	37	62	99	148	185	245	310	370	495	615	830
	4.000	15	44	73	117	176	220	295	365	440	585	735	1095
7.00	NONE	6	18	30	48	72	90	120	150	180	240	300	450
	3.000	7.5	22	37	59	88	110.5	147	184	220.5	294	367.5	551.5
	3.500	8	24	40	64	96	120	160	200	240	320	400	600
	4.000	9	26.5	44.5	71.5	107	133.5	178.5	223	267.5	356.5	445.5	668.5
	4.500	10	30.5	51	82	123	153.5	204.5	256	307	409	511.5	767.5
	5.000	12.5	37	61.5	98	147	184	245	306.5	367.5	490	612.5	919
8.00	NONE	4	14	23	36	55	69	92	115	135	185	230	345
	3.500	5.5	17	28	45	68	85	115	140	170	230	285	420
	4.000	6	18	30	49	73	90	122	150	180	240	305	450
	4.500	6.5	20	33	53	80	100	135	165	200	265	335	495
	5.000	7.5	22	38	60	90	114	150	185	225	300	375	555
	5.500	8.5	26	43	70	104	129	172	215	255	345	430	645

Data shown are cylinder rod travel speeds in inches per minute. The extension speeds represent the net piston area for rod diameters shown.

TECHNICAL DATA

'HH' SERIES BASIC CYLINDER WEIGHT CHART

WEIGHT IN POUNDS

BORE	ROD DIA. (MM)	MOUNT													ADD PER INCH OF STROKE
		MX0 MS4	ME5	ME6	MF1	MF2	MF5	MF6	MP1	MS2 MS3 MS7	MT1 MT2	MT4	MX1 MX2 MX3	SB	
1.50	0.625	7.3	9.5	9.2	7.9	8.5	8.7	9.2	7.7	7.6	7.8	10.4	7.5	7.6	0.47
	1.000	7.5	9.6	9.3	8.1	8.6	8.9	9.4	7.8	7.7	7.9	10.6	7.6	7.7	0.61
2.00	1.000	11.5	14.6	14.2	12.9	14.2	14.9	16.1	12.6	12.2	12.6	16.0	11.8	12.3	0.78
	1.375	11.6	14.8	14.3	13.3	14.3	15.2	16.2	12.7	12.3	12.8	16.1	11.9	12.5	0.98
2.50	1.000	15.2	18.9	18.4	18.1	18.7	20.2	20.8	16.3	17.0	16.4	20.2	15.6	16.1	1.02
	1.375	16.5	20.1	19.6	18.3	19.9	20.5	22.1	17.6	18.2	17.6	21.4	16.8	17.3	1.22
	1.750	17.1	20.8	20.3	19.2	20.6	21.3	22.7	18.2	18.8	18.2	22.0	17.4	18.0	1.48
3.25	1.375	28.7	35.4	34.6	34.4	35.5	38.4	39.5	30.7	30.5	31.1	39.0	29.4	30.4	1.50
	1.750	31.8	38.5	37.6	35.2	38.6	39.2	42.6	33.8	33.5	34.2	42.1	32.5	33.5	1.76
	2.000	32.4	39.1	38.2	36.0	39.2	40.0	43.2	34.4	34.1	34.8	42.7	33.1	34.1	1.97
4.00	1.750	39.9	47.3	46.4	47.5	49.3	52.4	54.3	45.1	43.4	42.2	49.3	40.6	44.7	2.44
	2.000	41.0	48.4	47.5	48.3	50.4	53.2	55.4	46.3	44.6	43.4	50.5	41.7	45.9	2.65
	2.500	45.7	53.2	52.3	50.9	55.2	55.9	60.1	51.0	49.3	48.1	55.2	46.5	50.6	3.15
5.00	2.000	70.4	82.3	80.8	83.9	86.1	91.7	93.9	78.3	73.9	72.8	88.7	72.5	79.1	4.01
	2.500	73.1	85.0	83.6	86.5	88.8	94.4	96.6	81.0	76.7	75.5	91.4	75.3	81.8	4.51
	3.000	76.3	88.3	86.8	89.4	92.0	97.3	99.9	84.3	79.9	78.7	94.6	78.5	85.1	5.13
	3.500	83.6	95.6	94.1	92.4	99.3	100.2	107.2	91.6	87.2	86.0	101.9	85.8	92.4	5.85
6.00	2.500	111.9	129.8	129.8	130.5	132.7	140.9	143.2	121.7	118.8	115.4	145.9	115.1	122.7	5.17
	3.000	115.0	132.9	132.9	133.3	135.9	143.7	146.4	124.9	121.9	118.6	149.0	118.2	125.8	5.78
	3.500	118.0	135.9	135.9	136.2	138.9	146.7	149.3	127.9	124.9	121.5	152.0	121.2	128.8	6.50
	4.000	124.0	141.9	141.9	141.3	144.9	151.7	155.4	133.9	131.0	127.6	158.1	127.3	134.9	7.33
7.00	3.000	167.5	194.8	194.8	191.4	194.0	204.3	206.9	184.8	179.0	174.4	214.5	172.1	—	6.46
	3.500	170.3	197.6	197.6	194.3	196.9	207.2	209.8	187.7	181.9	177.3	217.4	175.0	—	7.18
	4.000	176.8	204.1	204.1	203.0	207.2	217.8	222.0	194.2	188.4	183.8	223.9	181.5	—	8.02
	4.500	184.4	211.7	211.7	209.6	214.7	224.3	229.5	201.7	195.9	191.3	231.4	189.0	—	8.96
	5.000	191.7	219.0	219.0	217.7	222.1	232.5	236.8	209.1	203.3	198.7	238.8	196.4	—	10.02
8.00	3.500	232.6	268.9	268.9	262.9	265.6	278.5	281.2	251.2	244.2	244.6	309.6	238.9	—	7.89
	4.000	239.1	275.4	275.4	272.5	276.7	290.4	294.6	257.6	250.7	251.1	316.1	245.3	—	8.72
	4.500	246.6	282.9	282.9	279.0	284.2	296.9	302.0	265.1	258.1	258.6	323.6	252.8	—	9.67
	5.000	255.1	291.4	291.4	287.2	292.7	305.0	310.6	273.7	266.7	267.1	332.1	261.4	—	10.72
	5.500	266.3	302.6	302.6	297.1	304.0	314.9	321.8	284.9	277.9	278.3	343.4	272.6	—	11.89

Note: Add 20% to mount and stroke weight for double rod end cylinders. Add 1% for cushions.

ACCESSORIES WEIGHT CHART

WEIGHT IN POUNDS

ROD CLEVIS		ROD EYES		EYE BRACKETS		CLEVIS BRACKETS		CLEVIS PINS				WELD PLATE		FLANGE END CPL.	
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	WP3000	6.74	FEC3000	6.66
RC1750	12.7	RE1500	10.52	EB3000	44	CB3000	44	CP3000C	13.69	CP3000E	13.57	WP3500	10.91	FEC3500	10.83
RC1875	18	RE1875	11.5	EB3500	113	CB3500	113	CP3500C	24.42	CP3500E	24.12	WP4000	10.91	FEC4000	10.83
RC2250	27	RE2250	23	EB4000	179	CB4000	—	CP4000C	35.45	CP4000E	35.06	WP4500	14.26	FEC4500	14.86
RC2500	36	RE2500	32	—	—	—	—	—	—	—	—	WP5000	14.26	FEC5000	14.86
RC3250	71	RE3250	36	—	—	—	—	—	—	—	—	WP5500	22.55	FEC5500	22.47
RC4000	107	RE3500	36	—	—	—	—	—	—	—	—	—	—	—	—
—	—	RE4000	84	—	—	—	—	—	—	—	—	—	—	—	—

TECHNICAL DATA

'MH' SERIES BASIC CYLINDER WEIGHT CHART

WEIGHT IN POUNDS

BORE	ROD DIA. (MM)	MOUNT												ADD PER INCH OF STROKE
		MX0 MS4 ME3 ME4	MF1	MF2	MF5	MF6	MP1	MP2	MS2 MS3 MS7	MT1 MT2	MT4	MX1 MX2 MX3	SB	
1.50	0.625	3.8	4.2	4.5	4.7	5.0	4.2	4.6	4.1	4.3	5.6	3.9	4.1	0.31
	1.000	4.0	4.4	4.7	4.9	5.2	4.3	4.7	4.3	4.4	5.8	4.0	4.2	0.45
2.00	0.625	5.9	6.7	6.9	7.4	7.7	6.2	6.8	6.2	6.3	8.4	5.9	6.1	0.39
	1.000	6.3	6.9	7.4	7.7	8.1	6.7	7.3	6.6	6.8	8.9	6.4	6.6	0.53
	1.375	6.6	7.4	7.7	8.1	8.4	7.0	7.6	7.0	7.1	9.2	6.7	6.9	0.73
2.50	0.625	8.6	9.9	10.1	10.7	10.9	9.0	9.9	9.0	9.1	11.8	8.7	8.9	0.45
	1.000	9.4	10.1	10.9	10.9	11.7	9.7	10.7	9.7	9.9	12.5	9.5	9.7	0.59
	1.375	9.7	10.6	11.2	11.4	12.0	10.0	11.0	10.0	10.2	12.8	9.8	10.0	0.78
	1.750	10.5	11.5	12.0	12.3	12.8	10.8	11.8	10.8	10.9	13.6	10.6	10.7	1.04
3.25	1.000	15.5	19.1	19.2	20.8	20.9	16.6	19.1	16.3	16.0	21.4	15.7	16.4	0.70
	1.375	17.7	19.4	21.4	21.1	23.1	18.8	21.3	18.5	18.2	23.5	17.9	18.6	0.90
	1.750	18.3	20.3	22.0	22.0	23.7	19.4	21.9	19.1	18.8	24.2	18.5	19.2	1.16
	2.000	19.0	21.1	22.6	22.8	24.3	20.1	22.6	19.7	19.4	24.8	19.1	19.8	1.37
4.00	1.000	23.0	27.3	28.0	29.2	29.9	24.1	27.7	23.8	23.5	30.3	23.2	23.9	0.79
	1.375	23.8	27.6	28.8	29.6	30.7	24.9	28.5	24.5	24.2	31.1	23.9	24.6	0.99
	1.750	24.4	28.5	29.4	30.4	31.3	25.5	29.1	25.2	24.9	31.7	24.6	25.3	1.25
	2.000	26.9	29.3	31.9	31.2	33.9	28.0	31.6	27.7	27.4	34.2	27.1	27.8	1.45
	2.500	29.2	32.0	34.2	33.9	36.2	30.3	33.9	30.0	29.7	36.5	29.4	30.1	1.95
5.00	1.000	35.8	42.5	43.3	45.4	46.1	36.9	42.3	37.2	36.3	45.3	36.2	36.7	0.98
	1.375	36.6	42.9	44.0	45.7	46.9	37.7	43.1	38.0	37.1	46.0	37.0	37.5	1.18
	1.750	37.2	43.7	44.7	46.6	47.5	38.3	43.7	38.6	37.7	46.6	37.6	38.1	1.44
	2.000	38.7	44.6	46.1	47.4	49.0	39.8	45.1	40.0	39.1	48.1	39.0	39.5	1.65
	2.500	43.8	47.3	51.2	50.1	54.1	44.9	50.3	45.2	44.3	53.2	44.2	44.7	2.15
	3.000	46.3	50.3	53.7	53.2	56.6	47.4	52.7	47.7	46.7	55.7	46.6	47.1	2.76
	3.500	48.8	53.4	56.2	56.2	59.1	49.9	55.3	50.2	49.2	58.2	49.1	49.7	3.48
6.00	1.375	56.7	67.2	68.6	71.1	72.4	58.6	67.6	58.2	57.8	70.7	57.0	58.3	1.29
	1.750	57.7	68.0	69.6	71.9	73.5	59.6	68.6	59.2	58.8	71.7	58.0	59.3	1.55
	2.000	58.8	68.8	70.7	72.7	74.5	60.7	69.7	60.3	59.9	72.8	59.1	60.4	1.76
	2.500	61.5	71.4	73.4	75.3	77.3	63.5	72.4	63.0	62.6	75.5	61.8	63.2	2.26
	3.000	64.7	74.4	76.6	78.3	80.5	66.7	75.7	66.3	65.9	78.7	65.1	66.4	2.87
	3.500	68.0	77.4	79.9	81.3	83.8	70.0	78.9	69.5	69.1	82.0	68.3	69.7	3.59
	4.000	76.0	82.7	87.9	86.5	91.7	77.9	86.9	77.5	77.1	90.0	76.3	77.6	4.43
8.00	1.375	98.9	—	—	—	—	100.9	—	100.5	100.0	126.6	99.6	100.6	2.09
	1.750	99.9	—	—	—	—	101.9	—	101.5	101.1	127.6	100.6	101.6	2.35
	2.000	101.0	—	—	—	—	103.0	—	102.5	102.1	128.7	101.7	102.7	2.56
	2.500	103.7	—	—	—	—	105.7	—	105.3	104.9	131.4	104.4	105.4	3.06
	3.000	107.0	—	—	—	—	108.9	—	108.5	108.1	134.7	107.7	108.6	3.67
	3.500	110.2	—	—	—	—	112.2	—	111.8	111.4	137.9	110.9	111.9	4.39
	4.000	116.3	—	—	—	—	118.3	—	117.8	117.4	144.0	117.0	117.9	5.23
	4.500	123.9	—	—	—	—	125.9	—	125.4	125.0	151.6	124.6	125.6	6.17
	5.000	131.9	—	—	—	—	133.9	—	133.5	133.1	159.6	132.6	133.6	7.23
	5.500	141.0	—	—	—	—	143.0	—	142.6	142.2	168.7	141.7	142.7	8.39

Note: Add 20% to mount and stroke weight for double rod end cylinders. Add 1% for cushions.

TECHNICAL DATA

'TAS' SERIES BASIC CYLINDER WEIGHT CHART

WEIGHT IN POUNDS

BORE	ROD DIA. (MM)	MOUNT													ADD PER INCH OF STROKE
		MX0 MS4 ME3 ME4	MF1	MF2	MF5	MF6	MP1*	MP2* MP4*	MS1	MS2	MT1 MT2	MT4	MX1 MX2 MX3	SB*	
1.50	0.625	3.5	3.8	4.2	4.3	4.7	3.9	4.3	3.9	3.8	3.9	5.3	3.5	3.7	0.31
	1.000	3.6	4.1	4.3	4.6	4.8	4.0	4.4	4.0	3.9	4.0	5.4	3.6	3.9	0.45
2.00	0.625	5.5	6.1	6.6	6.8	7.3	6.0	6.6	6.1	5.8	6.0	8.1	5.6	5.8	0.39
	1.000	5.7	6.3	6.8	7.0	7.5	6.1	6.8	6.2	6.0	6.1	8.3	5.8	5.9	0.53
	1.375	6.0	6.7	7.1	7.5	7.8	6.4	7.1	6.5	6.3	6.4	8.6	6.1	6.3	0.73
2.50	0.625	8.1	8.8	9.6	9.5	10.4	8.6	9.5	8.8	8.4	8.6	11.3	8.2	8.4	0.45
	1.000	8.3	9.0	9.7	9.8	10.5	8.7	9.7	8.9	8.6	8.7	11.4	8.4	8.5	0.59
	1.375	8.6	9.4	10.1	10.2	10.9	9.0	10.0	9.2	8.9	9.0	11.7	8.7	8.9	0.78
	1.750	9.4	10.3	10.8	11.1	11.6	9.8	10.7	10.0	9.7	9.8	12.5	9.4	9.6	1.04
3.25	1.000	15.7	17.1	19.3	18.9	21.0	16.7	19.2	16.3	16.4	16.1	21.5	15.8	16.6	0.70
	1.375	15.8	17.5	19.4	19.2	21.1	16.8	19.3	16.5	16.5	16.2	21.6	15.9	16.7	0.90
	1.750	16.4	18.4	20.1	20.1	21.8	17.4	19.9	17.1	17.2	16.9	22.2	16.6	17.3	1.16
	2.000	17.1	19.2	20.7	20.9	22.4	18.1	20.6	17.7	17.8	17.5	22.9	17.2	18.0	1.37
4.00	1.000	22.7	24.4	27.6	26.3	29.6	23.9	27.5	23.6	23.4	23.1	29.9	22.8	23.6	0.79
	1.375	22.8	24.7	27.7	26.6	29.7	24.0	27.6	23.7	23.5	23.2	30.0	22.9	23.7	0.99
	1.750	23.4	25.6	28.4	27.5	30.3	24.7	28.3	24.3	24.1	23.8	30.7	23.5	24.3	1.25
	2.000	24.0	26.4	29.0	28.3	30.9	25.3	28.9	25.0	24.8	24.5	31.3	24.2	25.0	1.45
	2.500	26.3	29.1	31.3	31.0	33.2	27.6	31.2	27.3	27.1	26.8	33.6	26.5	27.3	1.95
5.00	1.000	34.7	37.1	42.1	39.9	45.0	36.0	41.3	36.6	36.1	35.1	44.1	35.0	35.6	0.98
	1.375	34.8	37.4	42.2	40.3	45.1	36.1	41.4	36.7	36.2	35.3	44.2	35.2	35.7	1.18
	1.750	35.4	38.3	42.9	41.1	45.7	36.7	42.1	37.4	36.8	35.9	44.8	35.8	36.4	1.44
	2.000	36.1	39.1	43.5	42.0	46.4	37.4	42.7	38.0	37.4	36.5	45.5	36.4	37.0	1.65
	2.500	38.4	41.8	45.8	44.7	48.7	39.7	45.0	40.3	39.7	38.8	47.8	38.7	39.3	2.15
	3.000	40.8	44.9	48.3	47.7	51.1	42.1	47.5	42.8	42.2	41.3	50.3	41.2	41.8	2.76
	3.500	43.4	47.9	50.8	50.8	53.6	44.6	50.0	45.3	44.7	43.8	52.8	43.7	44.3	3.48
6.00	1.375	55.7	59.3	67.6	63.2	71.5	57.7	66.7	58.0	57.3	56.9	69.7	56.1	57.6	1.29
	1.750	56.3	60.2	68.2	64.0	72.1	58.3	67.2	58.6	57.8	57.4	70.3	56.6	58.1	1.55
	2.000	56.9	60.9	68.8	64.8	72.7	58.9	67.8	59.2	58.4	58.0	70.9	57.2	58.7	1.76
	2.500	59.0	63.6	70.9	67.5	74.8	61.0	70.0	61.3	60.6	60.2	73.0	59.4	60.9	2.26
	3.000	61.3	66.5	73.1	70.4	77.0	63.2	72.2	63.5	62.8	62.4	75.3	61.6	63.1	2.87
	3.500	63.6	69.5	75.5	73.4	79.4	65.6	74.5	65.9	65.1	64.7	77.6	63.9	65.4	3.59
	4.000	68.1	74.8	80.0	78.7	83.9	70.1	79.1	70.4	69.7	69.3	82.1	68.5	69.9	4.43
8.00	1.375	83.8	—	—	—	—	85.8	—	89.5	85.3	84.9	111.5	84.5	85.6	2.09
	1.750	84.3	—	—	—	—	86.3	—	90.0	85.9	85.5	112.0	85.0	86.2	2.35
	2.000	87.0	—	—	—	—	89.0	—	92.7	88.6	88.2	114.7	87.7	88.9	2.56
	2.500	89.2	—	—	—	—	91.2	—	94.9	90.8	90.4	116.9	89.9	91.0	3.06
	3.000	91.8	—	—	—	—	93.8	—	97.6	93.4	93.0	119.6	92.6	93.7	3.67
	3.500	94.9	—	—	—	—	96.8	—	100.6	96.4	96.0	122.6	95.6	96.7	4.39
	4.000	101.2	—	—	—	—	103.1	—	106.9	102.7	102.3	128.9	101.9	103.0	5.23
	4.500	108.8	—	—	—	—	110.8	—	114.5	110.3	109.9	136.5	109.5	110.6	6.17
	5.000	116.8	—	—	—	—	118.8	—	122.5	118.4	118.0	144.5	117.5	118.6	7.23
	5.500	125.9	—	—	—	—	127.9	—	131.6	127.5	127.1	153.6	126.6	127.7	8.39

*Weight includes clevis pins.

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

TECHNICAL DATA

SEAL COMPATIBILITY

SEAL COMPATIBILITY WITH COMMON FLUIDS

R = RECOMMENDED S = SATISFACTORY M = MARGINAL U = UNSATISFACTORY — = INSUFFICIENT DATA

FLUID NAME	MFG. CODE	MILITARY SPECIFICATION	TRADE NAME/NUMBER	COLOR	TYPE OF SEAL COMPOUND - COMMON NAME								
					BUNA-N	BUTYL	CORFAM	EP	VITON	SILICONE	NEOPRENE	NAT. RUBBER	POLYURETHANE
Water-Glycol	1		Houghto-Safe 600 Series	red	R	R	R	R	R	S	S	R	U
	1		Houghto-Safe 500 Series	red	R	R	R	R	R	S	S	R	U
	1	MIL-H22072	Houghto-Safe 271	red	R	R	R	R	R	S	S	—	U
	4		Ucon Hydrolube	yel. or red	R	R	R	R	R	R/S	S	R	U
	4		Ucon M1	yellow	R	R	R	R	R	S	S	S	U
	5		Celluguard	red	R	R	R	R	R	S	S	—	U
	10		Safety Fluid 200	bright pink	R	R	R	R	R	S	S	—	U
Water/Oil	1		Houghto-Safe 5000 Series	white	R	U	R	U	R	—	S	U	U
Emulsion	3		FR	creamy	R	U	R	U	R	—	S	U	U
	7		Irus 902	yellow	R	U	R	U	R	U	S	U	M
	8		Pyrogard C & D	pale yellow	R	U	R	U	R	—	S	U	U
Water-Soluble Oil	—		—	milky	R	M	R	—	R	—	S	S	M/U
Water-Fresh	—		—	—	R	R	R	R	R	R	M	R	M/U
Water-Salt	—		—	—	R	R	R	R	R	R	M	R	M/U
Phosphate Ester	1		Houghto-Safe 1000 Series	green	U	R	M/U	R	R	M	U	U	M
	1	MIL-H-19547B	Houghto-Safe 1120	green	U	R	M/U	R	R	M	U	U	M
	2		Pydraul F-9, 150, 625	cloudy bl.	U	R/S	M/U	S	R	R	U	U	S
	5		Fyrquel	lt. green	U	R	M/U	R	R	M	U	U	M
	7		Shell SRF B.C.D.	aqua gr.	U	R	M/U	R	R	M	U	U	M
	8		Pyrogard 42, 43, 53, 55, 190, 600	pale yel.	U	R	M/U	R	R/S	M	U	U	M
	2		Skydrol 500B	purple	U	S	U	R	U	M	U	U	U
	2		Skydrol 7000	green	U	S	U	R	U	M	U	U	U
	2		Pydraul 312, 135 (2)	blue gr.	U	M	M	M	R	R	U	U	—
	2		Pydraul AC	cloudy bl.	U	S	M/U	S	R	R	U	U	M/U
	2		Pydraul 60	cloudy bl.	U	R	M/U	R	U	S	U	U	M/U
	8		Pydraul 210 (3)	yellow	U	M	—	M	R	R	U	U	M/U
Diester	—	MIL-H-7808	Lube Oil-Aircraft	amber	S	U	R	U	R	U	U	U	U
Clorinat. Hydrocarb	2		Aroclor 1200 Series 1	clear	M	S	—	S	R	S	U	U	U
	2		Pydraul A-200	cloudy bl.	U	M	M	M	R	R	U	U	M/U
Silicate Ester	2		OS-45 Type 4	clear	S	U	—	S	R	U	R	U	R
	6	MILO-8200	Oronite 8200	clear	S	U	—	U	R	U	R	U	R
	6	MIL-8515	Oronite 8515	clear	S	U	—	U	R	U	R	U	R
	9	MIL-H-8446B	Brayco 846	red brown	S	U	—	U	R	U	R	U	R
Kerosene	—			clear	R	U	R	U	R	U	M/U	U	R
Jet Fuel	—	MIL-J-5624	JP-3, 4, 5 (RP-1)	lt. straw	R	U	R	U	R	U	U	U	S
Diesel Fuel	—	—	—	clear	R	U	R	U	R	U	M/U	U	R
Gasoline	—	—	Gasoline	various	R	U	R/S	U	R	U	U	U	R
Petroleum Base	—	MIL-H-6083	Preservative Oil	red	R	U	R	U	R	U	R	S	R
Petroleum Base	—	MIL-H-5606	Aircraft Hyd. Fluid	red	R	U	R	U	R	U	S	U	R

Notes: (1) Halogenated
(2) Petroleum and halogenated hydrocarbon and phosphate ester mixture
(3) Chlorinated phosphate ester

Manufacturer's Code Numbers

No. Manufacturer
1. E.F. Houghton
2. Monsanto
3. Gulf
4. Union Carbide & Chemical
5. Stauffer Chemical
6. Standard Oil (Ortho Chemical)
7. Shell Chemical
8. Mobile Oil
9. Bray Oil - Royal Lubricant
10. Texaco

ELASTOMER CHARACTERISTICS

ELASTOMER	STYRENE BUTADIENE	BUTYL	CHLOROSULPHONATED POLYETHYLEN	ETHYLENE PROPYLENE	FLUOROCARBON	FLUOROSILICONE	NATURAL	POLYCHLOROPRENE	NITRILE	POLYACRYLIC	POLYSULPHIDE	POLYURETHANE	SILICONE	EPICHLOROHYDRIN	POLYIMIDE	POLYTETRAFLUOROETHYLENE
SYMBOL	**SBR**	**IIR**	**CSM**	**EPM**	**V**	**FPM**	**FSI**	**NR**	**NBR**		**ACM**	**TR**	**AU-EU**	**SI**	**ECD**	
UPPER TEMP. LIMIT °F	194	500	212	248	284	347	392	176	230	266	320	221	212	392	284	896
LOWER TEMP. LIMIT °F	-58	-148	-22	-4	-49	5	-76	-76	-40	-49	-4	-67	-58	-76	-40	-400
ABRASION RESISTANCE	S	U	M	R	•	S	•	R	R	S	•	•	R	•	S	R
COMPRESSION SET RESIST.	•	•	U	M	M	S	U	R	S	R	U	U	S	S	M	•
RESILIENCE	M	U	U	U	U	M	U	R	S	M	M	U	S	U	S	U
RADIATION	U	U	•	•	•	•	M	•	•	•	•	•	S	U	U	R
WEATHER RESISTANCE	M	R	R	R	R	R	R	U	U	U	R	R	R	R	S	R
OZONE RESISTANCE	M	R	R	R	R	R	R	M	•	M	R	S	R	R	S	•
ADHESION TO METAL	R	S	S	R	S	R	R	R	•	R	S	R	R	R	S	S

R = RECOMMENDED S = SATISFACTORY M = MARGINAL U = UNSATISFACTORY • = CONSULT MANUFACTURER

CONVERSION CHARTS

FRACTION EQUIVALENTS

FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (X 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (X 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (X 25.4)	FRACTION (INCHES)	DECIMAL (INCHES)	METRIC (MM) (X 25.4)
1/64	.016	.4	17/64	.266	6.8	33/64	.516	13.1	49/64	.766	19.5
1/32	.031	.8	9/32	.281	7.1	17/32	.531	13.5	25/32	.781	19.8
3/64	.047	1.2	19/64	.297	7.5	35/64	.547	13.9	51/64	.797	20.2
1/16	.062	1.6	5/16	.312	7.9	9/16	.562	14.3	13/16	.812	20.6
5/64	.078	2.0	21/64	.328	8.3	37/64	.578	14.7	53/64	.828	21.0
3/32	.094	2.4	11/32	.344	8.7	19/32	.594	15.1	27/32	.844	21.4
7/64	.109	2.8	23/64	.359	9.1	39/64	.609	15.5	55/64	.859	21.8
1/8	.125	3.2	3/8	.375	9.5	5/8	.625	15.9	7/8	.875	22.2
9/64	.141	3.6	25/64	.391	9.9	41/64	.641	16.3	57/64	.891	22.6
5/32	.156	4.0	13/32	.406	10.3	21/32	.656	16.7	29/32	.906	23.0
11/64	.172	4.4	27.64	.422	10.7	43/64	.672	17.1	59/64	.922	23.4
3/16	.187	4.7	7/16	.437	11.1	11/16	.687	17.4	15/16	.937	23.8
13/64	.203	5.2	29/64	.453	11.5	45/64	.703	17.9	61/64	.953	24.2
7/32	.219	5.6	15/32	.469	11.9	23/32	.719	18.3	31/32	.969	24.6
15/64	.234	5.9	31/64	.484	12.3	47/64	.734	18.6	63/64	.984	25.0
1/4	.250	6.3	1/2	.500	12.7	3/4	.750	19.0	1	1.000	25.4

TEMPERATURE EQUIVALENTS

FAHRENHEIT TO CELSIUS CONVERSION

F°	C°	F°	C°
-30	-34.4	130	54.4
-20	-28.9	140	60.0
-10	-23.3	150	65.6
0	-17.8	160	71.1
10	-12.2	170	76.7
20	-6.7	180	82.2
30	-1.1	190	87.8
40	4.4	200	93.3
50	10.0	210	98.9
60	15.6	220	104.4
70	21.1	230	110.0
80	26.7	240	115.6
90	32.2	250	121.1
100	37.8	300	148.9
110	43.3	350	176.7
120	48.9	400	204.4

C° = (F° - 32) ÷ 1.8

CELSIUS TO FAHRENHEIT CONVERSION

C°	F°	C°	F°
-30	-22	65	149
-20	-4	70	158
-10	14	75	167
0	32	80	176
5	41	85	185
10	50	90	194
15	59	95	203
20	68	100	212
25	77	105	221
30	86	110	230
35	95	115	239
40	104	120	248
45	113	125	257
50	122	130	266
55	131	150	302
60	140	200	392

F° = C° x 1.8 + 32

PRESSURE CONVERSIONS

PSI	KG/CM_2	BARS	KG/CM_2	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/cm^2 = PSI x .0703
Bars = PSI x .0689

PSI = Kg/cm^2 x 14.22
Bars = Kg/cm^2 x .98

MEASUREMENT CONVERSIONS

INCHES	CM	MM	CM	INCHES
1	2.5	25.4	1	.4
2	5.1	50.8	2	.8
3	7.6	76.2	3	1.2
4	10.2	101.6	4	1.6
5	12.7	127.0	5	2.0
6	15.2	152.4	6	2.4
7	17.8	177.8	7	2.8
8	20.3	203.2	8	3.1
9	22.9	228.6	9	3.5
10	25.4	254.0	10	3.9
15	38.1	381.0	20	7.9
20	50.8	508.0	30	11.8
25	63.5	635.0	40	15.8
30	76.2	762.0	50	19.7
35	88.9	889.0	60	23.6
40	101.6	1016.0	70	27.6
45	114.3	1143.0	80	31.5
50	127.0	1270.0	90	35.5
55	139.7	1397.0	100	39.4
60	152.4	1524.0	110	43.3
65	165.1	1651.0	120	47.3
70	177.8	1778.00	130	51.2
75	190.5	1905.0	140	55.2
80	203.2	2032.0	150	59.1
85	215.9	2159.0	160	63.0
90	228.6	2286.0	170	67.0
95	241.3	2413.0	180	70.9
100	254.0	2540.0	190	74.9
—	—	—	200	78.8
—	—	—	210	82.7
—	—	—	220	86.7
—	—	—	230	90.6
—	—	—	240	94.6
—	—	—	250	98.5
—	—	—	260	102.4

cm = in. x 2.54 mm = in. x 25.4 in. = cm x .394

TECHNICAL DATA

COMMON FLUID POWER FORMULAS

PROPERTY	WORD FORMULA	MATHEMATIC EQUATION
FLUID PRESSURE PSI (POUNDS PER SQUARE INCH)	$\text{Pressure} = \frac{\text{Force (lbs)}}{\text{Area (in}^2\text{)}}$	$P = \frac{F}{A}$
CYLINDER AREA EXTEND IN^2 (SQUARE INCHES)	$\text{Area} = \frac{\pi}{A4} \times \text{Diameter}^2 \text{ (inches)}$	$A = .7854\ D^2$
CYLINDER AREA RETRACT IN^2 (SQUARE INCHES)	$\text{Area} = \left(\frac{\pi}{A4} \times \text{Bore Diameter}^2\right) - \left(\frac{\pi}{A4} \times \text{Rod Diameter}^2\right)$	$A = (.7854\ D_b^2) - (.7854\ D_r^2)$
CYLINDER FORCE LBS. (POUNDS OF FORCE)	Force = Pressure (PSI) x Net Area (in^2)	$F = PA$
CYLINDER VELOCITY FT/S (FEET PER SECOND)	$\text{Velocity} = \frac{231 \times \text{Flow Rate (GPM)}}{12 \times 60 \times \text{Net Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$
CYLINDER VOLUME G (GALLONS OF FLUID)	$\text{Volume} = \frac{\text{Net Area (in}^2\text{)} \times \text{Stroke (in)}}{231}$	$V = \frac{A\ L}{231}$
CYLINDER FLOW RATE GPM (GALLONS PER MINUTE)	$\text{Flow Rate} = \frac{12 \times 60 \times \text{Velocity (ft/s)} \times \text{Net Area (in}^2\text{)}}{231}$	$Q = 3.117\ v\ A$
CYLINDER POWER HP (HORSEPOWER)	$\text{Horsepower} = \frac{\text{Pressure (PSI)} \times \text{Flow Rate (GPM)}}{1714}$	$hp = \frac{P\ Q}{1714}$
FLUID MOTOR TORQUE LB-IN (INCH POUNDS)	$\text{Torque} = \frac{\text{Pressure (PSI)} \times \text{F.M. Displacement (in}^3\text{/rev.)}}{2\pi}$	$T = \frac{P\ d}{2\pi}$
	$\text{Torque} = \frac{\text{Horsepower} \times 63025}{\text{RPM}}$	$T = \frac{63025\ hp}{n}$
	$\text{Torque} = \frac{\text{Flow Rate (GPM)} \times \text{Pressure (PSI)} \times 36.77}{\text{RPM}}$	$T = \frac{36.77\ Q\ P}{N}$
FLUID MOTOR SPEED RPM (REVOLUTIONS PER MINUTE)	$\text{Speed} = \frac{231 \times \text{Flow Rate (GPM)}}{\text{F.M. Displacement (in}^3\text{/rev.)}}$	$n = \frac{231\ Q}{d}$
FLUID MOTOR POWER HP (HORSEPOWER)	$\text{Horsepower} = \frac{\text{Torque (lbs-in)} \times \text{RPM}}{63025}$	$hp = \frac{T\ n}{63025}$
PUMP OUTLET FLOW GPM (GALLONS PER MINUTE)	$\text{Flow} = \frac{\text{RPM} \times \text{Pump Displacement (in}^3\text{/rev.)}}{231}$	$Q = \frac{n\ d}{231}$
FLOW RATE THROUGH PIPING FT/S VELOCITY (FEET PER SECOND)	$\text{Velocity} = \frac{.3208 \times \text{Flow Rate Through I.D. (GPM)}}{\text{Internal Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$
TORQUE REQUIREMENT LB-IN (INCH POUNDS)	Torque = Lever Length (in.) x Pull (lbs.)	$T = L \times F$

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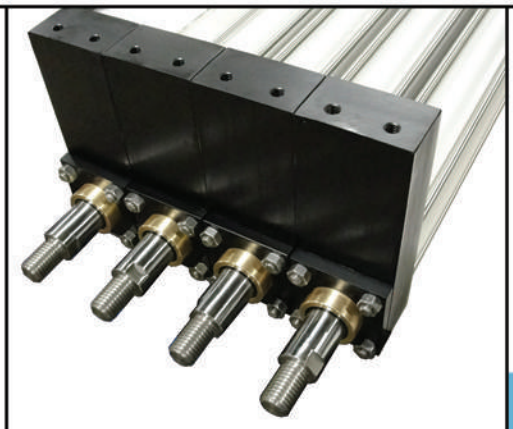
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SERIES	DELIVERY SCHEDULE
HH (Heavy-Duty Industrial Hydraulic)	2-3 Days
HH with Hydraulic Rod Lock (1.50”-5.00“ Bores)	3-4 Weeks
HH with Hydraulic Rod Lock (6.00”-8.00“ Bores)	5-6 Weeks
MH (Medium-Duty Industrial Hydraulic)	2-3 Days
TAS (Heavy-Duty Industrial Pneumatic)	2-3 Days
TA, TD, FM, TRA, MSE, MSR	2-3 Days
BTB, TM, 3P	2-3 Days
Air Boosters, Air/Oil Tanks, BTP	2-3 Days
SS	2-3 Days
SS-MSE, SS-MSR	3-5 Days
RS	3-4 Days
TC	3-5 Days
TRD Switches	1 Day
Rod Clevis, Pins & Mounts, Alignment Couplers	1 Day
Balluff Strokemaster (Quantity of 2-4 Cylinders)	3-4 Days
Balluff Strokemaster (Quantity of 5+ Cylinders)	7-10 Days
Balluff Micropulse Transducers	10-12 Days
MTS Temposonics	10-12 Days

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