BASIC OPTIONS

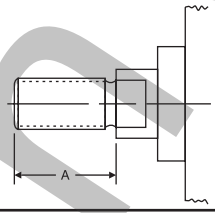
Index To Standard Options:

Uncommon Options:

A= Extended Piston Rod Thread

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

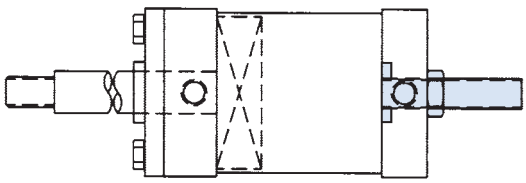
Shorter than standard lengths can be furnished at no charge. Longer than standard lengths can be furnished at a nominal price adder. *Special length threads do not delay orders!*



AS Adjustable Stroke (Retract)

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

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



A/O Air/Oil Piston

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

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

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

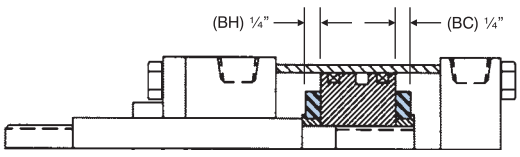
Note: Due to the nature of oil to remain in the tubing finish recesses, a condition called "collaring" will allow oil to seep past the A/O seal over time, escaping in the air valve exhaust.

B BC BH Bumpers

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

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

(Note: Each bumper adds ¼" to cylinder length)



BASIC OPTIONS

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

1½" Bore Shown

Available on 1½" 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 (-25°C to 90°C)

Optional Material: Fluorocarbon
Available in 1½"-8" Bores
Operating Temp: 0°F to 400°F (-18°C to 205°C)

Operating Pressure: 250 PSI Air (17 BAR)

Benefits

- **Reduces cycle rates** - Higher piston velocities can be achieved due to rapid deceleration feature, increasing productivity.
- **Provides maximum impact dampening** - Reduces machine vibration
- **Reduces cylinder end-of-stroke noise**
- **Available in Fluorocarbon Seals (1½" to 8" Bore)**

Design Tips

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

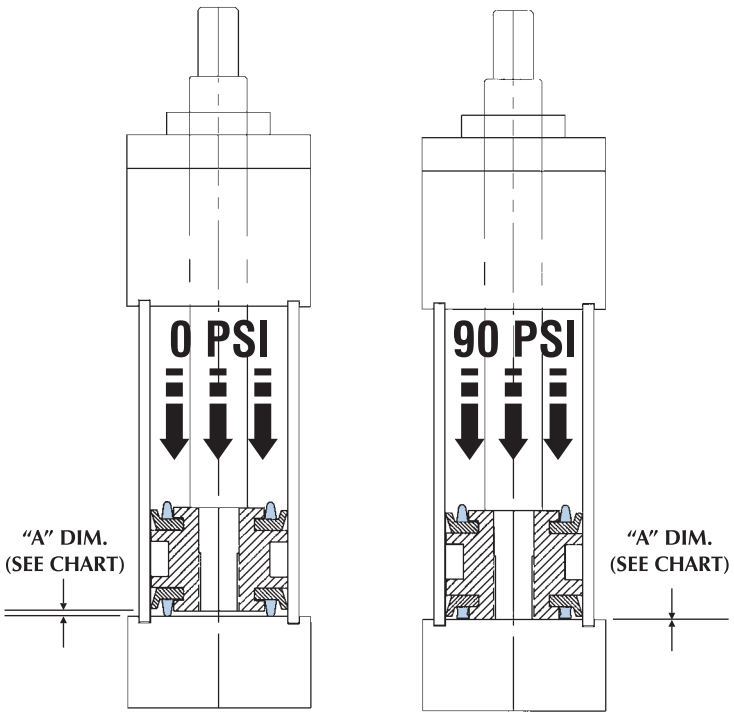
Bumper Piston Seals will shorten the cylinder stroke when operated at less than 90 PSI supply air. The charts below show the approximate (average) stroke reduction, at various pressure (for new cylinders). As the cylinders are cycled, the seals will take a slight set. Tests have shown that after 1,500,000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

TOTAL STROKE REDUCTION
("A" DIMENSION X 2) (IN INCHES)

BORE	0 PSI	10 PSI	30 PSI	50 PSI	70 PSI	90 PSI
1½	.10	.09	.07	.06	.04	.00
2	.14	.11	.07	.04	.01	.00
2½	.18	.14	.08	.05	.02	.00
3¼	.14	.12	.08	.04	.01	.00
4	.17	.14	.09	.05	.02	.00
5	.18	.14	.07	.03	.01	.00
6	.23	.18	.10	.05	.01	.00
8	.31	.26	.15	.07	.03	.00

PER END STROKE REDUCTION
("A" DIMENSION) (IN INCHES)

BORE	0 PSI	10 PSI	30 PSI	50 PSI	70 PSI	90 PSI
1½	.048	.043	.035	.028	.021	.00
2	.069	.056	.037	.020	.010	.00
2½	.091	.070	.042	.024	.008	.00
3¼	.071	.059	.039	.020	.002	.00
4	.087	.069	.045	.026	.009	.00
5	.092	.072	.036	.013	.005	.00
6	.113	.091	.051	.023	.003	.00
8	.154	.132	.076	.037	.016	.00

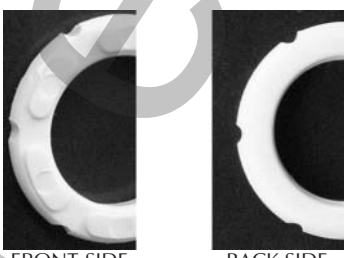


BASIC OPTIONS

H C LH LC ELH ELC Cushions

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

SEAL DESIGN



FRONT SIDE BACK SIDE

HEAD CUSHIONS

- **H** Standard Length Head Cushion
- **LH** Long Head Cushion
- **ELH** Extra-Long Head Cushion*

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

CAP CUSHIONS

- **C** Standard Length Cap Cushion
- **LC** Long Cap Cushion
- **ELC** Extra-Long Cap Cushion*

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

HOW TO SIZE CUSHIONS FOR YOUR APPLICATION

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

STEP 1: Determine the total load to be stopped by the cylinder. Include the piston rod weight *(see piston rod weight chart below)*.
STEP 2: Determine the velocity (in feet per second) at which the load impacts the cylinder end caps.
STEP 3: Use the following formula to calculate the energy the cylinder generates.
STEP 4: Using the table below, select the proper cushion length. Note: You can choose a larger bore size to increase cushion capacities.

CUSHION SIZING FORMULA:

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

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 2½" bore cylinder, 10" stroke, ⅝" piston rod, moving a 25 lb. load at 6 feet per second with 80 PSI air.

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

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

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

MAXIMUM ENERGY DATA				
BORE	K	H or C Standard Cushion Series Max Energy (ft-lbs)	LH or LC Long Cushion Series Max Energy (ft-lbs)	ELH or ELC Extra-Long Cushion Series Max Energy (ft-lbs)
1½	.06	8.2	12.8	26.9
2	.11	13.8	21.7	45.8
2½	.17	24.6	38.6	81.5
3¼	.25	45.7	83.6	172.2
4	.38	57.3	137.1	282.6
5	.59	94.6	226.0	465.8
6	1.37	225.5	334.4	767.6
8	2.43	411.3	609.8	1399.8
10	3.79	379.4	621.4	1620.9
12	5.47	554.8	908.8	2370.6

PISTON ROD WEIGHT CHART	
Rod Dia.	Piston Rod Weight*
⅝"	.35 lb. + .09 lb./in. of stroke
1"	1.1 lb. + .22 lb./in. of stroke
1⅜"	2.3 lb. + .42 lb./in. of stroke
1¾"	5.0 lb. + .68 lb./in. of stroke
2"	6.1 lb. + .88 lb./in. of stroke
2½"	10.4 lb. + 1.39 lb./in. of stroke

*Double Weight for double rod end cylinders.

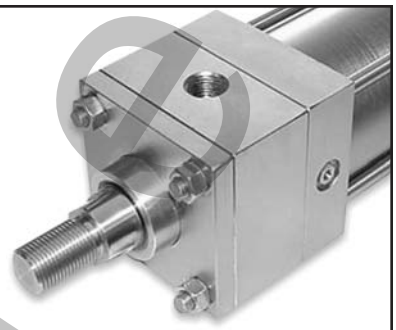
Design Tips:

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

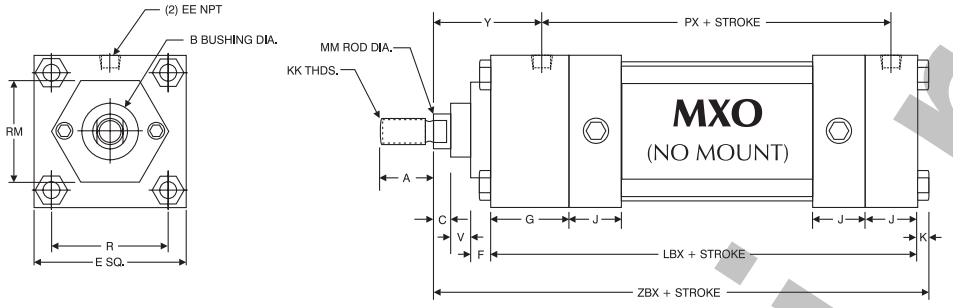
BASIC OPTIONS

ELH ELC

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



(TA-MS4-1½" X 6" ELH - EN) Shown



BASIC DIMENSIONS "MXO" STANDARD & OVERSIZE RODS

BORE	ROD DIAMETER	A	B	C	E	EE	F	G	J	K	KK	LBX	MM	PX	R	RM	V	Y	ZBX
1½	⅝ Standard	¾	1⅛	⅜	2	⅜	⅜	1½	1	¼	7/16-20	5⅝	⅝	4⅜	1.43	2 SQ.	¼	1⅞	6⅞
	1 Oversize	N/A	N/A	N/A							N/A		N/A				N/A	N/A	N/A
2	⅝ Standard	¾	1⅛	⅜	2½	⅜	⅜	1½	1	5/16	7/16-20	5⅝	⅝	4⅜	1.84	1¾ HEX	¼	1⅞	6 15/16
	1 Oversize	1⅛	1½	½							¾-16		1			2½ SQ.	½	2¼	7 5/16
2½	⅝ Standard	¾	1⅛	⅜	3	⅜	⅜	1½	1	5/16	7/16-20	5¾	⅝	4½	2.19	1¾ HEX	¼	1⅞	7 1/16
	1 Oversize	1⅛	1½	½							¾-16		1			3 SQ.	½	2¼	7 7/16
3¼	1 Standard	1⅛	1½	½	3¾	½	⅝	1¾	1¼	⅜	¾-16	6¾	1	5¼	2.76	2¾ DIA.	¼	2⅜	8½
	1⅜ Oversize	1⅝	2	⅝							1-14		1⅜			3¾ SQ.	⅜	2⅝	8¾
4	1 Standard	1⅛	1½	½	4½	½	⅝	1¾	1¼	⅜	¾-16	6¾	1	5¼	3.32	2¾ DIA.	¼	2⅜	8½
	1⅜ Oversize	1⅝	2	⅝							1-14		1⅜			3½ DIA.	⅜	2⅝	8¾
5	1 Standard	1⅛	1½	½	5½	½	⅝	1¾	1¼	7/16	¾-16	7	1	5½	4.10	2¾ DIA.	¼	2⅜	8 13/16
	1⅜ Oversize	1⅝	2	⅝							1-14		1⅜			3½ DIA.	⅜	2⅝	9 1/16
6	1⅜ Standard	1⅝	2	⅝	6½	¾	⅝	2	1½	7/16	1-14	8	1⅜	6¼	4.88	3½ DIA.	⅜	2¾	10 1/16
	1¾ Oversize	2	2⅜	¾							1¼-12		1¾				½	3	10 5/16
8	1⅜ Standard	1⅝	2	⅝	8½	¾	⅝	2	1½	9/16	1-14	8⅛	1⅜	6⅜	6.44	3½ DIA.	⅜	2¾	10 5/16
	1¾ Oversize	2	2⅜	¾							1¼-12		1¾				½	3	10 9/16
10	1¾ Standard	2	2⅜	¾	10⅝	1	⅝	2¼	2	11/16	1¼-12	10⅜	1¾	8 5/16	7.92	3½ DIA.	½	3 1/16	12 15/16
	2 Oversize	2¼	2⅝	⅞			¾				1½-12		2			5 DIA.	⅜	3 3/16	13 1/16
12	2 Standard	2¼	2⅝	⅞	12¾	1	¾	2¼	2	11/16	1½-12	10⅞	2	8 13/16	9.40	5 DIA.	⅜	3 3/16	13 9/16
	2½ Oversize	3	3⅛	1							1⅞-12		2½				½	3 7/16	13 13/16

CUSTOM LENGTH CUSHIONS

Custom length cushions can be designed for your application. *Contact TRD for details!*

Example: An OEM manufacturer of industrial equipment needed a cylinder to shuttle a 125 lb. rolling (and guided) fixture 36 inches of travel, at low airline pressure to avoid operator injury. TRD developed a 3½" long head and cap cushion to meet the operating specifications.

BASIC OPTIONS

BSPT British Standard Pipe Taper

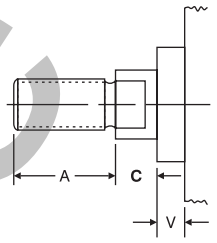
British Standard Pipe Taper **(BSPT)** threads have the same taper as American NPT tapered threads, but use a 55° Whitworth thread form and different diameters. (Not interchangeable with NPT)

BSPP British Standard Pipe Parallel

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

C= Extended Piston Rod

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



EN Electroless Nickel

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

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

COMMON USAGES:

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

EN CYLINDER SPECIFICATIONS

EN PLATED PARTS:

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

OTHER COMPONENTS:

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

EN PLATING SPECIFICATIONS:

HIGH PHOSPHORUS (highest corrosion resistant Electroless Nickel plating available)

COMPOSITION:	87-90% Nickel, 10-13% Phosphorus
HARDNESS:	Rc 46-48
THICKNESS:	.0005"-.0007"
LUBRICITY:	Excellent (Similar to chrome)
COEFFICENT OF FRICTION:	Low
FINISH:	Bright and very smooth

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

NEW

TRD PART NUMBER REVISION:

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

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

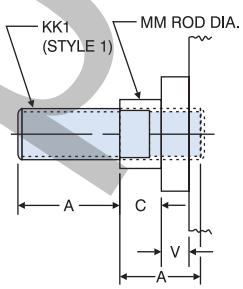
By offering "EN" as an option, you can now make any TRD Series an Electroless Nickel Plated cylinder!

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

KK3S 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.



LF Low Friction

"LF" Low Friction 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 (-25°C to 90°C)

OPERATING PRESSURE: 250 PSI AIR (17 BAR)

NEW

TRD PART NUMBER REVISION:

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

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

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

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

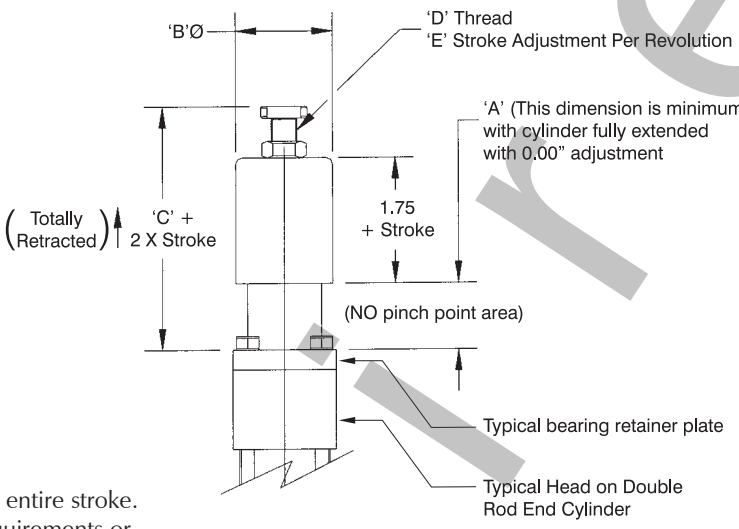
BASIC OPTIONS

MA Micro-Adjust

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

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

SKETCH A



TA-MF1D-MA (SHOWN)

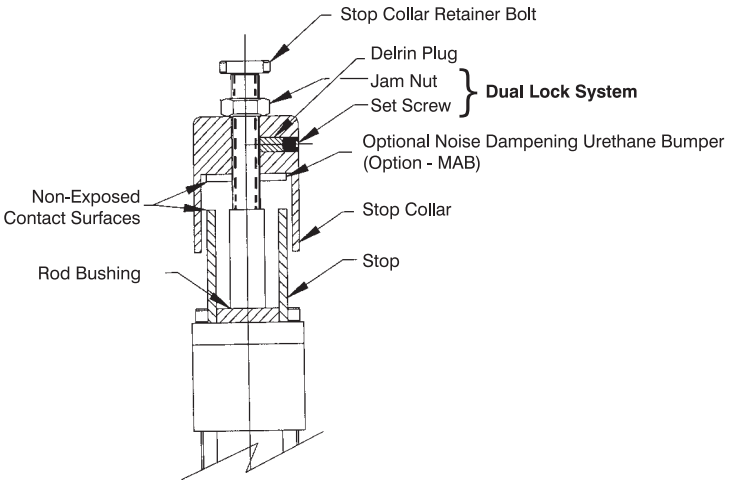
MICRO-ADJUST DIMENSIONS					
BORE	A	B	C	D	E
1½	1.00	1.88	3.71	½-20	.050
2	1.00	1.88	3.71	½-20	.050
2½	1.00	1.88	3.71	½-20	.050
3¼	1.00	2.81	3.71	¾-16	.063
4	.75	2.81	3.47	¾-16	.063
5	.75	2.81	3.47	¾-16	.063
6	.75	3.75	3.47	¾-16	.063
8	.75	3.75	3.47	¾-16	.063

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

MICRO-ADJUST SET-UP INSTRUCTIONS:

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

SKETCH B



MAB Micro-Adjust with Urethane Bumper

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

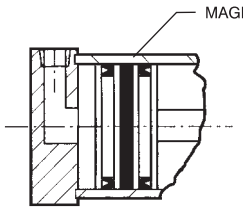
If the option you need isn't listed, just call TRD! We can accommodate most requests.

BASIC OPTIONS

MPR MPH Magnetic Piston

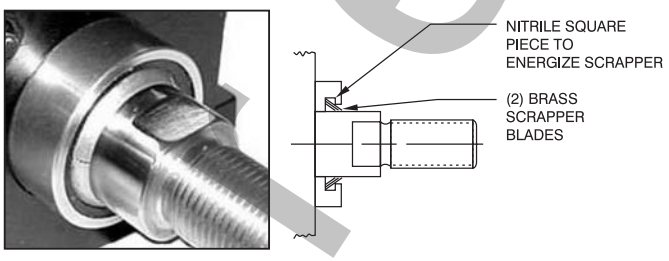
"MPR" Magnetic Pistons are used in conjunction with TRD R10, R10P, RAC Reed and MSS Solid State Switches. *(See pages 105-111 for switches)*

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



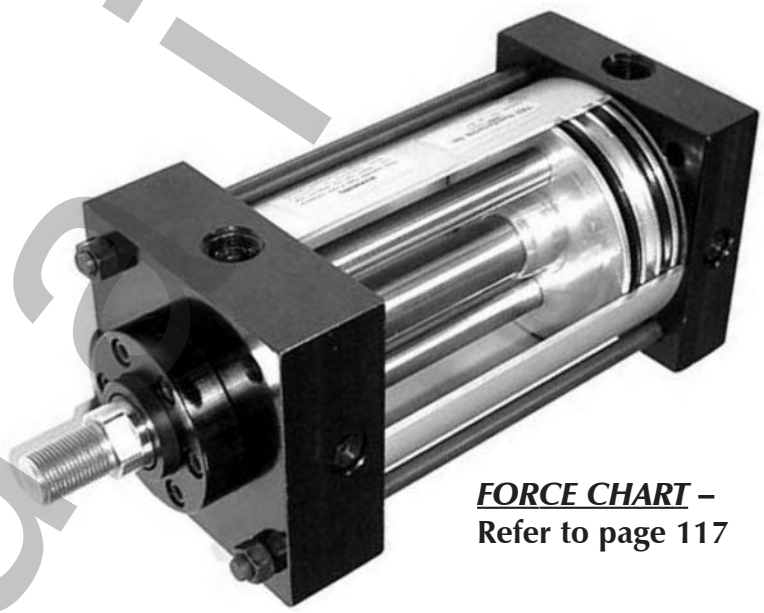
MS Metallic Rod Scapper

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



NR Non-Rotating (NFPA) Cylinders

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



FORCE CHART **– Refer to page 117**

Benefits

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

Advantages

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

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

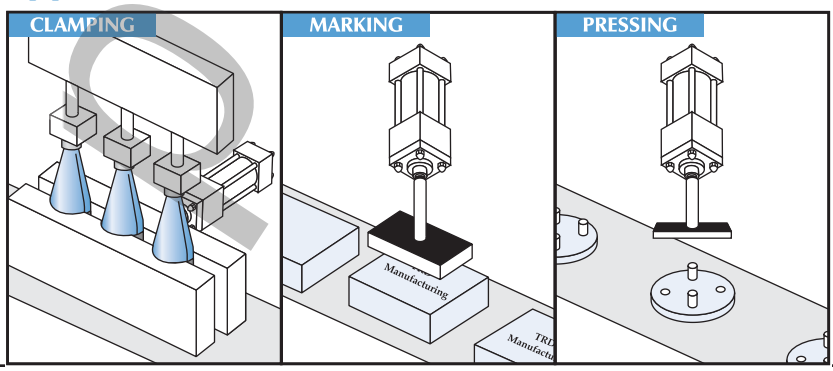
NEW **TRD PART NUMBER REVISION:**
The "NR" Series used to be ordered as:
NR - MS4 - 2 X 10.

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

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

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

Application Possibilities:



'NR' GUIDE ROD SIZES AND MAX. STROKE

BORE	ROD DIA.	CUSHIONS	GUIDE ROD DIAMTERS	MAXIMUM STROKE
2	5/8 Standard	Cap Only	0.250	10"
2 1/2	5/8 Standard	Cap Only	0.312	12"
	1 Oversize	N/A	0.312	12"
3 1/4	1 Standard	Available	0.375	18"
	1 3/8 Oversize	Cap Only	0.375	18"
4	1 Standard	Available	0.625	30"
	1 3/8 Oversize		0.625	30"
5	1 Standard	Available	0.625	30"
	1 3/8 Oversize		0.625	30"
6	1 3/8 Standard	Available	0.625	30"
	1 3/4 Oversize		0.625	30"
8	1 3/8 Standard	Available	1.000	40"
	1 3/4 Oversize		1.000	40"
10	1 3/4 Standard	Available	1.000	40"
	2 Oversize		1.000	40"
12	2 Standard	Available	1.000	40"
	2 1/2 Oversize		1.000	40"

BASIC OPTIONS

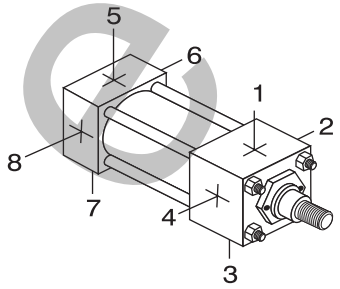
OP Optional Port Location

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

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

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

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



NEW Optional Port and Cushion at Same Location

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

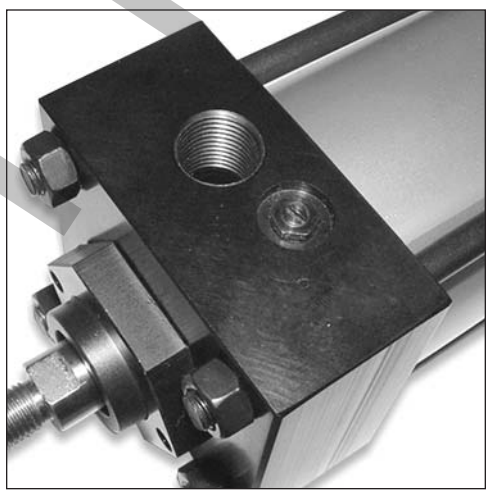
Ordering Examples:

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

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

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

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



BASIC DIMENSIONS:

HEAD VIEWS

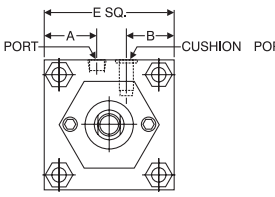


FIGURE #1

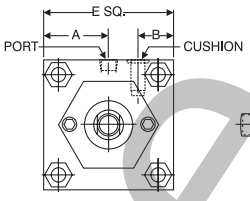
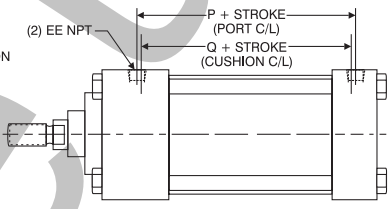


FIGURE #2



CAP VIEWS

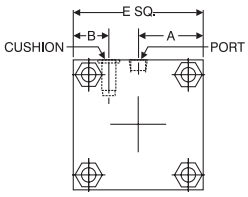


FIGURE #2

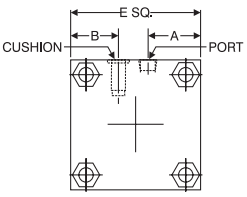


FIGURE #1

BORE	ROD DIAMETER	FIGURE	A	B	E	P	Q	EE
1 1/2	5/8 Standard	1	3/4	5/8	2	2 3/8	2 1/8	1/4
	1 Oversize	N/A	N/A	N/A	N/A			
2	5/8 Standard	1	7/8	15/16	2 1/2	2 3/8	2 1/8	3/8
	1 Oversize	1	1	3/4	2 1/2			
2 1/2	5/8 Standard	1	1 1/8	1 1/8	3	2 1/2	2 1/4	3/8
	1 Oversize	1	1 1/8	1	3			
3 1/4	1 Standard	1	1 1/2	1 3/8	3 3/4	2 3/4	2 1/2	1/2
	1 3/8 Oversize	2	1 7/8	1	3 3/4			
4	1 Standard	2	2 1/4	1 1/4	4 1/2	2 3/4	2 1/2	1/2
	1 3/8 Oversize	2	2 1/4	1 1/8	4 1/2			
5	1 Standard	2	2 3/4	1 3/4	5 1/2	3	3	1/2
	1 3/8 Oversize	2	2 3/4	1 5/8	5 1/2			
6	1 3/8 Standard	2	3 1/4	1 7/8	6 1/2	3 1/4	3	3/4
	1 3/4 Oversize	2	3 1/4	1 7/8	6 1/2			
8	1 3/8 Standard	2	4 1/4	2 3/4	8 1/2	3 3/8	3 1/8	3/4
	1 3/4 Oversize	2	4 1/4	2 3/4	8 1/2			
10	1 3/4 Standard	2	5 5/16	3 11/16	10 5/8	4 5/16	4 1/8	1
	2 Oversize	2	5 5/16	3 11/16	10 5/8			
12	2 Standard	2	6 3/8	4 3/4	12 3/4	4 13/16	4 5/8	1
	2 1/2 Oversize	2	6 3/8	4 3/4	12 3/4			

BASIC OPTIONS

OS Oversize Rod

OVERSIZED PISTON ROD | STANDARD PISTON ROD

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

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

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

RECOMMENDED SAE PORT SIZE BY CYLINDER BORE			
BORE	SAE#	BORE	SAE#
1½	#4 (7/16-20)	5	#6 (9/16-18)
2	#4 (7/16-20)	6	#8 (¾-16)
2½	#4 (7/16-20)	8	#8 (¾-16)
3¼	#6 (9/16-18)	10	#10 (⅞-14)
4	#6 (9/16-18)	12	#10 (⅞-14)

SE Spring Extend (1½"-2½" Bore)

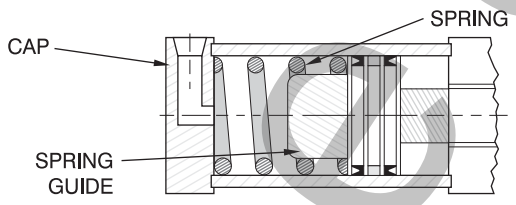
"SE" Option is designed to provide a spring bias to extend cylinder in the event of air pressure loss.

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.

1½", 2" AND 2½" BORE SPECS			
STROKE (inches)	OVERALL LENGTH ADDER FOR "SE" OPTION (inches)	SPRING RATE (lbs. per inch)	SPRING FORCE AT FULL EXTEND (lbs.)
½	⅝	18	16
1	⅞	12	13
1½	1⅛	9	12
2	1⅜	7	11
2½	1½	7	12

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



SR Spring Retract (1½"-2½" Bore)

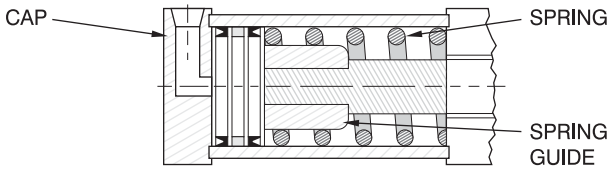
"SR" Option is designed to provide a spring bias to retract cylinder in the event of air pressure loss.

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.

1½", 2" AND 2½" BORE SPECS			
STROKE (inches)	OVERALL LENGTH ADDER FOR "SR" OPTION (inches)	SPRING RATE (lbs. per inch)	SPRING FORCE AT FULL RETRACT (lbs.)
½	¾	18	16
1	1	12	13
1½	1½	9	12
2	1½	7	11
2½	1⅝	7	12
3	2½	6	10
3½	3	6	10
4	3¼	6	10
4½	3¾	6	9
5	4	6	9
5½	4	5	8
6	4	5	8

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



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

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

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

SSF Stainless Steel Fasteners (Bushing Retainer Screws)

SSR Stainless Steel Piston Rod (Hard-Chrome Plated)

SST Stainless Steel Tie Rods and Nuts

BASIC OPTIONS

ST Stop Tube

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

Stop Tube Selection

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

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

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

Example:

TA - MP1 - 3¼" X 40" effective stroke - ST=2

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

Chart 1

Find the value of "D" for your application

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

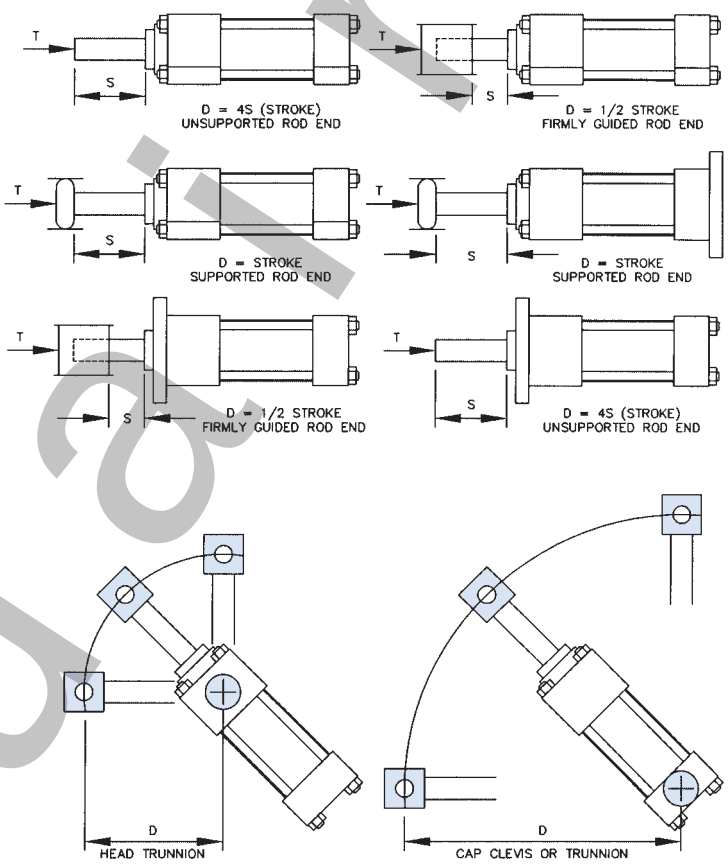


Chart 2

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

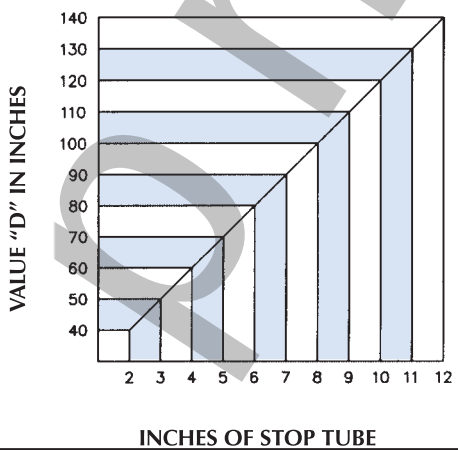
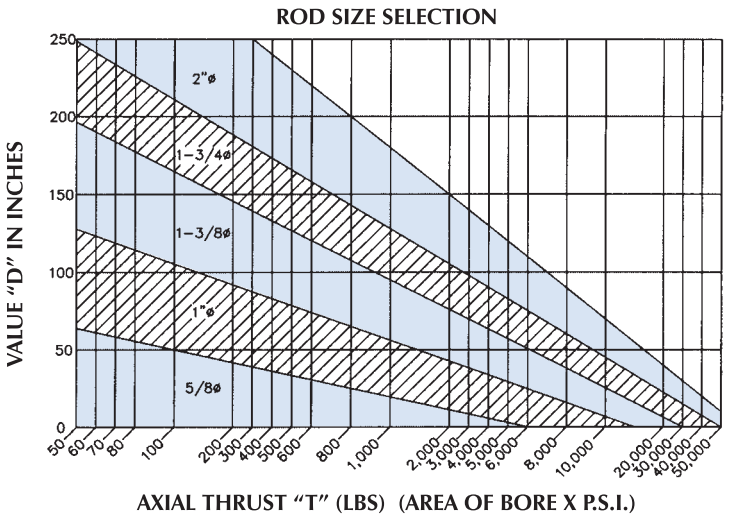


Chart 3



BASIC OPTIONS

STEEL TUBE

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

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

BENEFITS:

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

DESIGN TIPS:

- The steel tube option was designed to replace many 100% all steel cylinders in use today, but it is not intended to replace "mill" type cylinder applications. Since "TA" Series mounts are standard, they may not offer adequate strength to replace 1-piece all steel pivot style mount applications. As an option, TRD can furnish 1-piece steel mounts on request.
- For applications where internal tube scoring is an issue, use "WB" wearband option.
- Since hard chrome plating is not a 100% homogenous coating, steel cylinders are prone to internal rusting of the cylinder bore when used in pneumatic applications. Care must be taken to remove excessive line moisture and properly lubricate the air with standard FRL units for maximum seal life.
- For end of stroke position sensing, see pages 112 - 115 for Balluff Proximity end of stroke Sensors.

TH 400 PSI Hydraulic (Non-Shock)

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

RATING: 400 PSI Hydraulic, Non-Shock

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

NEW **TRD PART NUMBER REVISION:**
The "TH" Series used to be ordered as:
TH - MS4 - 2 X 10.
(Note: The "TH" Series was the "TA" Series with "TH" 400 PSI feature)
By offering "TH" as an option, you can now make the "TA" or "FM" Series a 400 PSI Hydraulic cylinder!
New Part Number: TA - MS4 - 2 X 10 - TH

VS Fluorocarbon Seals

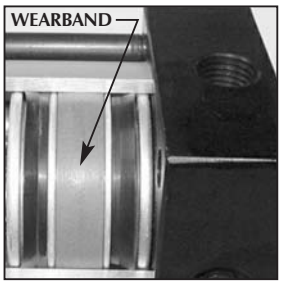
Benefits of Fluorocarbon Seals:

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

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

WB Piston Wear Band

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



Material: 90% Virgin PTFE
10% Polyphenylene Sulfide
Tensile Strength: 2,700 - 3,300 PSI
Compressive Modulus: 65,000 PSI
Wear Factor: Extremely low

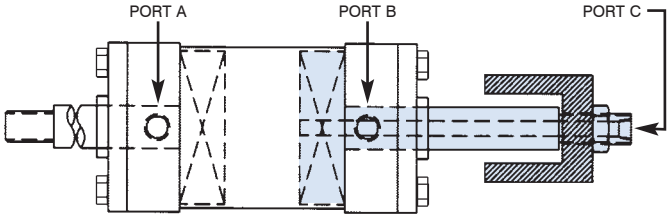
Special wear band widths are available. (Note: MPR magnetic piston options are available with Piston Wear Bands)

UNCOMMON OPTIONS

AS3POS — Adjustable Mid Stroke (3 Position Cyl.)

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

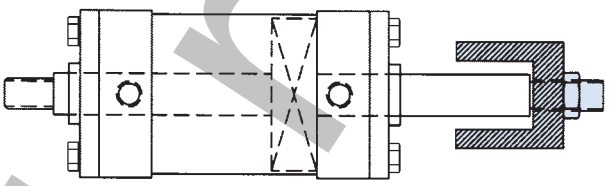
To order, specify "AS3POS" and length of adjustment. (Example: AS3POS = 4")



DAS — Double Rod Adjustable Stroke (Extend)

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

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



SPHERICAL PIVOT BEARINGS

Spherical pivot bearing mounts can be furnished as a weldment.

Contact TRD with your specifications.

EXTRA WIDE MULTIPLE WEAR BANDS

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

HOLLOW PISTON RODS

This cylinder shows a multitude of options:

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

ROD BOOTS

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

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

SPECIAL MF1 FLANGE

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

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

SPECIAL SHORT TAP WITH ORIFICE

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

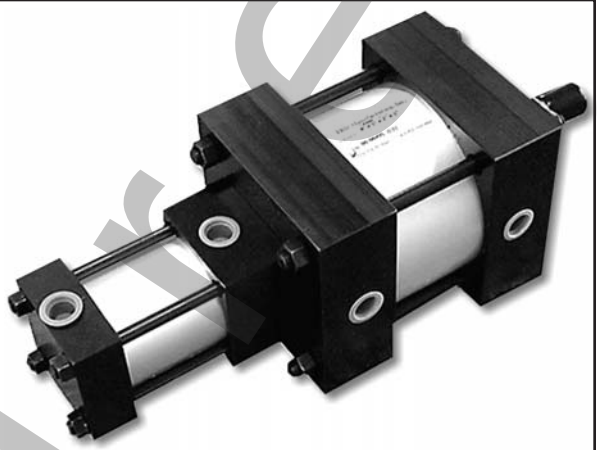
UNCOMMON OPTIONS AND SPECIALS

MT4X BOLT-ON SIDE PLATES

'FM' WITH FLUSH ROD BUSHING

'FM' WITH NO ROD BUSHING

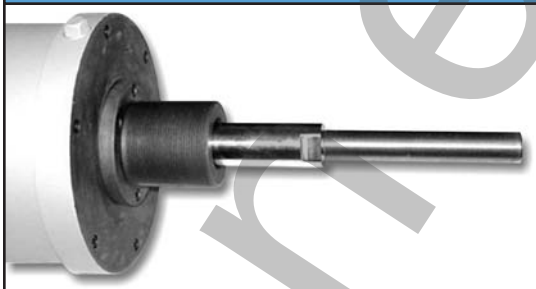
TANDEM WITH DIFFERENT SIZE BORES



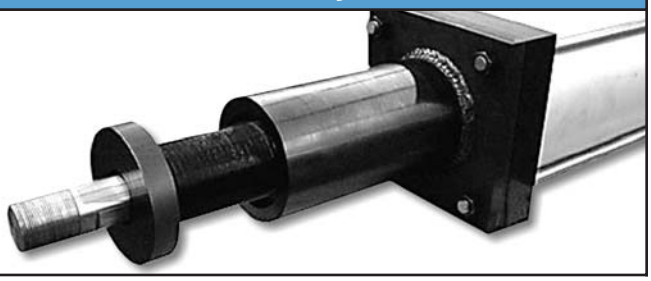
SOLID BRASS PISTONS

168" STROKE STAINLESS STEEL

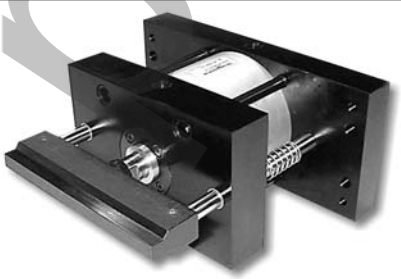
7" BORE STEEL NON-TIE ROD DESIGN WITH "STEEL-IT" PAINT (FOOD GRADE DESIGN)



8" BORE - FRONT EXTENSION ADJUSTABLE STROKE



EXTERNAL NON-ROTATING WITH SPECIAL TOOL PLATE



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

BALLUFF

MICROPULSE
Linear Position Transducers

Enhanced Magnetostrictive Technology

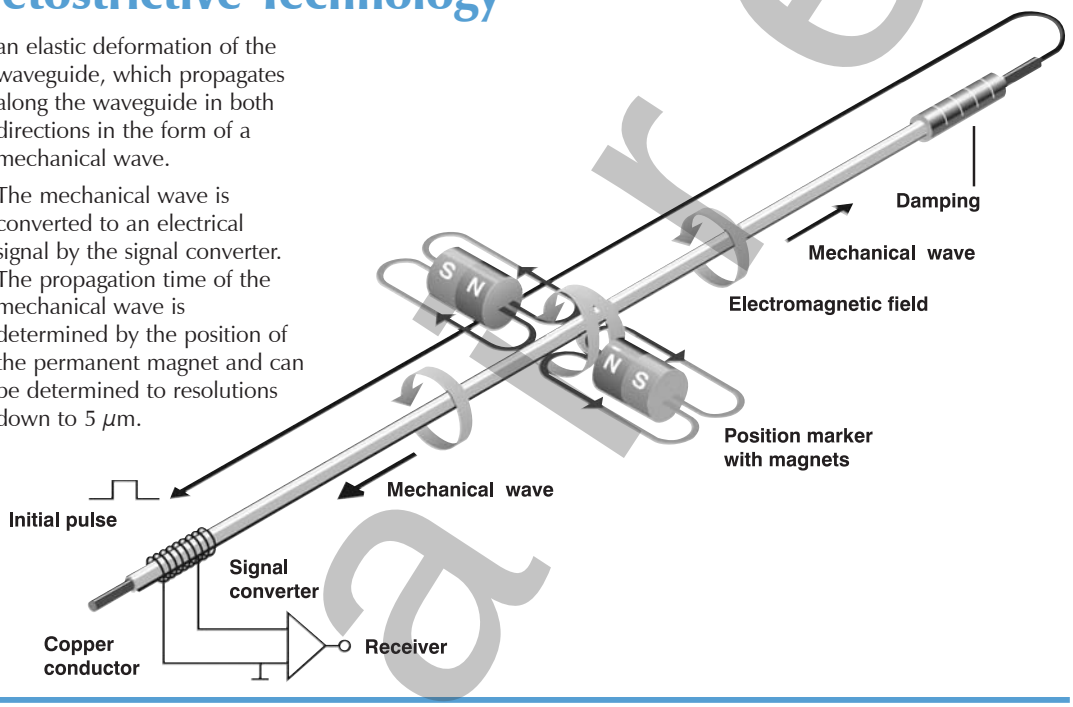
The waveguide consists of a special nickel-iron alloy with 0.7 mm O.D. and 0.5 mm I.D.

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

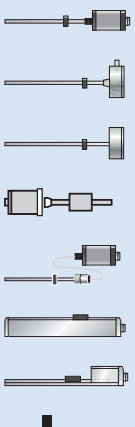
A permanent magnet at the point of measurement is used as the marker element, whose lines of field run at right angles to the electromagnetic field.

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

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



MICROPULSE



Balluff has the right transducer for any application!

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

Rod Style

Z

- ¾" x 16 UNF threads
- Pressure rated to 8700 PSI for use in hydraulic cylinders
- Replaceable electronics head
- Analog signal adjustable in field

Rugged, Compact Rod Style

W

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

Compact, Bolt-in Rod Style

K

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

Low-Profile Housing

R

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

	Z	W	K	R
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)	●			
10 µm				
Stroke Length				
Active measurement area: 2" to 156" (Consult factory for longer lengths)	2" - 156"	2" - 156"	2" - 156"	2" - 156"
Wiring Options				
Quick disconnect	●	●	●	●
Cable-out	●	●	●	●
Operating Voltage				
24 V DC (±20%)	●	●	●	●
±15 V DC (±2%)	●	●	●	

*(24 or 25 bit binary or gray code)

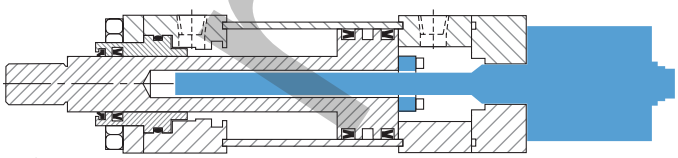
BALLUFF TRANSDUCERS

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

INTERNAL MODELS (BALLUFF Z, W, K SERIES)

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

SERIES "Z" SHOWN



EXTERNAL MODEL (BALLUFF R SERIES)

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

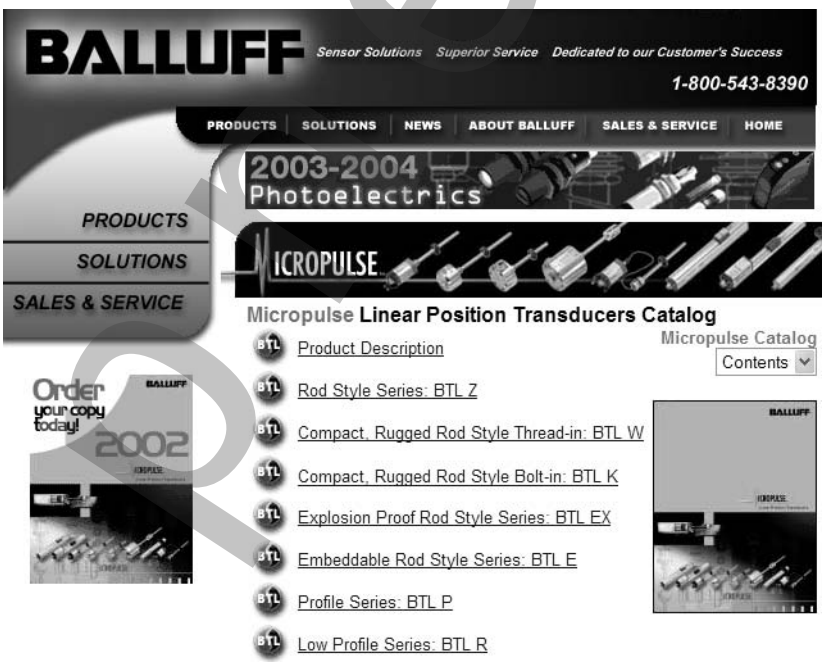
SERIES "R" SHOWN

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

  Visit www.balluff.com/micropulsecatalog2002

- Other Balluff models are available. Call TRD Mfg. (800-654-2535, ext. 216) for information and cylinder design assistance.

SERIES "R" SHOWN



SERIES "Z" SHOWN