



# Medium Duty Hydraulic Cylinders

Series 3L



ENGINEERING YOUR SUCCESS.

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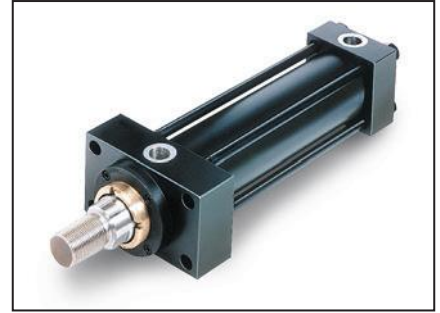
**Series CHE / CHD**

- 20 through 100mm Bore Sizes
- Stroke Lengths to 150mm
- Operating Pressure to 207 bar
- 4 Different Rod Ends Available



**Series RDH**

- 1.50 through 8.00 Bore Sizes
- Gross stroke available in any practical length
- Operating Pressure to 3,000 psi
- 9 Standard Mounting Styles



**Series HMI**

- Bore Sizes 25 through 200mm
- ISO 6020/2 Interchangeable
- 12 Standard Mounting Styles
- 210 Bar Hydraulic Pressure



**Custom Cylinder**

- Bore Sizes to 42.00"
- Stroke Lengths to 70'
- Operating Pressure to 10,000 psi
- Third Party Agency Approval



**Series 2H**

- Bore Sizes 1.50" through 6.00"
- 3000 psi Hydraulic Service
- 16 NFPA Mounting Styles
- Specials to Order



**3LX**

- Bore Sizes 2.00" through 8.00"
- LDT or LRT Feedback
- Integrated Manifolds Available
- Protective Covers Available

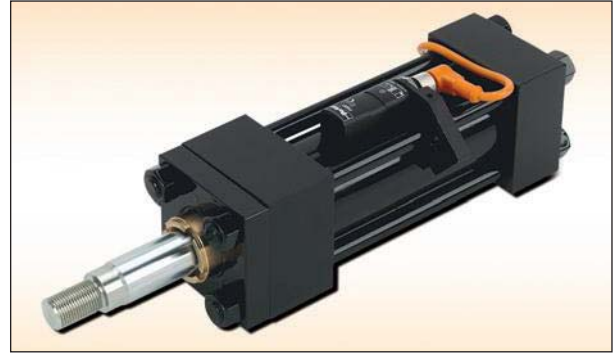
Parker Hannifin's Cylinder Division offers products that are designed to meet and exceed the most demanding application requirements. Our extensive product line offers OEM's and End Users hydraulic and pneumatic cylinder solutions that provide value through reduced maintenance, increased productivity, and long service life. Parker Cylinder's wide breadth of product encompasses NFPA, ISO, and Custom designed products in a multitude of configurations and sizes.



## Series 3L/2H Magnetic Piston

Position Sensing Technology  
for Hydraulic Cylinders

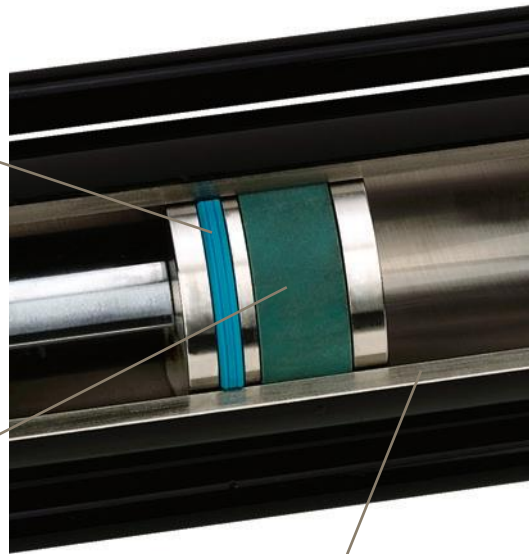
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Series 3L Cylinder – with Hi-Load magnetic piston

**Durable polyurethane bi-directional seal** – for positive sealing with no by-pass and long life.

**WearGard™ wear band** – improves resistance to bearing loads and provides support for magnet.



**Cylinder Body** – Standard steel material for ALS Switch or 316 stainless steel for conventional solid state or reed switches. Aluminum material available for global switches at reduced operating pressure rating. See facing page for details.

### Customer Value Proposition:

Parker's magnetic sensing option for hydraulic steel/tie rod construction cylinders provides OEM's and end users the ability to sense piston position in an economical and reliable fashion through the use of innovative magnet and switching technology. The magnetic piston option offers all users the choice to eliminate added cylinder

machining costs, stand alone external brackets/hardware, and reduced system set-up time. By incorporating sensing capability into steel/tie rod style cylinders, the need to fabricate, install, wire, and adjust stand alone proximity switches can be eliminated – thus providing a clean and more efficient position monitoring system.

### Product Features:

- Available for Series 3L, 2H and 2A cylinders
- Available for Series 2H in 1.50" - 6.00" bores. Series 3L and 2A in 1.00" - 4.00" bores.
- Available on 15 different mounting styles
- Adjustability over the entire working stroke length
- Multiple switches can be used per cylinder
- Non intrusive design eliminates potential leakage



# Magnetic Switch Choices

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## Making The Best Choice

Parker's ALS Switch and Global Switch are designed to offer customers an alternative means of sensing hydraulic cylinder piston position. Depending on the application, and the budget, one switch type may be better suited to fulfill customer needs than the other. Some of the important things to consider when analyzing what switch to choose are listed at right.

- Can be positioned at any location along the cylinder to indicate end-of-stroke or mid-stroke locations.
- Allow multiple switches to be installed with numbers only restricted by available tie rod mounting space.
- Available for Series 2H in 1.50" - 6.00" bores. Series 3L and 2A in 1.00" - 4.00" bores.

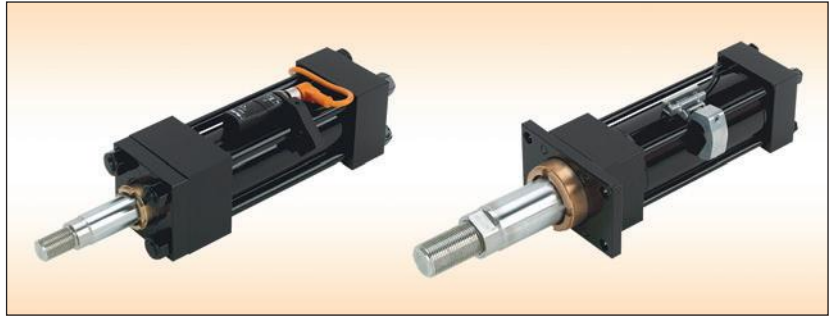
## Maximum Pressure Rating for 3L Cylinder with Aluminum Tube

| Bore Ø | Pressure Rating (psi) <sup>1</sup> |
|--------|------------------------------------|
| 1.00   | 1900                               |
| 1.50   | 1500                               |
| 2.00   | 1100                               |
| 2.50   | 950 <sup>2</sup>                   |
| 3.25   | 750                                |
| 4.00   | 600                                |

<sup>1</sup> When using Series 3L cylinders with aluminum bodies, do not introduce any shock or high inertia loading conditions. Pressure spikes must be avoided.

<sup>2</sup> Maximum pressure for aluminum tube in 2.50" bore with code 7 rod is 700 psi.

## Technology Comparison

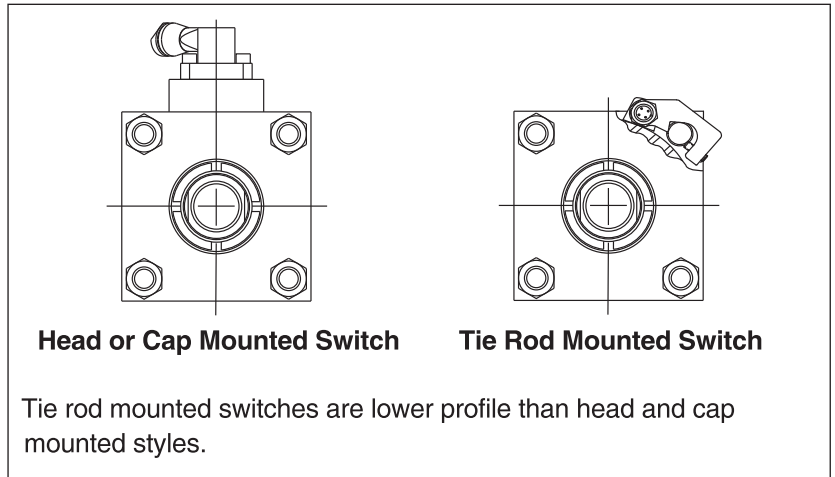


### ALS Switch

- Compatible with standard steel tube
- +10 to +30 VDC power requirement
- PNP/NPN wired NO or NC
- Solid state construction
- 2 LED indicators (power & target)
- 12mm connector
- IP 67 rated
- Temperature Range: -25°C to +85°C
- Short circuit protection

### Global Switch

- Uses 316 stainless steel tube (aluminum tube is optional in Series 3L and 2A)
- +10 to +30 VDC, +10 to +120 VAC power requirement
- PNP/NPN, Reed
- Solid state construction
- 1 power LED indicator
- 12mm or 8mm connector, flying leads
- IP 68 rated
- Temperature Range: -25°C to +75°C
- Short circuit protection



Head or Cap Mounted Switch

Tie Rod Mounted Switch

Tie rod mounted switches are lower profile than head and cap mounted styles.



## Extreme High Temperature Seal Option – Up to 400° F

For Series 3L, 2H/2HD, 3H/3HD and 2A Cylinders

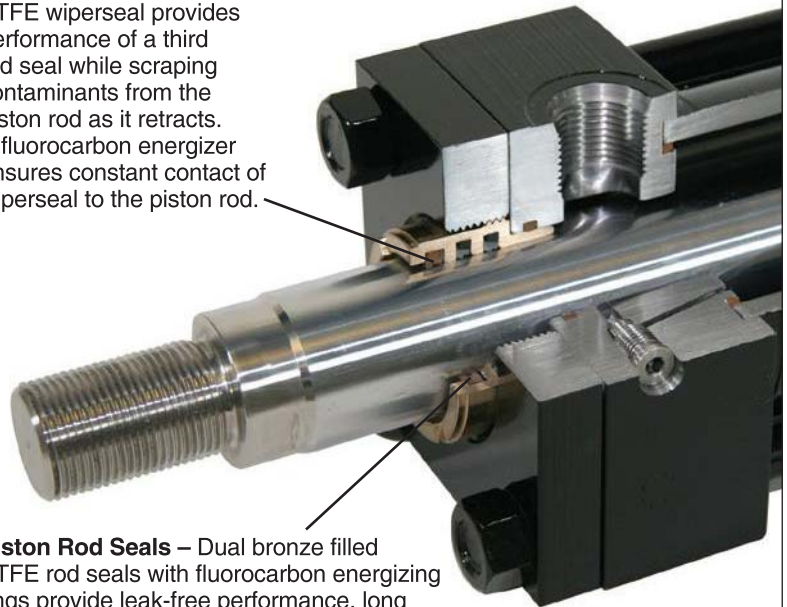
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### Customer Value Proposition:

Parker’s Extreme High Temperature Seal Option will provide OEM’s and End Users an increase in machine productivity through improved resistance to heat degradation as compared to typical fluorocarbon seals. With a maximum continuous temperature rating of 400° F, the Extreme High Temperature Seal Option will allow longer service life in applications that require the use of alternative fluid types and demand superior heat resistance. Parker’s innovative seal design utilizes PTFE materials that are constantly energized to provide excellent seal performance and long life. Customers utilizing this design will realize a reduction in machine downtime due to seal failure associated with high temperature exposure.

**Wiperseal** – Unique profile of bronze filled PTFE wiperseal provides performance of a third rod seal while scraping contaminants from the piston rod as it retracts. A fluorocarbon energizer ensures constant contact of wiperseal to the piston rod.



**Piston Rod Seals** – Dual bronze filled PTFE rod seals with fluorocarbon energizing rings provide leak-free performance, long life, and heat resistance to 400° F.

### Product Features:

- Operating temperature to 400° F
- Broad range of fluid compatibility
- Available bore sizes: 1.50" through 8.00"; rod diameters 1.000" through 5.500"
- Stainless steel spring loads both dynamic and static piston seal lips
- No additional delivery time



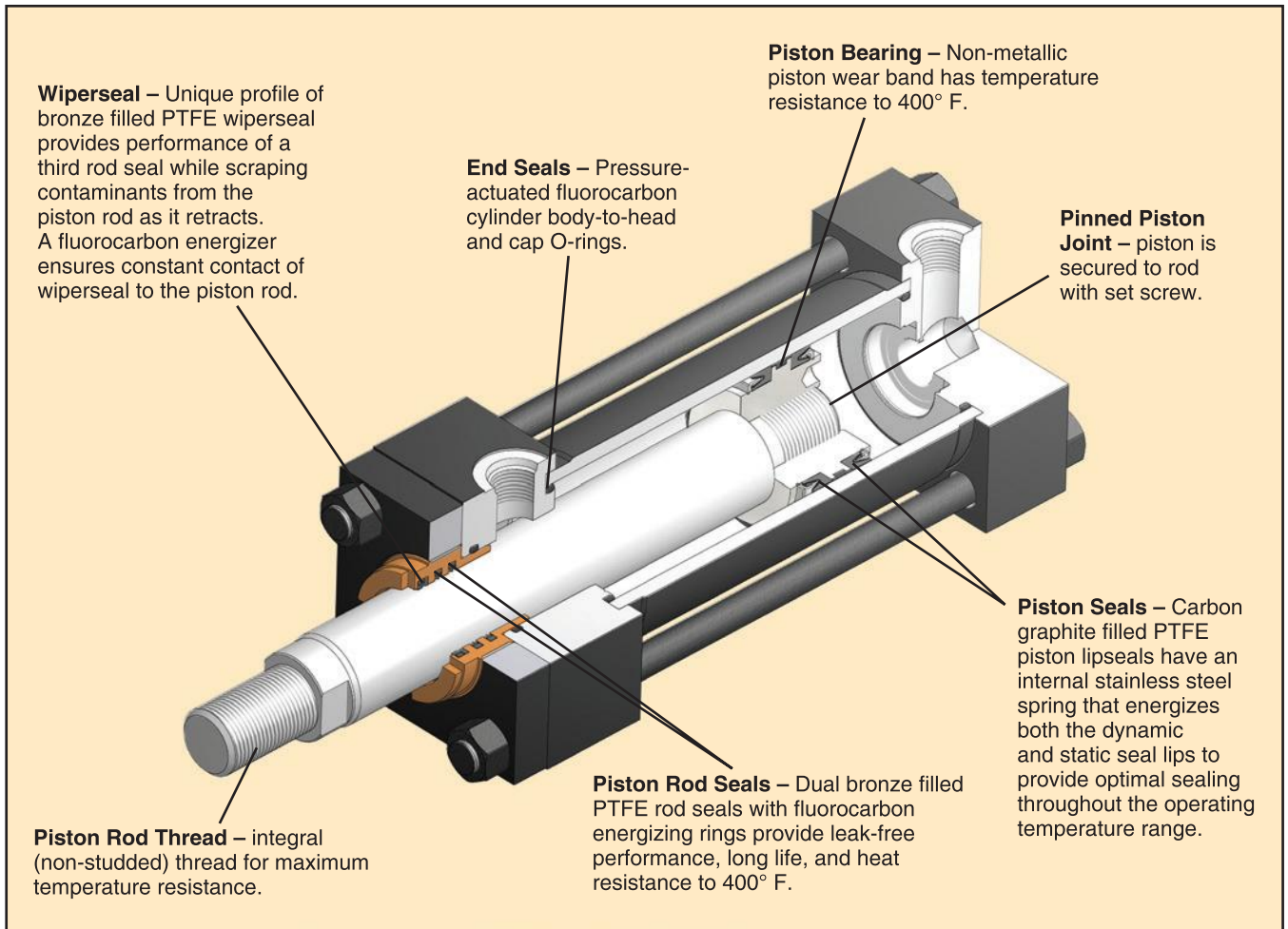
# Cylinders for High Temperature Applications

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When your customer demands a long life cylinder with outstanding heat resistance, look no further than Parker's new Extreme High Temperature Seal option.

Filled PTFE piston seals, rod seals, and wiperseal provide maximum resistance to extreme heat (up to 400° F) with excellent service life.

PTFE seals are mechanically energized to maintain uniform contact to dynamic sealing surfaces for positive leak-free performance across the entire operating pressure range. Static seals are fluorocarbon for a complete heat resistant assembly.



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With annual sales of approximately \$13 billion in fiscal year 2015, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company employs approximately 55,000 people in 50 countries around the world. Parker has increased its annual dividends paid to shareholders for 59 consecutive fiscal years, among the top five longest-running dividend-increase records in the S&P 500 index. For more information, visit the company's website at [www.parker.com](http://www.parker.com), or its investor information website at [www.phstock.com](http://www.phstock.com).

**Parker is Engineering**

Fluid Power and application expertise provide customers the

opportunity to use us as an extension of their design teams. From new system design to improvements required for existing applications, Parker offers unparalleled engineering expertise. We'll help you develop cost saving, high performance solutions that provide value through increased productivity, improved machine efficiency, and reduced downtime.

Our design engineers utilize the highest quality materials and cutting edge manufacturing processes available to push the envelope for performance, value and reliability.

Parker components and systems are made to last. We offer complete system solutions for the following industries:

- Plastics
- Metal Forming
- Steel
- Press
- Off Shore Oil
- Forestry
- Mining
- Entertainment
- Flight Simulation
- Fatigue Testing
- Automation

**Worldwide Supplier to Industrial Markets**

Parker Hannifin is the world's leading supplier of motion and control technologies that include; motion control products, systems, and complete engineered solutions for industrial markets. Parker's broad and extensive breadth of product offer single



source capability with limitless possibilities. Our industrial product solutions range from state of the art stand-alone components to complete engineered systems that are designed to provide value and efficiency to all of our customers. Each component and system is backed up with superior application expertise and technical support that you would expect from Parker Hannifin.





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## ***Manufacturing Locations***

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**California**  
221 Helicopter Circle  
Corona, CA 92880  
Tel.: (951) 280-3800  
Fax: (951) 280-3808  
Fax: (800) 869-9886

**Connecticut**  
80 Shaker Road  
Enfield, CT 06082  
Tel.: (860) 749-2215  
Fax: (800) 323-0105

**Georgia**  
1300 Six Flags Road  
Lithia Springs, GA 30122  
Tel.: (770) 819-3400  
Fax: (800) 437-3498

**Indiana**  
Goodland Plant  
715 South Iroquois Street  
Goodland, IN 47948  
Tel.: (219) 297-3182  
Fax: (800) 328-8120

**Michigan**  
900 Plymouth Road  
Plymouth, MI 48170  
Tel.: (734) 455-1700  
Fax: (734) 455-1007

**Oregon**  
29289 Airport Road  
Eugene, OR 97402-0079  
Tel.: (541) 689-9111  
Fax: (541) 688-6771  
Fax: (800) 624-7996



## Section A

### Series 3L Medium Duty Hydraulic Cylinders

|  | 1.00" - 5.00" Bore | 6.00" & 8.00" Bore      |
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| TB, TC, TD and T Mount Dimensions              | 12                 | 28                      |
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| F Mount Dimensions                             | 19                 | 32                      |
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| DB Mount Dimensions                            | 22                 | 35                      |
| DD Mount Dimensions                            | 23                 | 36                      |
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# The medium-duty hydraulic cylinder with a proven record of performance.

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Parker Series 3L cylinders provide value through proven reliability, efficient performance, and quality that you expect from every Parker Cylinder Division product line. Each Series 3L cylinder incorporates design features one would not expect to see in a 1,000 psi nominally rated cylinder. These features include the “Jewel” rod gland, adjustable floating cushions, case hardened piston rod assemblies, and high strength tie rods with

rolled threads instead of cut threads. Each and every Parker cylinder is hand built and tested before it leaves our facility to ensure leak and trouble free operation. At Parker, we place a high emphasis on quality and design to ensure value and productivity for all of our customers. Make the Parker Series 3L your choice for medium duty hydraulic cylinders today and for the future.



**Standard Specifications**

- Medium Duty Service – ANSI/(NFPA) T3.6.7R3-2009 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 1000 psi Dependent on Bore Size<sup>1</sup>
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10°F to +165°F<sup>2</sup>
- Bore Sizes – 1.00" through 8.00"

Note: Series 3L Hydraulic Cylinders fully meet ANSI/(NFPA) T3.6.7R3-2009 Specifications and Mounting Dimensions for Square Head Industrial Fluid Power Cylinders.

*In line with our policy of continuing product improvement, specifications in this catalog are subject to change.*

- Piston Rod Diameter – 0.500" through 5.500"
- Mounting Styles – 15 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Rod Ends – Four Standard Choices – Specials to Order

<sup>1</sup> See Section D to determine maximum pressure rating by bore and rod combination.

<sup>2</sup> See Section D – Fluids/Temperature/Pressure Ratings for information regarding higher temperature service.

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**Available Mounting Styles**

|   |  |  |  |
|---|--|--|--|
| <p>Basic<br/><b>Style T</b></p> <p>(NFPA MX0)</p>                   | <p>Tie Rods Extended Head End<br/><b>Style TB</b></p> <p>(NFPA MX3)</p>  | <p>Tie Rods Extended Cap End<br/><b>Style TC</b></p> <p>(NFPA MX2)</p> | <p>Tie Rods Extended Both Ends<br/><b>Style TD</b></p> <p>(NFPA MX1)</p> |
| <p>Head Rectangular Flange<br/><b>Style J</b></p> <p>(NFPA MF1)</p> | <p>Head Square Flange<br/><b>Style JB</b></p> <p>(NFPA MF5)</p>          | <p>Head Rectangular<br/><b>Style JJ<sup>3</sup></b></p>                | <p>Cap Rectangular Flange<br/><b>Style H</b></p> <p>(NFPA MF2)</p>       |
| <p>Cap Square Flange<br/><b>Style HB</b></p> <p>(NFPA MF6)</p>      | <p>Side Lug<br/><b>Style C</b></p> <p>(NFPA MS2)</p>                     | <p>Side Tapped<br/><b>Style F</b></p> <p>(NFPA MS4)</p>                | <p>Head Trunnion<br/><b>Style D</b></p> <p>(NFPA MT1)</p>                |
| <p>Cap Trunnion<br/><b>Style DB</b></p> <p>(NFPA MT2)</p>           | <p>Intermediate Fixed Trunnion<br/><b>Style DD</b></p> <p>(NFPA MT4)</p> | <p>Cap Fixed Clevis<br/><b>Style BB</b></p> <p>(NFPA MP1)</p>          | <p>Spherical Bearing<br/><b>Style SB</b></p>                             |
| <p>Double Rod<br/>Cylinders</p> <p><b>Style KTB<br/>Shown</b></p>   |  |  |  |

<sup>3</sup>Parker Style JJ mount for the Series 3L is a non-NFPA mount.

Most of the above illustrated mounting styles are available in double rod cylinders.



# The inside story on why Series 3L is your best choice in medium duty hydraulic cylinders

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**Primary Seal** – TS-2000 Rod Seal is a proven leakproof design – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur.

**Secondary Seal** – Double-Service Wiperseal™ wipes clean any oil film adhering to the rod on the extend stroke and cleans the rod on the return stroke.

**Piston Rod Stud** – Furnished on 2.000" diameter rods and smaller when standard style #4 rod end threads are required. Studs have rolled threads and are made from high strength steel. Anaerobic adhesive is used to permanently lock the stud to the piston rod.

**Piston Rod** – Medium carbon steel, induction case-hardened, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 85,000 to 100,000 psi minimum yield material in .500" through 4.000" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter. The piston thread equals the catalog style #4 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.

**Alloy Steel Tie Rod Nuts**

**Steel Head** – Bored and grooved to provide concentricity for mating parts.

**End Seals** – Pressure-actuated cylinder body-to-head and cap o-rings.

**“Jewel” Rod Gland Assembly** – Externally removable without cylinder disassembly. Long bearing surface is inboard of the seals, assuring positive lubrication from within the cylinder. An o-ring is used as a seal between gland and head, and also serves as a prevailing torque-type lock.

**Align-A-Groove** – A  $\frac{3}{16}$ " wide surface machined at each end of the cylinder body. Makes precise mounting quick and easy.

**The Cylinder Body** – Heavy-wall steel tubing, honed to a micro finish bore.

## Adjustable floating cushions

Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. All Parker cushions are adjustable.

The Series 3L cylinder design incorporates the longest cushion sleeve and cushion spear that can be provided in the standard envelope without decreasing the rod bearing and piston bearing lengths.

- (1) When a cushion is specified at the head end:
  - a. A self-centering sleeve is furnished on the piston rod assembly.
  - b. A needle valve is provided that is flush with the side of the head when wide open. It may be identified by the fact that it is socket keyed. It is located on side number 2, in all mounting styles except D, DB and DD. In these styles it is located on side number 3.
  - c. On 3.25" bores and larger, a springless check valve is provided that is also flush with the side of the head and is mounted adjacent to the needle valve except on certain bores of mounting style C where it is mounted opposite the needle valve. It may be identified by the fact that it is slotted.
- d. The check and needle valves are interchangeable in the head.
- e. 1.00" - 2.50" bore 3L's utilize a slotted sleeve design in place of the check valve.
- (2) When a cushion is specified at the cap end:
  - a. A cushion spear is provided on the piston rod assembly.
  - b. A "float check" self-centering bushing is provided which incorporates a large flow check valve for fast "out-stroke" action.
  - c. A socket-keyed needle valve is provided that is flush with the side of the cap when wide open. It is located on side number 2 in all mounting styles except D, DB, and DD. In these styles it is located on side number 3.



**One-Piece Nodular Iron Piston** – The wide piston surface contacting cylinder bore reduces bearing loads. Anaerobic adhesive is used to permanently lock and seal the piston to the rod.

**High Strength Tie Rods** – Made from 100,000 psi minimum yield steel with rolled threads for added strength.

**Steel Cap** – Bored and grooved to provide concentricity for mating parts.

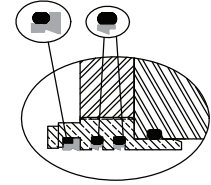
**Ports** – NPTF ports are standard.

**Optional Ports**

**Ports** – SAE “O” ring ports are optional at no extra charge. Oversize NPTF and SAE ports are available at extra charge.

**Seals** – Buna-N (Nitrile) seals are standard.

**Fluorocarbon Seals** – Optional at extra charge.



**Optional High Temperature Gland**

– Dual filled PTFE rod seals and filled PTFE wiper seal are energized with fluorocarbon o-rings to maintain consistent contact with the piston rod. Excellent sealing performance produce dry rod on extend stroke with rod scraping to clean rod on retract. Combine with Spring Loaded PTFE Piston Seals for cylinder heat resistance to 400° F. See class 8 seal specification on Operating Fluids and Temperature Range page.

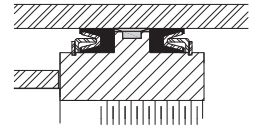
**Lipseal Piston**

Zero leakage under static conditions. Seals are self-compensating to conform to variations in pressure, mechanical deflection, and wear. Back-up washers prevent extrusion.

**Optional Spring Loaded PTFE Piston Seals**

Filled PTFE piston Lipseals utilize an internal stainless steel spring to energize both the dynamic and static sealing lips to optimize seal performance throughout the operating temperature range. Non-metallic piston wear ring reduces possibility of damaging piston which can score expensive tubing. Combine with High Temperature Gland

for cylinder heat resistance to 400° F. See class 8 seal specification on Operating Fluids and Temperature Range page.



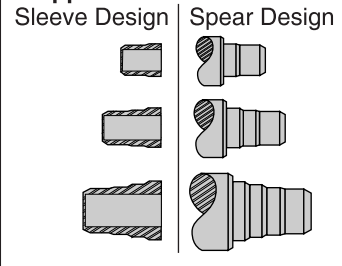
**Cushion Length**

| Bore Ø | Rod Ø <sup>1</sup> | Rod Number | Cushion Length    |      |
|--------|--------------------|------------|-------------------|------|
|        |                    |            | Head <sup>1</sup> | Cap  |
| 1.00   | 0.500              | 1          | 0.88              | 0.75 |
|        | 0.625              | 2          | 0.88              | 0.75 |
| 1.50   | 0.625              | 1          | 0.88              | 0.81 |
|        | 1.000              | 2          | 0.88              | 0.81 |
| 2.00   | 0.625              | 1          | 0.88              | 0.81 |
|        | 1.375              | 2          | 0.88              | 0.81 |
| 2.50   | 1.000              | 1          | 0.88              | 0.81 |
|        | 1.750              | 2          | 0.88              | 0.81 |
| 3.25   | 1.000              | 1          | 1.13              | 1.00 |
|        | 2.000              | 2          | 0.81              | 1.00 |
| 4.00   | 1.375              | 1          | 1.13              | 1.00 |
|        | 2.500              | 2          | 0.81              | 1.00 |
| 5.00   | 1.750              | 1          | 1.13              | 1.00 |
|        | 3.500              | 2          | 0.81              | 1.00 |
| 6.00   | 1.750              | 1          | 1.38              | 1.25 |
|        | 4.000              | 2          | 1.06              | 1.25 |
| 8.00   | 2.000              | 1          | 1.06              | 1.25 |
|        | 5.500              | 2          | 0.94              | 1.25 |

<sup>1</sup>Head end cushions for rod diameters not listed have cushion lengths within the limits shown.

**Adjustable Stepped Floating Cushions** – Optional at extra charge. For faster cycle time and increased productivity – for maximum performance – economical and flexible for even the most demanding applications – reduces shock and machine noise – lower maintenance costs – can be supplied at head, cap or both ends.

**Optional Adjustable Floating Stepped Cushions**



## Application Checklist

The following checklist should be used to select the best possible cylinder for a given application. Additional information can be referenced in the following pages to help assist in this process. In the event that you have additional questions or concerns, or if more information is required, please contact your local Parker distributor or our customer service representatives for assistance.

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- 1. Establish the system requirements**..... **Series 3L**
  - How heavy is the load to be moved?
  - What is the nominal operating pressure of the system?
  - How far does the load have to move?
  - What is the speed at which the load will move?
  - What is the fluid type and the temperature to which the cylinder will be exposed?
- 2. Mounting Style**..... Page 7
  - Determine the best mounting style for the application.
- 3. Cylinder Bore and Operating Pressure**..... Page 64
  - Review the theoretical push and pull force for a given bore size to determine.
- 4. Piston Rod**..... Page 74
  - Determine what rod size will be required to avoid buckling.
  - Determine if a single or double rod cylinder is required.
  - Determine the rod end style and rod end thread.
  - Will stop tubing be required?
- 5. Piston Seals** ..... Page 5
  - Determine the best seal type for your application.
  - Select the proper seal type and configuration for the application.
  - Select the proper seal to assure fluid and temperature compatibility.
- 6. Cushioning** ..... Page 78
  - Determine if cushions are required to safely stop the load.
- 7. Ports**..... Page 69
  - Select the best possible port size for a given speed requirement.
  - Select port position.
- 8. Piston rod and mounting accessories**..... Page 42
  - Determine how you will attach the cylinder to the load.
- 9. Custom modifications**..... Page 55





## Mounting Styles & Tips for Applying Them

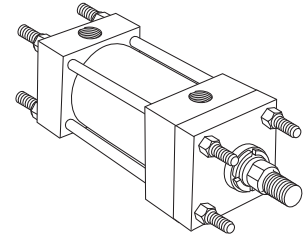
### Extended Tie Rod Mountings – TB, TC and TD

**Application:**

- Straight line force transfer
- Compression loads (push)  
– use TC or TD
- Tension loads (pull)  
– use TB or TD

**Advantages:**

- Ease of mounting in tight spaces
- Force is transferred along the centerline of the cylinder



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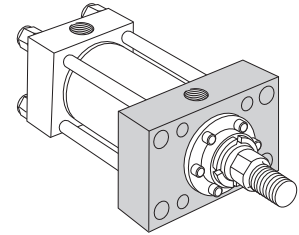
### Flange Mountings – J, JB, JJ, H and HB

**Application:**

- Straight line force transfer
- Compression loads (push)  
– use H or HB
- Tension loads (pull)  
– use J, JB, or JJ

**Advantages:**

- Rigid base mounting due to large flange area
- Force is transferred along the centerline of the cylinder



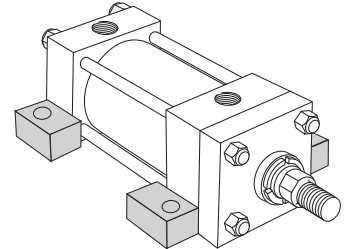
### Side Tap Mounting – F / Side Lug Mounting – C

**Application:**

- Straight line force transfer
- Can be used in compression or tension loads
- Thrust key and secure mounting area are vital

**Advantages:**

- Ease of mounting



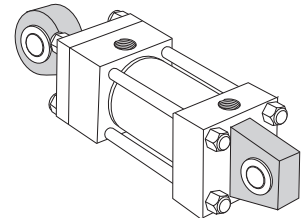
### Pivot Mountings – BB and SB

**Application:**

- Curved or arc line force transfer
- Can be used in compression or tension loads
- Movement in a simple arc  
– use BB mountings
- Movement in a compound arc  
– use SB mountings

**Advantages:**

- Ease of mounting
- Design flexibility
- Self aligning (SB)



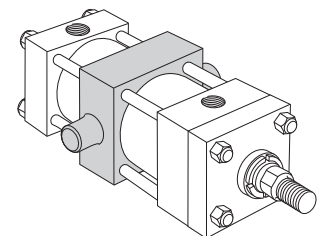
### Trunnion Mountings – D, DB and DD

**Application:**

- Curved or arc line force transfer
- Can be used in compression or tension loads
- Compression loads – use DB or DD mountings
- Tension loads – use D or DD mountings

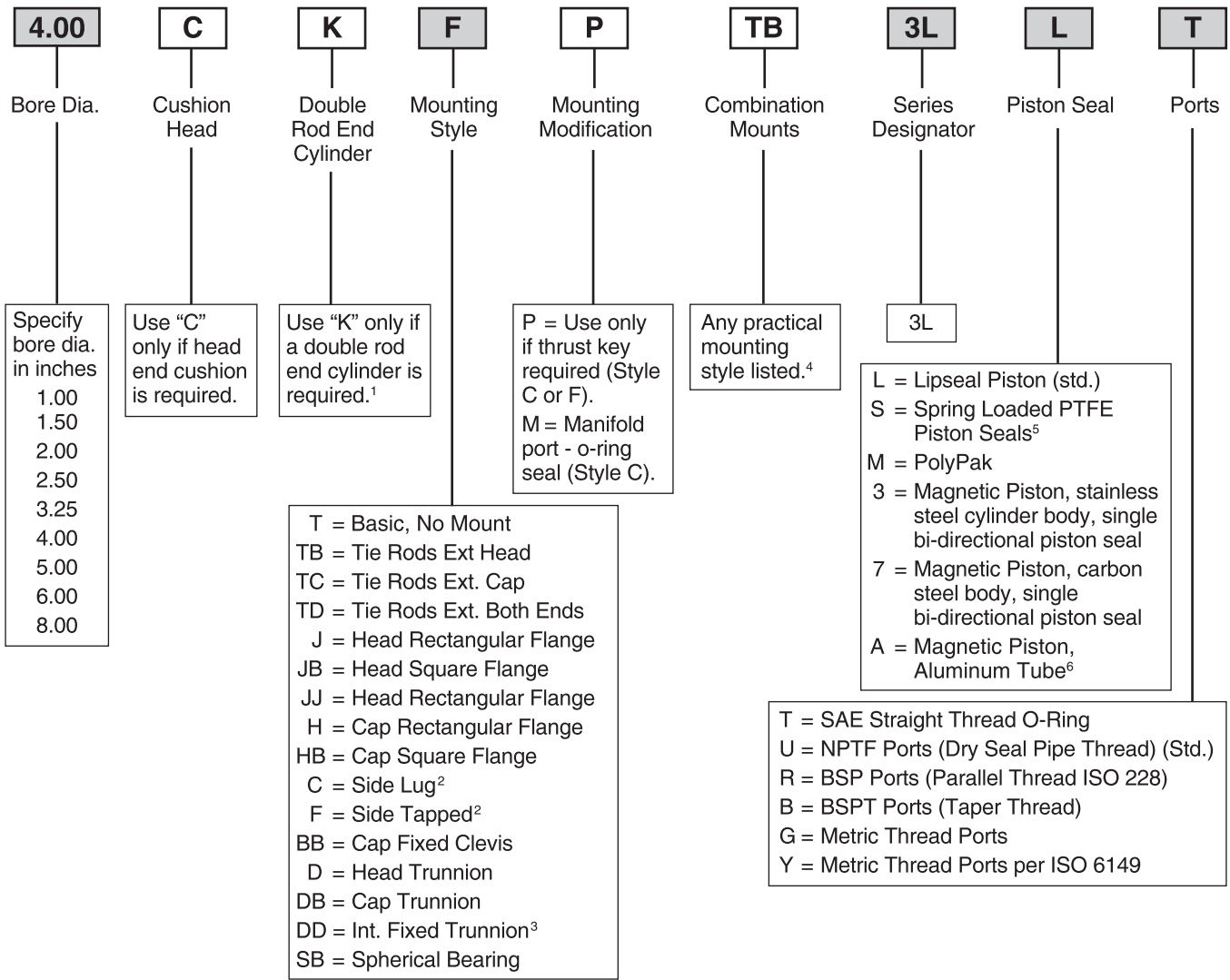
**Advantages:**

- Ease of mounting
- Design flexibility
- Self aligning



3L Model Code

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Shaded boxes identify required model number fields.

<sup>1</sup> Available mounting styles for K Type cylinders are located at the end of Section A. When ordering a double rod end cylinder, the piston rod number and piston rod end threads are to be specified for both rod ends.

The model number should be created as viewing the primary rod end on the left hand side.

Example: K Type Cylinder:  
4.00CKTD3LT14A28AC10.000

<sup>2</sup> Mounting Styles C and F should have a minimum stroke length equal to or greater than their bore size.

<sup>3</sup> Specify XI dimension.

<sup>4</sup> In general, the model numbers as read left to right corresponding to the cylinder as viewed from left to right with the primary end at the left. The second or subsequent mountings are mountings called out as they appear in the assembly moving away from the rod end. Except when tie rod extension mountings are part of a combination, all combinations should have a "S" (Special) in the model code and a note in the body of the order clarifying the mounting arrangement. The "P", as used to define a thrust key is not considered to be a mounting. However it is located at the primary end.

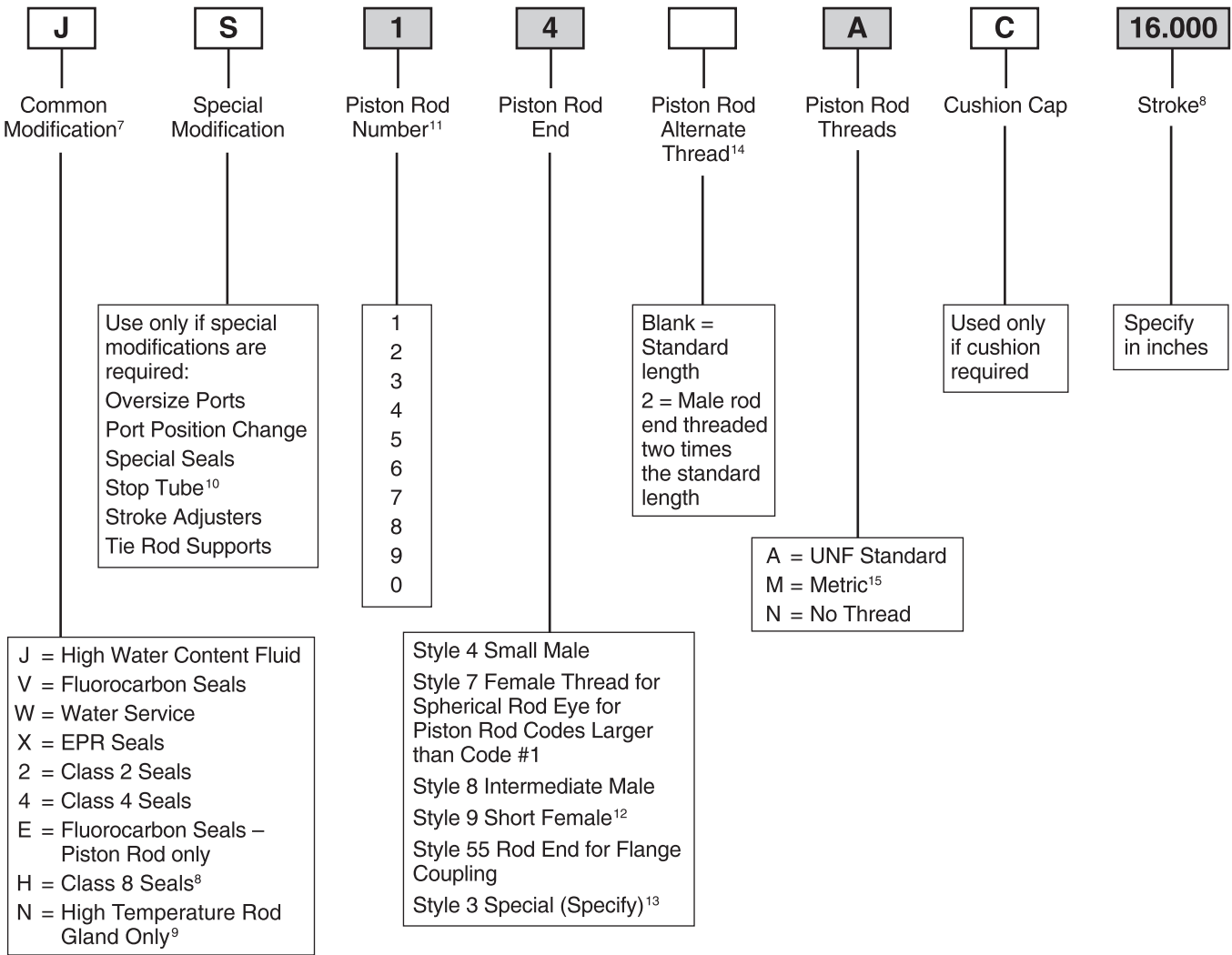
<sup>5</sup> Spring loaded PTFE piston seals are not available in 1.50", 2.00" and 2.50" bore with Code 2 rod.

<sup>6</sup> See 3L pressure rating table on Introduction page III for aluminum tube option associated with magnetic piston.



3L Model Code

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Shaded boxes identify required model number fields.

<sup>7</sup> See common modifications Section C for additional options.

<sup>8</sup> Cast iron piston ring seals will be supplied in 1.50", 2.00" and 2.50" bores with Code 2 rod when Class 8 seals are specified.

<sup>9</sup> Energized PTFE rod seals & wiper seal. All other seals are fluorocarbon.

<sup>10</sup> S = Stop Tube. Specify: stop tube length, net stroke and gross stroke. Gross stroke = stop tube length + net stroke. Gross stroke to be placed in the model number field.

Example:

2.000 inches long stop tube

+14.000 inches net stroke

16.000 inches gross stroke

<sup>11</sup> Refer to Rod buckling chart in Section D to assure rod number selected will not buckle under load.

<sup>12</sup> Style 9 stroke restrictions may apply. See Style 9 Minimum Stroke Table for details.

<sup>13</sup> Provide dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

<sup>14</sup> Available only in combination with rod end Style 4 or Style 8.

<sup>15</sup> See Section C for detailed information regarding standard metric rod end thread sizes.

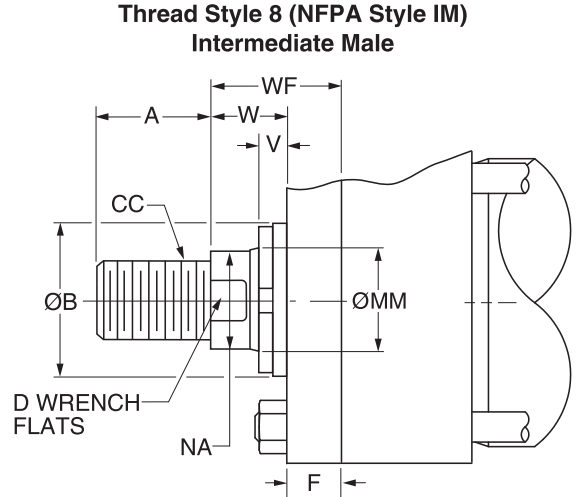
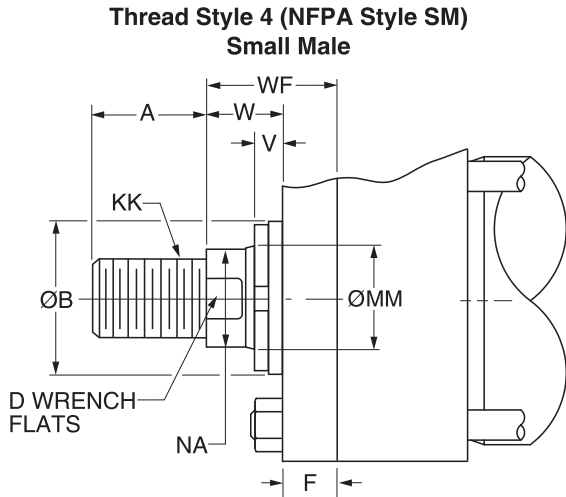
Style 9 Minimum Stroke Table

| Bore Ø      | Rod Ø | Minimum Stroke |
|-------------|-------|----------------|
| 1.00 - 4.00 | All   | None           |
| 5.00        | 2.000 | None           |
|             | 2.500 | 1.000          |
|             | 3.000 | 1.375          |
|             | 3.500 | 1.625          |
| 6.00        | 2.500 | None           |
|             | 3.000 | 1.375          |
|             | 3.500 | 1.375          |
|             | 4.000 | 2.000          |
| 8.00        | 3.500 | 1.500          |
|             | 4.000 | 1.500          |
|             | 5.000 | 2.875          |
|             | 5.500 | 3.625          |



**Rod End Dimensions**

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**Rod End Dimensions**

| Bore Ø | Rod No.  | MM Rod Ø | Thread        |               | A    | B Ø<br>+.000<br>-.002 | D    | F    | NA   | V    | W    | WF   |
|--------|----------|----------|---------------|---------------|------|-----------------------|------|------|------|------|------|------|
|        |          |          | Style 8<br>CC | Style 4<br>KK |      |                       |      |      |      |      |      |      |
| 1.00   | 1 (Std.) | 0.500    | 7/16-20       | 5/16-24       | 0.63 | 0.999                 | 0.38 | 0.38 | 0.44 | 0.25 | 0.63 | 1.00 |
|        | 2        | 0.625    | 1/2-20        | 7/16-20       | 0.75 | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 |
| 1.50   | 1 (Std.) | 0.625    | 1/2-20        | 7/16-20       | 0.75 | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 |
|        | 2        | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 |
| 2.00   | 1 (Std.) | 0.625    | 1/2-20        | 7/16-20       | 0.75 | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 |
|        | 2        | 1.375    | 1 1/4-12      | 1-14          | 1.63 | 1.999                 | 1.13 | 0.38 | 1.31 | 0.63 | 1.25 | 1.63 |
|        | 3        | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 |
| 2.50   | 1 (Std.) | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 |
|        | 2        | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00 | 2.374                 | 1.50 | 0.38 | 1.69 | 0.75 | 1.50 | 1.88 |
|        | 3        | 1.375    | 1 1/4-12      | 1-14          | 1.63 | 1.999                 | 1.13 | 0.38 | 1.31 | 0.63 | 1.25 | 1.63 |
|        | 7        | 0.625    | 1/2-20        | 7/16-20       | 0.75 | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 |
| 3.25   | 1 (Std.) | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 |
|        | 2        | 2.000    | 1 3/4-12      | 1 1/2-12      | 2.25 | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 |
|        | 3        | 1.375    | 1 1/4-12      | 1-14          | 1.63 | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 |
|        | 4        | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00 | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 |
| 4.00   | 1 (Std.) | 1.375    | 1 1/4-12      | 1-14          | 1.63 | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 |
|        | 2        | 2.500    | 2 1/4-12      | 1 7/8-12      | 3.00 | 3.124                 | 2.06 | 0.63 | 2.38 | 0.63 | 1.63 | 2.25 |
|        | 3        | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00 | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 |
|        | 4        | 2.000    | 1 3/4-12      | 1 1/2-12      | 2.25 | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 |
|        | 7        | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 |
| 5.00   | 1 (Std.) | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00 | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 |
|        | 2        | 3.500    | 3 1/4-12      | 2 1/2-12      | 3.50 | 4.249                 | 3.00 | 0.63 | 3.38 | 0.63 | 1.63 | 2.25 |
|        | 3        | 2.000    | 1 3/4-12      | 1 1/2-12      | 2.25 | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 |
|        | 4        | 2.500    | 2 1/4-12      | 1 7/8-12      | 3.00 | 3.124                 | 2.06 | 0.63 | 2.38 | 0.63 | 1.63 | 2.25 |
|        | 5        | 3.000    | 2 3/4-12      | 2 1/4-12      | 3.50 | 3.749                 | 2.63 | 0.63 | 2.88 | 0.63 | 1.63 | 2.25 |
|        | 7        | 1.000    | 7/8-14        | 3/4-16        | 1.13 | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 |
|        | 8        | 1.375    | 1 1/4-12      | 1-14          | 1.63 | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 |

**“Special” Thread Style 3**

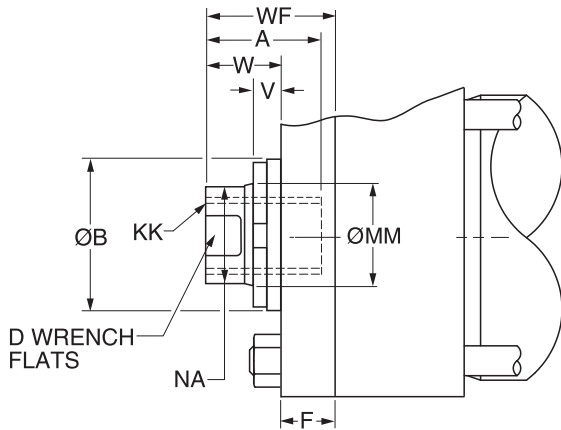
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify “Style 3” and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

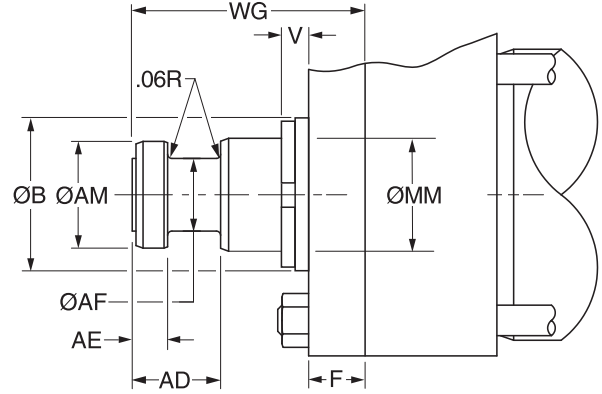


**Rod End Dimensions**

**Thread Style 9<sup>2</sup> (NFPA Style SF)  
Small Female**



**Style 55<sup>1</sup>  
Flanged Rod End**



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**Rod End Dimensions**

| Bore Ø | Rod No.  | MM Rod Ø | Thread<br>Style 9<br>KK | Rod Extensions and Pilot Dimensions |      |                      |         |         |                       |      |      |      |      |      |      |      |
|--------|----------|----------|-------------------------|-------------------------------------|------|----------------------|---------|---------|-----------------------|------|------|------|------|------|------|------|
|        |          |          |                         | A                                   | AD   | AE<br>+.001<br>-.001 | AF<br>Ø | AM<br>Ø | B Ø<br>+.000<br>-.002 | D    | F    | NA   | V    | W    | WF   | WG   |
| 1.00   | 1 (Std.) | 0.500    | 5/16-24                 | 0.63                                | —    | —                    | —       | —       | 0.999                 | 0.38 | 0.38 | 0.44 | 0.25 | 0.63 | 1.00 | —    |
|        | 2        | 0.625    | 7/16-20                 | 0.75                                | 0.63 | 0.249                | 0.38    | 0.57    | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 | 1.75 |
| 1.50   | 1 (Std.) | 0.625    | 7/16-20                 | 0.75                                | 0.63 | 0.249                | 0.38    | 0.57    | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 | 1.75 |
|        | 2        | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 | 2.38 |
| 2.00   | 1 (Std.) | 0.625    | 7/16-20                 | 0.75                                | 0.63 | 0.249                | 0.38    | 0.57    | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 | 1.75 |
|        | 2        | 1.375    | 1-14                    | 1.63                                | 1.06 | 0.374                | 0.88    | 1.32    | 1.999                 | 1.13 | 0.38 | 1.31 | 0.63 | 1.25 | 1.63 | 2.75 |
|        | 3        | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 | 2.38 |
| 2.50   | 1 (Std.) | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.38 | 0.94 | 0.50 | 1.00 | 1.38 | 2.38 |
|        | 2        | 1.750    | 1 1/4-12                | 2.00                                | 1.31 | 0.499                | 1.13    | 1.70    | 2.374                 | 1.50 | 0.38 | 1.69 | 0.75 | 1.50 | 1.88 | 3.13 |
|        | 3        | 1.375    | 1-14                    | 1.63                                | 1.06 | 0.374                | 0.88    | 1.32    | 1.999                 | 1.13 | 0.38 | 1.31 | 0.63 | 1.25 | 1.63 | 2.75 |
|        | 7        | 0.625    | 7/16-20                 | 0.75                                | 0.63 | 0.249                | 0.38    | 0.57    | 1.124                 | 0.50 | 0.38 | 0.56 | 0.25 | 0.63 | 1.00 | 1.75 |
| 3.25   | 1 (Std.) | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 | 2.38 |
|        | 2        | 2.000    | 1 1/2-12                | 2.25                                | 1.69 | 0.624                | 1.38    | 1.95    | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 | 3.75 |
|        | 3        | 1.375    | 1-14                    | 1.63                                | 1.06 | 0.374                | 0.88    | 1.32    | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 | 2.75 |
|        | 4        | 1.750    | 1 1/4-12                | 2.00                                | 1.31 | 0.499                | 1.13    | 1.70    | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 | 3.13 |
| 4.00   | 1 (Std.) | 1.375    | 1-14                    | 1.63                                | 1.06 | 0.374                | 0.88    | 1.32    | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 | 2.75 |
|        | 2        | 2.500    | 1 7/8-12                | 3.00                                | 1.94 | 0.749                | 1.75    | 2.45    | 3.124                 | 2.06 | 0.63 | 2.38 | 0.63 | 1.63 | 2.25 | 4.50 |
|        | 3        | 1.750    | 1 1/4-12                | 2.00                                | 1.31 | 0.499                | 1.13    | 1.70    | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 | 3.13 |
|        | 4        | 2.000    | 1 1/2-12                | 2.25                                | 1.69 | 0.624                | 1.38    | 1.95    | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 | 3.75 |
|        | 7        | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 | 2.38 |
| 5.00   | 1 (Std.) | 1.750    | 1 1/4-12                | 2.00                                | 1.31 | 0.499                | 1.13    | 1.70    | 2.374                 | 1.50 | 0.63 | 1.69 | 0.50 | 1.25 | 1.88 | 3.13 |
|        | 2        | 3.500    | 2 1/2-12                | 3.50                                | 2.69 | 0.999                | 2.50    | 3.45    | 4.249                 | 3.00 | 0.63 | 3.38 | 0.63 | 1.63 | 2.25 | 5.63 |
|        | 3        | 2.000    | 1 1/2-12                | 2.25                                | 1.69 | 0.624                | 1.38    | 1.95    | 2.624                 | 1.69 | 0.63 | 1.94 | 0.50 | 1.38 | 2.00 | 3.75 |
|        | 4        | 2.500    | 1 7/8-12                | 3.00                                | 1.94 | 0.749                | 1.75    | 2.45    | 3.124                 | 2.06 | 0.63 | 2.38 | 0.63 | 1.63 | 2.25 | 4.50 |
|        | 5        | 3.000    | 2 1/4-12                | 3.50                                | 2.44 | 0.874                | 2.25    | 2.95    | 3.749                 | 2.63 | 0.63 | 2.88 | 0.63 | 1.63 | 2.25 | 4.88 |
|        | 7        | 1.000    | 3/4-16                  | 1.13                                | 0.94 | 0.374                | 0.69    | 0.95    | 1.499                 | 0.88 | 0.63 | 0.94 | 0.25 | 0.75 | 1.38 | 2.38 |
|        | 8        | 1.375    | 1-14                    | 1.63                                | 1.06 | 0.374                | 0.88    | 1.32    | 1.999                 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 | 2.75 |

**“Special” Thread Style 3**

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify “Style 3” and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

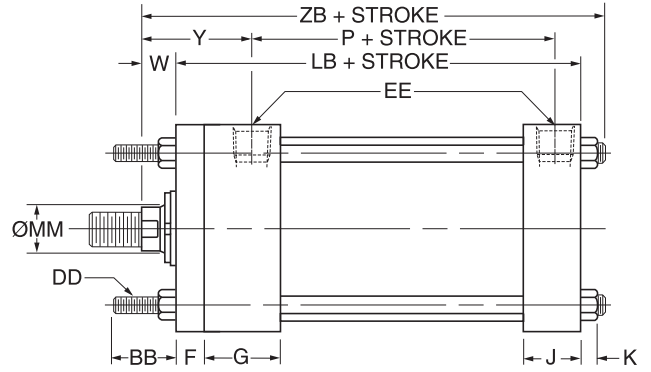
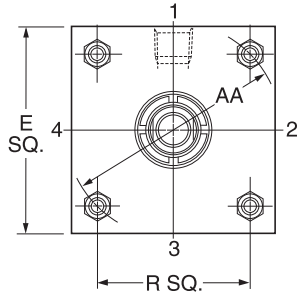
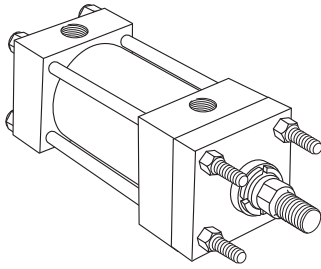
<sup>1</sup> For special WG dimension, specify “Style 3” and give desired dimension for WG. For other changes, place “S” in the model code, and describe rod end with dimensioned sketch.

<sup>2</sup> Style 9 stroke restrictions may apply. See Style 9 Minimum Stroke Table on How to Order page for details.



Mounting Information – 1.00" to 5.00" Bore

Tie Rods Extended Head End Mounting  
Style TB  
(NFPA Style MX3)



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Table 1 – Dimensional and Mounting Data

| Bore Ø            | AA   | BB   | DD      | E    | EE                |                  | F    | G    | J    | K    | R    | Add Stroke |      |
|-------------------|------|------|---------|------|-------------------|------------------|------|------|------|------|------|------------|------|
|                   |      |      |         |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 1.53 | 0.75 | 10-24   | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 1.08 | 3.88       | 2.13 |
| 1.50              | 2.02 | 1.00 | 1/4-28  | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 1.43 | 4.00       | 2.25 |
| 2.00              | 2.60 | 1.13 | 5/16-24 | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.84 | 4.00       | 2.25 |
| 2.50              | 3.10 | 1.13 | 5/16-24 | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 2.19 | 4.13       | 2.38 |
| 3.25              | 3.90 | 1.38 | 3/8-24  | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 2.76 | 4.88       | 2.63 |
| 4.00              | 4.70 | 1.38 | 3/8-24  | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 3.32 | 4.88       | 2.63 |
| 5.00              | 5.80 | 1.81 | 1/2-20  | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 4.10 | 5.13       | 2.88 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |
|--------|----------|----------|------|------|------------|
|        |          |          |      |      | ZB Max     |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 5.00       |
|        | 2        | 0.625    | 0.63 | 1.94 | 5.00       |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 5.06       |
|        | 2        | 1.000    | 1.00 | 2.31 | 5.44       |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 5.13       |
|        | 2        | 1.375    | 1.25 | 2.56 | 5.75       |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 2.31 | 5.63       |
|        | 2        | 1.750    | 1.50 | 2.81 | 6.13       |
|        | 3        | 1.375    | 1.25 | 2.56 | 5.88       |
|        | 7        | 0.625    | 0.63 | 1.94 | 5.25       |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 2.44 | 6.19       |
|        | 2        | 2.000    | 1.38 | 3.06 | 6.81       |
|        | 3        | 1.375    | 1.00 | 2.69 | 6.44       |
|        | 4        | 1.750    | 1.25 | 2.94 | 6.69       |

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |
|--------|----------|----------|------|------|------------|
|        |          |          |      |      | ZB Max     |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.69 | 6.44       |
|        | 2        | 2.500    | 1.63 | 3.31 | 7.06       |
|        | 3        | 1.750    | 1.25 | 2.94 | 6.69       |
|        | 4        | 2.000    | 1.38 | 3.06 | 6.81       |
| 5.00   | 7        | 1.000    | 0.75 | 2.44 | 6.19       |
|        | 1 (Std.) | 1.750    | 1.25 | 2.94 | 7.06       |
|        | 2        | 3.500    | 1.63 | 3.31 | 7.44       |
|        | 3        | 2.000    | 1.38 | 3.06 | 7.31       |
|        | 4        | 2.500    | 1.63 | 3.31 | 7.44       |
|        | 5        | 3.000    | 1.63 | 3.31 | 7.44       |
|        | 7        | 1.000    | 0.75 | 2.44 | 6.56       |
|        | 8        | 1.375    | 1.00 | 2.69 | 6.81       |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.

<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.

<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

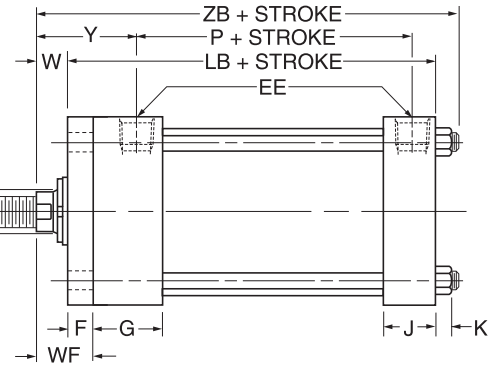
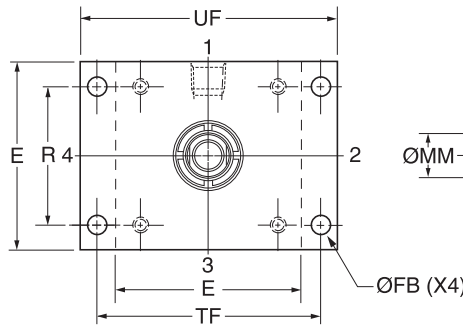
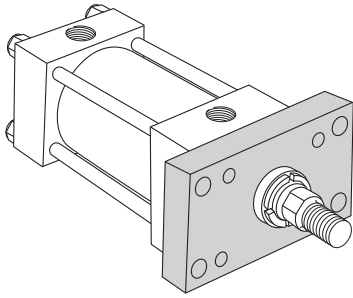
Style TB (NFPA MX3) Head Tie Rods Extended, illustrated: **Style TC** (NFPA MX2), Cap Tie Rods Extended; and **Style TD** (NFPA MX1), Both Ends Tie Rod Extended area also available. All "T" styles can be dimensioned from Style TB drawing above. Basic Mounting (T) – NFPA MX0 – no tie rods extended can be supplied upon request.



Mounting Information – 1.00" to 6.00" Bore Series 3L

Head Rectangular Flange Mounting

Style J  
(NFPA Style MF1)



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Table 1 – Dimensional and Mounting Data

| Bore Ø            | E            | EE                |                  | F    | FB Ø | G    | J    | K    | R    | TF   | UF   | Add Stroke |      |
|-------------------|--------------|-------------------|------------------|------|------|------|------|------|------|------|------|------------|------|
|                   |              | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | <sup>4</sup> | 1/4 <sup>5</sup>  | 6                | 0.38 | 0.25 | 1.50 | 1.00 | 0.19 | 1.08 | 2.00 | 2.50 | 3.88       | 2.13 |
| 1.50              | 2.00         | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 0.31 | 1.50 | 1.00 | 0.25 | 1.43 | 2.75 | 3.38 | 4.00       | 2.25 |
| 2.00              | 2.50         | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31 | 1.84 | 3.38 | 4.13 | 4.00       | 2.25 |
| 2.50              | 3.00         | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31 | 2.19 | 3.88 | 4.63 | 4.13       | 2.38 |
| 3.25              | 3.75         | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38 | 2.76 | 4.69 | 5.50 | 4.88       | 2.63 |
| 4.00              | 4.50         | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38 | 3.32 | 5.44 | 6.25 | 4.88       | 2.63 |
| 5.00              | 5.50         | 1/2               | 10               | 0.63 | 0.56 | 1.75 | 1.25 | 0.44 | 4.10 | 6.63 | 7.63 | 5.13       | 2.88 |
| 6.00              | 6.50         | 3/4               | 12               | 0.75 | 0.56 | 2.00 | 1.50 | 0.44 | 4.88 | 7.63 | 8.63 | 5.75       | 3.13 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W    | WF   | Y    | Add Stroke | ZB Max |
|--------|----------|----------|------|------|------|------------|--------|
|        |          |          |      |      |      |            | ZB Max |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.00 | 1.94 | 5.00       |        |
|        | 2        | 0.625    | 0.63 | 1.00 | 1.94 | 5.00       |        |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.00 | 1.94 | 5.06       |        |
|        | 2        | 1.000    | 1.00 | 1.38 | 2.31 | 5.44       |        |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.00 | 1.94 | 5.13       |        |
|        | 2        | 1.375    | 1.25 | 1.63 | 2.56 | 5.75       |        |
|        | 3        | 1.000    | 1.00 | 1.38 | 2.31 | 5.50       |        |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 1.38 | 2.31 | 5.63       |        |
|        | 2        | 1.750    | 1.50 | 1.88 | 2.81 | 6.13       |        |
|        | 3        | 1.375    | 1.25 | 1.63 | 2.56 | 5.88       |        |
|        | 7        | 0.625    | 0.63 | 1.00 | 1.94 | 5.25       |        |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 1.38 | 2.44 | 6.19       |        |
|        | 2        | 2.000    | 1.38 | 2.00 | 3.06 | 6.81       |        |
|        | 3        | 1.375    | 1.00 | 1.63 | 2.69 | 6.44       |        |
|        | 4        | 1.750    | 1.25 | 1.88 | 2.94 | 6.69       |        |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 1.63 | 2.69 | 6.44       |        |
|        | 2        | 2.500    | 1.63 | 2.25 | 3.31 | 7.06       |        |
|        | 3        | 1.750    | 1.25 | 1.88 | 2.94 | 6.69       |        |
|        | 4        | 2.000    | 1.38 | 2.00 | 3.06 | 6.81       |        |
|        | 7        | 1.000    | 0.75 | 1.38 | 2.44 | 6.19       |        |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.

| Bore Ø | Rod No.  | MM Rod Ø | W     | WF   | Y    | Add Stroke | ZB Max |
|--------|----------|----------|-------|------|------|------------|--------|
|        |          |          |       |      |      |            | ZB Max |
| 5.00   | 1 (Std.) | 1.750    | 1.25  | 1.88 | 2.94 | 7.06       |        |
|        | 2        | 3.500    | 1.63  | 2.25 | 3.31 | 7.44       |        |
|        | 3        | 2.000    | 1.38  | 2.00 | 3.06 | 7.31       |        |
|        | 4        | 2.500    | 1.63  | 2.25 | 3.31 | 7.44       |        |
|        | 5        | 3.000    | 1.63  | 2.25 | 3.31 | 7.44       |        |
|        | 7        | 1.000    | 0.75  | 1.38 | 2.44 | 6.56       |        |
|        | 8        | 1.375    | 1.00  | 1.63 | 2.69 | 6.81       |        |
|        | 6.00     | 1 (Std.) | 1.750 | 1.13 | 1.88 | 3.06       | 7.56   |
| 2      |          | 4.000    | 1.50  | 2.25 | 3.44 | 7.94       |        |
| 3      |          | 2.000    | 1.25  | 2.00 | 3.19 | 7.69       |        |
| 4      |          | 2.500    | 1.50  | 2.25 | 3.44 | 7.94       |        |
| 7      |          | 1.375    | 0.88  | 1.63 | 2.81 | 7.31       |        |

<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.  
<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

Table 3 – Maximum Operating Pressure

| Bore Ø | Max. psi Push |      |      |      |
|--------|---------------|------|------|------|
|        | Rod Code      |      |      |      |
|        | 1             | 2    | 3    | 4    |
| 1.00   | 1900          | 1500 | –    | –    |
| 1.50   | 1400          | 850  | –    | –    |
| 2.00   | 1050          | 450  | 800  | –    |
| 2.50   | 700           | 350  | 500  | –    |
| 3.25   | 1300          | 900  | 1300 | 1000 |
| 4.00   | 900           | 700  | 900  | 900  |
| 5.00   | 600           | 400  | 700  | 600  |
| 6.00   | 700           | 450  | 700  | 700  |
| Bore Ø | Max. psi Push |      |      |      |
|        | Rod Code      |      |      |      |
|        | 5             | 6    | 7    | 8    |
| 2.50   | –             | –    | 700  | –    |
| 3.25   | –             | –    | –    | –    |
| 4.00   | –             | –    | 900  | –    |
| 5.00   | 450           | –    | 600  | 800  |
| 6.00   | 650           | 600  | 700  | –    |



Mounting Information – 1.00" to 5.00" Bore Series 3L

Head Square Flange Mounting  
Style JB  
(NFPA Style MF5)

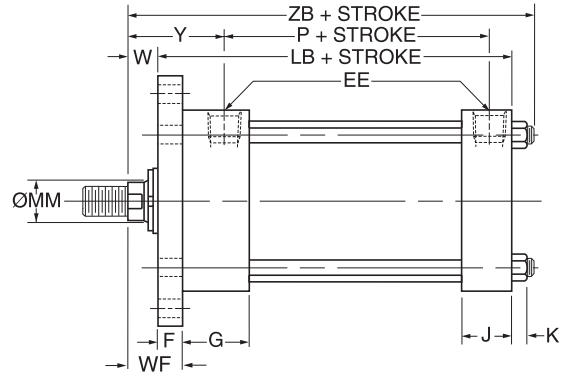
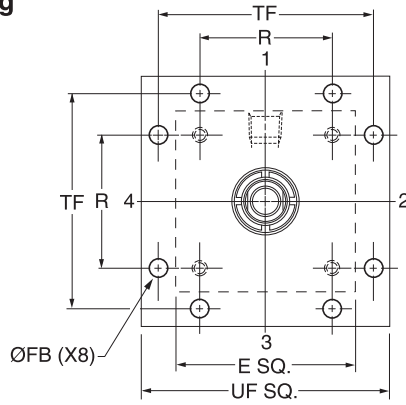
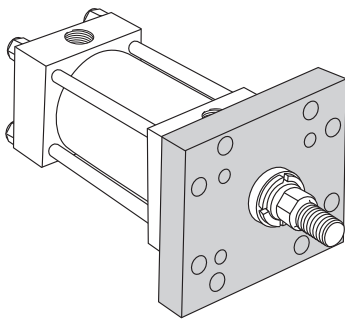


Table 1 – Dimensional and Mounting Data

| Bore Ø            | E    | EE                |                  | F    | FB Ø | G    | J    | K    | R    | TF   | UF   | Add Stroke |      |
|-------------------|------|-------------------|------------------|------|------|------|------|------|------|------|------|------------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 0.25 | 1.50 | 1.00 | 0.19 | 1.08 | 2.00 | 2.50 | 3.88       | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>5</sup>   | 0.38 | 0.31 | 1.50 | 1.00 | 0.25 | 1.43 | 2.75 | 3.38 | 4.00       | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31 | 1.84 | 3.38 | 4.13 | 4.00       | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31 | 2.19 | 3.88 | 4.63 | 4.13       | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38 | 2.76 | 4.69 | 5.50 | 4.88       | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38 | 3.32 | 5.44 | 6.25 | 4.88       | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 0.56 | 1.75 | 1.25 | 0.44 | 4.10 | 6.63 | 7.63 | 5.13       | 2.88 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W    | WF   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.00 | 1.94 | 5.00       |
|        | 2        | 0.625    | 0.63 | 1.00 | 1.94 | 5.00       |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.00 | 1.94 | 5.06       |
|        | 2        | 1.000    | 1.00 | 1.38 | 2.31 | 5.44       |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.00 | 1.94 | 5.13       |
|        | 2        | 1.375    | 1.25 | 1.63 | 2.56 | 5.75       |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 1.38 | 2.31 | 5.63       |
|        | 2        | 1.750    | 1.50 | 1.88 | 2.81 | 6.13       |
|        | 3        | 1.375    | 1.25 | 1.63 | 2.56 | 5.88       |
|        | 7        | 0.625    | 0.63 | 1.00 | 1.94 | 5.25       |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 1.38 | 2.44 | 6.19       |
|        | 2        | 2.000    | 1.38 | 2.00 | 3.06 | 6.81       |
|        | 3        | 1.375    | 1.00 | 1.63 | 2.69 | 6.44       |
|        | 4        | 1.750    | 1.25 | 1.88 | 2.94 | 6.69       |

| Bore Ø | Rod No.  | MM Rod Ø | W    | WF   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 1.63 | 2.69 | 6.44       |
|        | 2        | 2.500    | 1.63 | 2.25 | 3.31 | 7.06       |
|        | 3        | 1.750    | 1.25 | 1.88 | 2.94 | 6.69       |
|        | 4        | 2.000    | 1.38 | 2.00 | 3.06 | 6.81       |
| 5.00   | 7        | 1.000    | 0.75 | 1.38 | 2.44 | 6.19       |
|        | 1 (Std.) | 1.750    | 1.25 | 1.88 | 2.94 | 7.06       |
|        | 2        | 3.500    | 1.63 | 2.25 | 3.31 | 7.44       |
|        | 3        | 2.000    | 1.38 | 2.00 | 3.06 | 7.31       |
|        | 4        | 2.500    | 1.63 | 2.25 | 3.31 | 7.44       |
|        | 5        | 3.000    | 1.63 | 2.25 | 3.31 | 7.44       |
|        | 7        | 1.000    | 0.75 | 1.38 | 2.44 | 6.56       |
|        | 8        | 1.375    | 1.00 | 1.63 | 2.69 | 6.81       |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

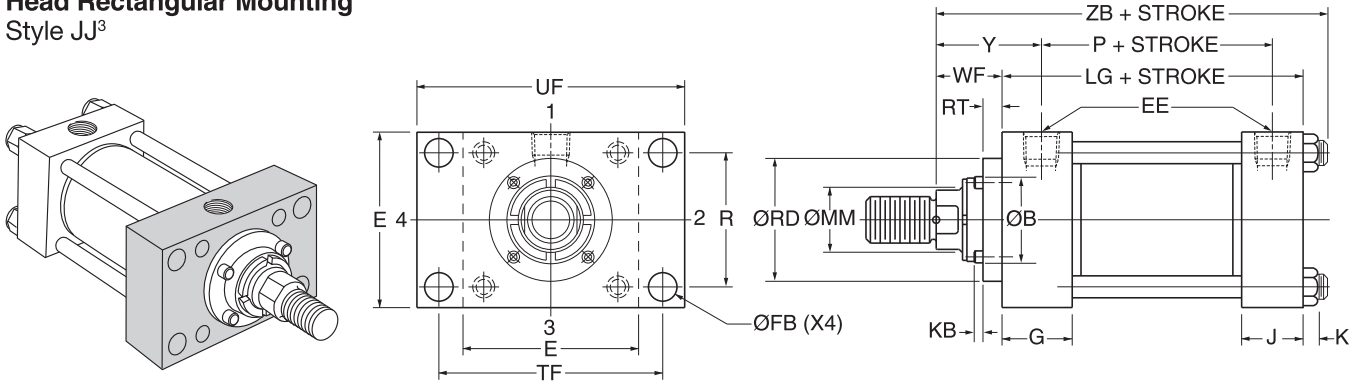




**Mounting Information – 1.50" to 6.00" Bore Series 3L**

**Head Rectangular Mounting**  
Style JJ<sup>3</sup>

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EE                |                  | FB Ø | G    | J    | K    | R    | TF   | UF   | Add Stroke |      |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|------------|------|
|        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      | LG         | P    |
| 1.50   | 2.00 | 3/8 <sup>4</sup>  | 6 <sup>5</sup>   | 0.31 | 1.50 | 1.00 | 0.25 | 1.43 | 2.31 | 2.75 | 3.63       | 2.25 |
| 2.00   | 2.50 | 3/8 <sup>4</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.84 | 2.88 | 3.38 | 3.63       | 2.25 |
| 2.50   | 3.00 | 3/8 <sup>4</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 2.19 | 3.25 | 3.75 | 3.75       | 2.38 |
| 3.25   | 3.75 | 1/2               | 10               | 0.44 | 1.75 | 1.25 | 0.38 | 2.76 | 4.00 | 4.63 | 4.25       | 2.63 |
| 4.00   | 4.50 | 1/2               | 10               | 0.44 | 1.75 | 1.25 | 0.38 | 3.32 | 4.50 | 5.13 | 4.25       | 2.63 |
| 5.00   | 5.50 | 1/2               | 10               | 0.56 | 1.75 | 1.25 | 0.44 | 4.10 | 5.63 | 6.44 | 4.50       | 2.88 |
| 6.00   | 6.50 | 3/4               | 12               | 0.56 | 2.00 | 1.50 | 0.44 | 4.88 | 6.44 | 7.25 | 5.00       | 3.13 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | B Ø +.000 -0.002 | KB   | RD Ø Max | RT   | WF   | Y    | Add Stroke |
|--------|----------|----------|------------------|------|----------|------|------|------|------------|
|        |          |          |                  |      |          |      |      |      | ZB Max     |
| 1.50   | 1 (Std.) | 0.625    | 1.124            | 0.19 | 1.967    | 0.25 | 1.00 | 1.94 | 5.06       |
| 2.00   | 1 (Std.) | 0.625    | 1.124            | 0.19 | 1.967    | 0.25 | 1.00 | 1.94 | 5.13       |
|        | 3        | 1.000    | 1.499            | 0.25 | 2.467    | 0.38 | 1.38 | 2.31 | 5.50       |
| 2.50   | 1 (Std.) | 1.000    | 1.499            | 0.25 | 2.467    | 0.38 | 1.38 | 2.31 | 5.63       |
|        | 3        | 1.375    | 1.999            | 0.25 | 2.967    | 0.38 | 1.63 | 2.56 | 5.88       |
| 3.25   | 1 (Std.) | 1.000    | 1.499            | 0.25 | 2.467    | 0.38 | 1.38 | 2.44 | 6.19       |
|        | 3        | 1.375    | 1.999            | 0.25 | 2.967    | 0.38 | 1.63 | 2.69 | 6.44       |
| 4.00   | 1 (Std.) | 1.375    | 1.999            | 0.25 | 2.967    | 0.38 | 1.63 | 2.69 | 6.44       |
|        | 3        | 1.750    | 2.374            | 0.25 | 3.467    | 0.38 | 1.88 | 2.94 | 6.69       |
| 5.00   | 1 (Std.) | 1.750    | 2.374            | 0.25 | 3.467    | 0.38 | 1.88 | 2.94 | 7.06       |
|        | 3        | 2.000    | 2.624            | 0.25 | 3.717    | 0.38 | 2.00 | 3.06 | 7.31       |
| 6.00   | 1 (Std.) | 1.750    | 2.374            | 0.25 | 3.467    | 0.38 | 1.88 | 3.06 | 7.56       |
|        | 3        | 2.000    | 2.624            | 0.25 | 3.717    | 0.38 | 2.00 | 3.19 | 7.69       |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

<sup>3</sup> Parker Style JJ Mount is a Non-NFPA Mount.

<sup>4</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.

<sup>5</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

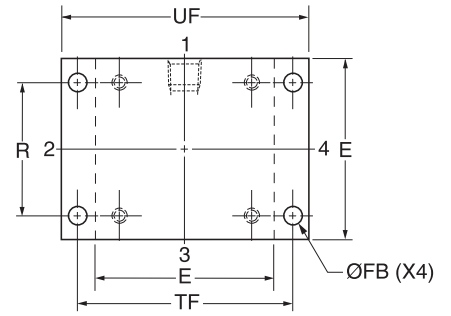
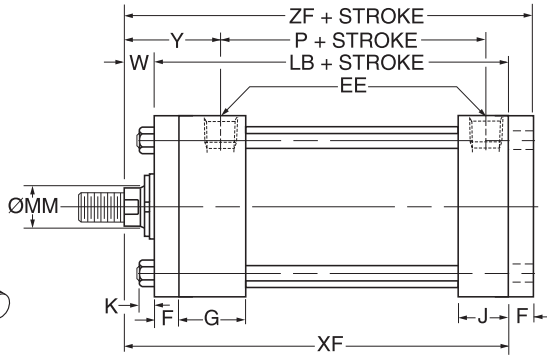
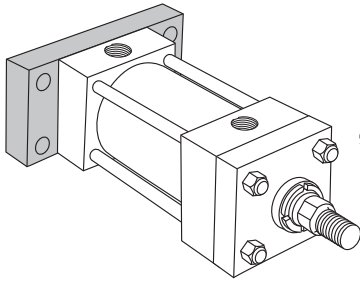


**Mounting Information – 1.00" to 6.00" Bore Series 3L**

**Cap Rectangular Flange Mounting**

Style H  
(NFPA Style MF2)

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø            | E    | EE                |                  | F    | FB Ø | G    | J    | K                 | R    | TF   | UF   | Add Stroke |      |
|-------------------|------|-------------------|------------------|------|------|------|------|-------------------|------|------|------|------------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                   |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 0.25 | 1.50 | 1.00 | 0.19 <sup>7</sup> | 1.08 | 2.00 | 2.50 | 3.88       | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>5</sup>   | 0.38 | 0.31 | 1.50 | 1.00 | 0.25              | 1.43 | 2.75 | 3.38 | 4.00       | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31              | 1.84 | 3.38 | 4.13 | 4.00       | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31              | 2.19 | 3.88 | 4.63 | 4.13       | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38              | 2.76 | 4.69 | 5.50 | 4.88       | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38              | 3.32 | 5.44 | 6.25 | 4.88       | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 0.56 | 1.75 | 1.25 | 0.44              | 4.10 | 6.63 | 7.63 | 5.13       | 2.88 |
| 6.00              | 6.50 | 3/4               | 12               | 0.75 | 0.56 | 2.00 | 1.50 | 0.44              | 4.88 | 7.63 | 8.63 | 5.75       | 3.13 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XF         | ZF   |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 4.50       | 4.88 |
|        | 2        | 0.625    | 0.63 | 1.94 | 4.50       | 4.88 |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.63       | 5.00 |
|        | 2        | 1.000    | 1.00 | 2.31 | 5.00       | 5.38 |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.63       | 5.00 |
|        | 2        | 1.375    | 1.25 | 2.56 | 5.25       | 5.63 |
|        | 3        | 1.000    | 1.00 | 2.31 | 5.00       | 5.38 |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 2.31 | 5.13       | 5.50 |
|        | 2        | 1.750    | 1.50 | 2.81 | 5.63       | 6.00 |
|        | 3        | 1.375    | 1.25 | 2.56 | 5.38       | 5.75 |
|        | 7        | 0.625    | 0.63 | 1.94 | 4.75       | 5.13 |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 2.44 | 5.63       | 6.25 |
|        | 2        | 2.000    | 1.38 | 3.06 | 6.25       | 6.88 |
|        | 3        | 1.375    | 1.00 | 2.69 | 5.88       | 6.50 |
|        | 4        | 1.750    | 1.25 | 2.94 | 6.13       | 6.75 |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.69 | 5.88       | 6.50 |
|        | 2        | 2.500    | 1.63 | 3.31 | 6.50       | 7.13 |
|        | 3        | 1.750    | 1.25 | 2.94 | 6.13       | 6.75 |
|        | 4        | 2.000    | 1.38 | 3.06 | 6.25       | 6.88 |

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XF         | ZF   |
| 5.00   | 1 (Std.) | 1.750    | 1.25 | 2.94 | 6.38       | 7.00 |
|        | 2        | 3.500    | 1.63 | 3.31 | 6.75       | 7.38 |
|        | 3        | 2.000    | 1.38 | 3.06 | 6.50       | 7.13 |
|        | 4        | 2.500    | 1.63 | 3.31 | 6.75       | 7.38 |
|        | 5        | 3.000    | 1.63 | 3.31 | 6.75       | 7.38 |
|        | 7        | 1.000    | 0.75 | 2.44 | 5.88       | 6.50 |
|        | 8        | 1.375    | 1.00 | 2.69 | 6.13       | 6.75 |
| 6.00   | 1 (Std.) | 1.750    | 1.13 | 3.06 | 6.88       | 7.63 |
|        | 2        | 4.000    | 1.50 | 3.44 | 7.25       | 8.00 |
|        | 3        | 2.000    | 1.25 | 3.19 | 7.00       | 7.75 |
|        | 4        | 2.500    | 1.50 | 3.44 | 7.25       | 8.00 |
|        | 5        | 3.000    | 1.50 | 3.44 | 7.25       | 8.00 |
|        | 6        | 3.500    | 1.50 | 3.44 | 7.25       | 8.00 |
|        | 7        | 1.375    | 0.88 | 2.81 | 6.63       | 7.38 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.

<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.  
<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.  
<sup>7</sup> 1.00" Bore 3L Style H and Style HB include head retainers tapped for tie rods. Cap Flanges are counterbored for tie rod nuts.

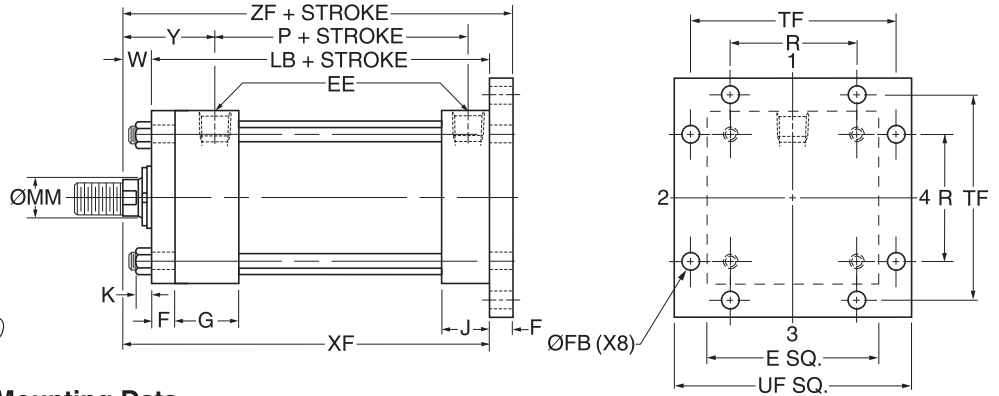
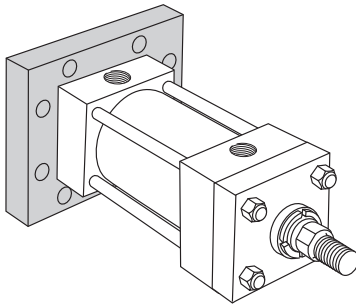


**Mounting Information – 1.00" to 5.00" Bore Series 3L**

**Cap Square Flange Mounting**

Style HB  
(NFFA Style MF6)

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø            | E    | EE                |                  | F    | FB Ø | G    | J    | K                 | R    | TF   | UF   | Add Stroke |      |
|-------------------|------|-------------------|------------------|------|------|------|------|-------------------|------|------|------|------------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                   |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 0.25 | 1.50 | 1.00 | 0.19 <sup>7</sup> | 1.08 | 2.00 | 2.50 | 3.88       | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>5</sup>   | 0.38 | 0.31 | 1.50 | 1.00 | 0.25              | 1.43 | 2.75 | 3.38 | 4.00       | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31              | 1.84 | 3.38 | 4.13 | 4.00       | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 0.38 | 1.50 | 1.00 | 0.31              | 2.19 | 3.88 | 4.63 | 4.13       | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38              | 2.76 | 4.69 | 5.50 | 4.88       | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 0.44 | 1.75 | 1.25 | 0.38              | 3.32 | 5.44 | 6.25 | 4.88       | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 0.56 | 1.75 | 1.25 | 0.44              | 4.10 | 6.63 | 7.63 | 5.13       | 2.88 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XF         | ZF   |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 4.50       | 4.88 |
|        | 2        | 0.625    | 0.63 | 1.94 | 4.50       | 4.88 |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.63       | 5.00 |
|        | 2        | 1.000    | 1.00 | 2.31 | 5.00       | 5.38 |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.63       | 5.00 |
|        | 2        | 1.375    | 1.25 | 2.56 | 5.25       | 5.63 |
| 2.50   | 3        | 1.000    | 1.00 | 2.31 | 5.00       | 5.38 |
|        | 1 (Std.) | 1.000    | 1.00 | 2.31 | 5.13       | 5.50 |
|        | 2        | 1.750    | 1.50 | 2.81 | 5.63       | 6.00 |
|        | 3        | 1.375    | 1.25 | 2.56 | 5.38       | 5.75 |
| 3.25   | 7        | 0.625    | 0.63 | 1.94 | 4.75       | 5.13 |
|        | 1 (Std.) | 1.000    | 0.75 | 2.44 | 5.63       | 6.25 |
|        | 2        | 2.000    | 1.38 | 3.06 | 6.25       | 6.88 |
|        | 3        | 1.375    | 1.00 | 2.69 | 5.88       | 6.50 |
| 4.00   | 4        | 1.750    | 1.25 | 2.94 | 6.13       | 6.75 |
|        | 1 (Std.) | 1.750    | 1.25 | 2.94 | 6.38       | 7.00 |
|        | 2        | 3.500    | 1.63 | 3.31 | 6.75       | 7.38 |
|        | 3        | 2.000    | 1.38 | 3.06 | 6.50       | 7.13 |
|        | 4        | 2.500    | 1.63 | 3.31 | 6.75       | 7.38 |
| 5.00   | 5        | 3.000    | 1.63 | 3.31 | 6.75       | 7.38 |
|        | 7        | 1.000    | 0.75 | 2.44 | 5.88       | 6.50 |
|        | 8        | 1.375    | 1.00 | 2.69 | 6.13       | 6.75 |
|        | 7        | 1.000    | 0.75 | 2.44 | 5.88       | 6.50 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.  
<sup>7</sup> 1.00" Bore 3L Style H and Style HB include head retainers tapped for tie rods. Cap Flanges are counterbored for tie rod nuts.



Mounting Information – 1.00" to 5.00" Bore Series 3L

Side Lug Mounting

Style C  
(NFPA Style MS2)

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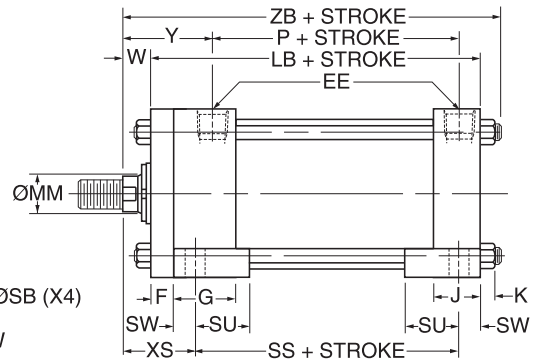
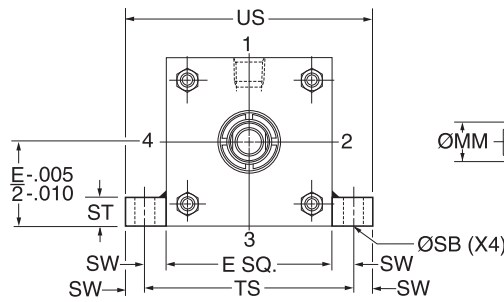
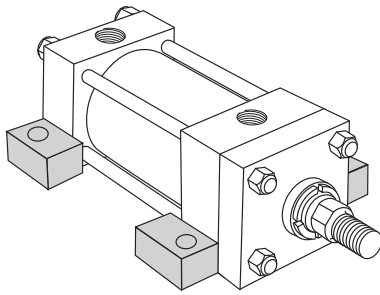


Table 1 – Dimensional and Mounting Data

| Bore Ø            | E    | EE                |                  | F    | G    | J    | K    | SB Ø | ST   | SU   | SW   | TS   | US   | Add Stroke |      |      |
|-------------------|------|-------------------|------------------|------|------|------|------|------|------|------|------|------|------|------------|------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      |      |      | LB         | P    | SS   |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 0.28 | 0.31 | 0.75 | 0.31 | 2.13 | 2.75 | 3.88       | 2.13 | 2.88 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 0.44 | 0.50 | 0.94 | 0.38 | 2.75 | 3.50 | 4.00       | 2.25 | 2.88 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.44 | 0.50 | 0.94 | 0.38 | 3.25 | 4.00 | 4.00       | 2.25 | 2.88 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.44 | 0.50 | 0.94 | 0.38 | 3.75 | 4.50 | 4.13       | 2.38 | 3.00 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 0.56 | 0.75 | 1.25 | 0.50 | 4.75 | 5.75 | 4.88       | 2.63 | 3.25 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 0.56 | 0.75 | 1.25 | 0.50 | 5.50 | 6.50 | 4.88       | 2.63 | 3.25 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 0.81 | 1.00 | 1.56 | 0.69 | 6.88 | 8.25 | 5.13       | 2.88 | 3.13 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W    | XS   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.31 | 1.94 | 5.00       |
|        | 2        | 0.625    | 0.63 | 1.31 | 1.94 | 5.00       |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.38 | 1.94 | 5.06       |
|        | 2        | 1.000    | 1.00 | 1.75 | 2.31 | 5.44       |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.38 | 1.94 | 5.13       |
|        | 2        | 1.375    | 1.25 | 2.00 | 2.56 | 5.75       |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 1.75 | 2.31 | 5.63       |
|        | 2        | 1.750    | 1.50 | 2.25 | 2.81 | 6.13       |
|        | 3        | 1.375    | 1.25 | 2.00 | 2.56 | 5.88       |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 1.88 | 2.44 | 6.19       |
|        | 2        | 2.000    | 1.38 | 2.50 | 3.06 | 6.81       |
|        | 3        | 1.375    | 1.00 | 2.13 | 2.69 | 6.44       |
|        | 4        | 1.750    | 1.25 | 2.38 | 2.94 | 6.69       |

| Bore Ø | Rod No.  | MM Rod Ø | W    | XS   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.13 | 2.69 | 6.44       |
|        | 2        | 2.500    | 1.63 | 2.75 | 3.31 | 7.06       |
|        | 3        | 1.750    | 1.25 | 2.38 | 2.94 | 6.69       |
|        | 4        | 2.000    | 1.38 | 2.50 | 3.06 | 6.81       |
| 5.00   | 7        | 1.000    | 0.75 | 1.88 | 2.44 | 6.19       |
|        | 1 (Std.) | 1.750    | 1.25 | 2.56 | 2.94 | 7.06       |
|        | 2        | 3.500    | 1.63 | 2.94 | 3.31 | 7.44       |
|        | 3        | 2.000    | 1.38 | 2.69 | 3.06 | 7.31       |
|        | 4        | 2.500    | 1.63 | 2.94 | 3.31 | 7.44       |
|        | 5        | 3.000    | 1.63 | 2.94 | 3.31 | 7.44       |
|        | 7        | 1.000    | 0.75 | 2.06 | 2.44 | 6.56       |
|        | 8        | 1.375    | 1.00 | 2.31 | 2.69 | 6.81       |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page. E/2 for this bore is .750 -.005/-.010.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

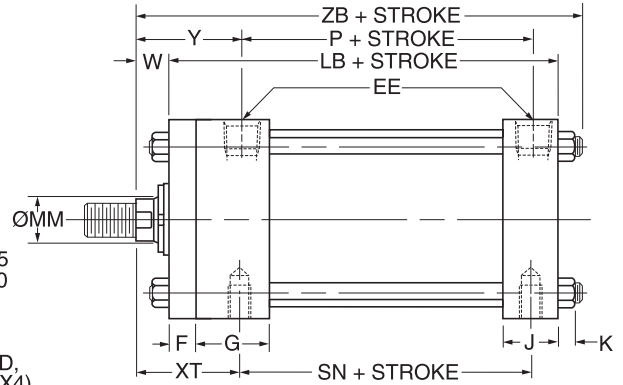
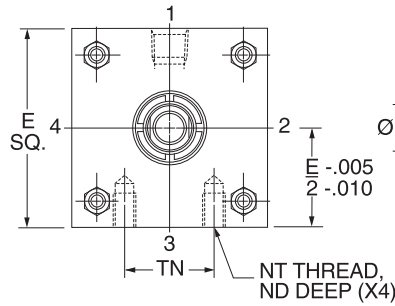
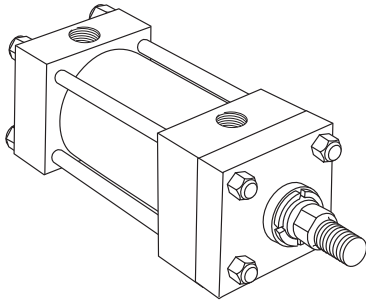


**Mounting Information – 1.00" to 5.00" Bore Series 3L**

**Side Tapped Mounting**

Style F  
(NFPA Style MS4)

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø            | E    | EE                |                  | F    | G    | J    | K    | ND   | NT      | TN   | Add Stroke |      |      |
|-------------------|------|-------------------|------------------|------|------|------|------|------|---------|------|------------|------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |         |      | LB         | P    | SN   |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 0.25 | 10-24   | 0.56 | 3.88       | 2.13 | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 0.31 | 1/4-20  | 0.63 | 4.00       | 2.25 | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.34 | 5/16-18 | 0.88 | 4.00       | 2.25 | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.44 | 3/8-16  | 1.25 | 4.13       | 2.38 | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 0.50 | 1/2-13  | 1.50 | 4.88       | 2.63 | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 0.63 | 1/2-13  | 2.06 | 4.88       | 2.63 | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 0.75 | 5/8-11  | 2.69 | 5.13       | 2.88 | 2.88 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | W    | XT   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 1.94 | 5.00       |
|        | 2        | 0.625    | 0.63 | 1.94 | 1.94 | 5.00       |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 1.94 | 5.06       |
|        | 2        | 1.000    | 1.00 | 2.31 | 2.31 | 5.44       |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 1.94 | 5.13       |
|        | 2        | 1.375    | 1.25 | 2.56 | 2.56 | 5.75       |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 2.31 | 2.31 | 5.63       |
|        | 2        | 1.750    | 1.50 | 2.81 | 2.81 | 6.13       |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 2.44 | 2.44 | 6.19       |
|        | 2        | 2.000    | 1.38 | 3.06 | 3.06 | 6.81       |

| Bore Ø | Rod No.  | MM Rod Ø | W    | XT   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------------|
|        |          |          |      |      |      | ZB Max.    |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.69 | 2.69 | 6.44       |
|        | 2        | 2.500    | 1.63 | 3.31 | 3.31 | 7.06       |
|        | 3        | 1.750    | 1.25 | 2.94 | 2.94 | 6.69       |
|        | 4        | 2.000    | 1.38 | 3.06 | 3.06 | 6.81       |
| 5.00   | 1 (Std.) | 1.750    | 1.25 | 2.94 | 2.94 | 7.06       |
|        | 2        | 3.500    | 1.63 | 3.31 | 3.31 | 7.44       |
|        | 3        | 2.000    | 1.38 | 3.06 | 3.06 | 7.31       |
|        | 4        | 2.500    | 1.63 | 3.31 | 3.31 | 7.44       |
| 5.00   | 5        | 3.000    | 1.63 | 3.31 | 3.31 | 7.44       |
|        | 7        | 1.000    | 0.75 | 2.44 | 2.44 | 6.56       |
|        | 7        | 1.000    | 0.75 | 2.44 | 2.44 | 6.56       |
|        | 8        | 1.375    | 1.00 | 2.69 | 2.69 | 6.81       |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page. E/2 for this bore is .750  $\pm$ .005/ $\pm$ .010.

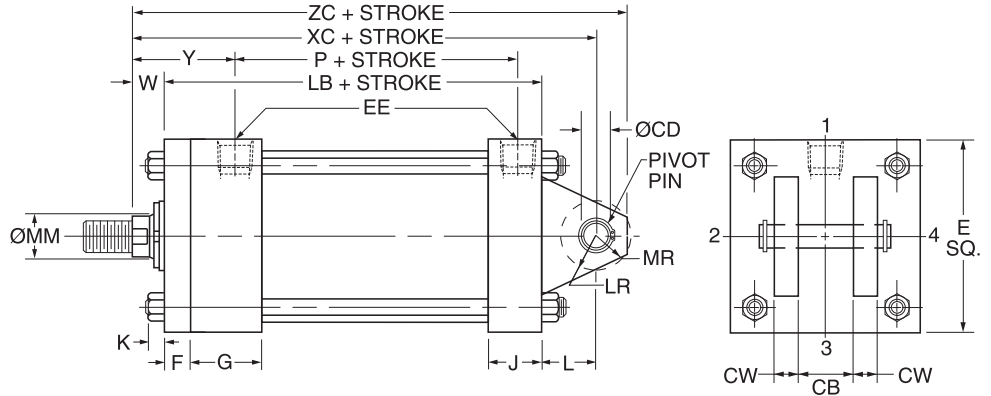
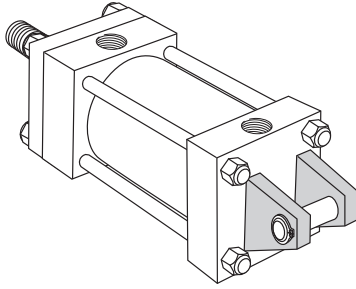
<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.



Mounting Information – 1.00" to 5.00" Bore Series 3L

Cap Fixed Clevis Mounting  
Style BB  
(NFPA Style MP1)

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Note: Tie rod nuts are supplied on both ends, as shown, on 1.00, 4.00 and 5.00 bores. Tie rods are threaded into the cap on all other bore sizes.

Table 1 – Dimensional and Mounting Data

| Bore Ø            | CB   | CD Ø<br>+.000<br>-.002 | CW   | E    | EE                |                  | F    | G    | J    | K    | L    | LR   | MR   | Add Stroke |      |
|-------------------|------|------------------------|------|------|-------------------|------------------|------|------|------|------|------|------|------|------------|------|
|                   |      |                        |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 7    | 0.441 <sup>7</sup>     | 7    | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 0.50 | 0.50 | 0.50 | 3.88       | 2.13 |
| 1.50              | 0.75 | 0.501                  | 0.50 | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 0.75 | 0.75 | 0.63 | 4.00       | 2.25 |
| 2.00              | 0.75 | 0.501                  | 0.50 | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.75 | 0.75 | 0.63 | 4.00       | 2.25 |
| 2.50              | 0.75 | 0.501                  | 0.50 | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 0.75 | 0.75 | 0.63 | 4.13       | 2.38 |
| 3.25              | 1.25 | 0.751                  | 0.63 | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.25 | 1.00 | 0.94 | 4.88       | 2.63 |
| 4.00              | 1.25 | 0.751                  | 0.63 | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.25 | 1.00 | 0.94 | 4.88       | 2.63 |
| 5.00              | 1.25 | 0.751                  | 0.63 | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 1.25 | 1.00 | 0.94 | 5.13       | 2.88 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XC         | ZC   |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 5.00       | 5.44 |
|        | 2        | 0.625    | 0.63 | 1.94 | 5.00       | 5.44 |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 5.38       | 5.88 |
|        | 2        | 1.000    | 1.00 | 2.31 | 5.75       | 6.25 |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 5.38       | 5.88 |
|        | 2        | 1.375    | 1.25 | 2.56 | 6.00       | 6.50 |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 2.31 | 5.88       | 6.38 |
|        | 2        | 1.750    | 1.50 | 2.81 | 6.38       | 6.88 |
|        | 3        | 1.375    | 1.25 | 2.56 | 6.13       | 6.63 |
|        | 7        | 0.625    | 0.63 | 1.94 | 5.50       | 6.00 |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 2.44 | 6.88       | 7.63 |
|        | 2        | 2.000    | 1.38 | 3.06 | 7.50       | 8.25 |
|        | 3        | 1.375    | 1.00 | 2.69 | 7.13       | 7.88 |
|        | 4        | 1.750    | 1.25 | 2.94 | 7.38       | 8.13 |

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XC         | ZC   |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.69 | 7.13       | 7.88 |
|        | 2        | 2.500    | 1.63 | 3.31 | 7.75       | 8.50 |
|        | 3        | 1.750    | 1.25 | 2.94 | 7.38       | 8.13 |
|        | 4        | 2.000    | 1.38 | 3.06 | 7.50       | 8.25 |
| 5.00   | 7        | 1.000    | 0.75 | 2.44 | 6.88       | 7.63 |
|        | 1 (Std.) | 1.750    | 1.25 | 2.94 | 7.63       | 8.38 |
|        | 2        | 3.500    | 1.63 | 3.31 | 8.00       | 8.75 |
|        | 3        | 2.000    | 1.38 | 3.06 | 7.75       | 8.50 |
|        | 4        | 2.500    | 1.63 | 3.31 | 8.00       | 8.75 |
|        | 5        | 3.000    | 1.63 | 3.31 | 8.00       | 8.75 |
|        | 7        | 1.000    | 0.75 | 2.44 | 7.13       | 7.88 |
|        | 8        | 1.375    | 1.00 | 2.69 | 7.38       | 8.13 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.  
<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.

<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.  
<sup>7</sup> In 1.00" bore size only, a single fixed eye mounting lug, .44" thick is used. Dimension CD (.441") is hole diameter. Pin not furnished.



Mounting Information – 1.00" to 5.00" Bore Series 3L

Head Trunnion Mounting

Style D  
(NFPA Style MT1)

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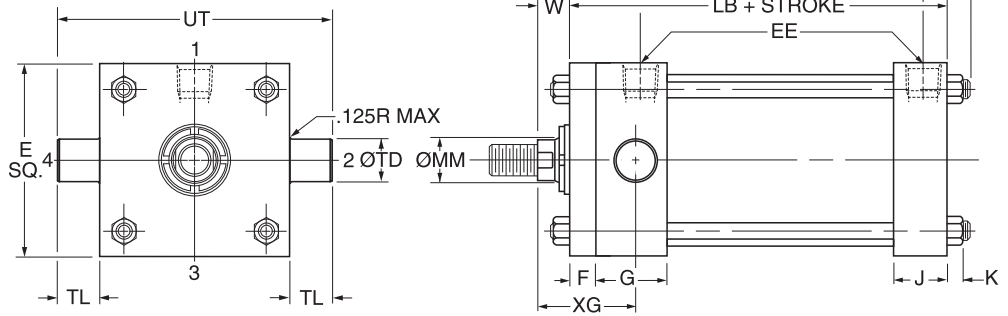
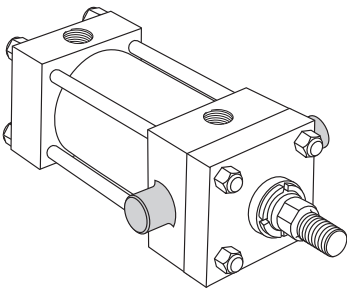


Table 1 – Dimensional and Mounting Data

| Bore Ø            | E    | EE                |                  | F    | G    | J    | K    | TD Ø<br>+.000<br>-.001 | TL   | UT   | Add Stroke |      |
|-------------------|------|-------------------|------------------|------|------|------|------|------------------------|------|------|------------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                        |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 0.750                  | 0.75 | 3.00 | 3.88       | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 1.000                  | 1.00 | 4.00 | 4.00       | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                  | 1.00 | 4.50 | 4.00       | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                  | 1.00 | 5.00 | 4.13       | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                  | 1.00 | 5.75 | 4.88       | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                  | 1.00 | 6.50 | 4.88       | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 1.000                  | 1.00 | 7.50 | 5.13       | 2.88 |

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | W     | XG   | Y    | Add Stroke |      |
|--------|----------|----------|-------|------|------|------------|------|
|        |          |          |       |      |      | ZB Max     |      |
| 1.00   | 1 (Std.) | 0.500    | 0.63  | 1.75 | 1.94 | 5.00       |      |
|        | 2        | 0.625    | 0.63  | 1.75 | 1.94 | 5.00       |      |
| 1.50   | 1 (Std.) | 0.625    | 0.63  | 1.75 | 1.94 | 5.06       |      |
|        | 2        | 1.000    | 1.00  | 2.13 | 2.31 | 5.44       |      |
| 2.00   | 1 (Std.) | 0.625    | 0.63  | 1.75 | 1.94 | 5.13       |      |
|        | 2        | 1.375    | 1.25  | 2.38 | 2.56 | 5.75       |      |
|        | 3        | 1.000    | 1.00  | 2.13 | 2.31 | 5.50       |      |
| 2.50   | 1 (Std.) | 1.000    | 1.00  | 2.13 | 2.31 | 5.63       |      |
|        | 2        | 1.750    | 1.50  | 2.63 | 2.81 | 6.13       |      |
|        | 3        | 1.375    | 1.25  | 2.38 | 2.56 | 5.88       |      |
|        | 7        | 0.625    | 0.63  | 1.75 | 1.94 | 5.25       |      |
| 3.25   | 1 (Std.) | 1.000    | 0.75  | 2.25 | 2.44 | 6.19       |      |
|        | 2        | 2.000    | 1.38  | 2.88 | 3.06 | 6.81       |      |
|        | 3        | 1.375    | 1.00  | 2.50 | 2.69 | 6.44       |      |
|        | 4        | 1.750    | 1.25  | 2.75 | 2.94 | 6.69       |      |
| 4.00   | 1 (Std.) | 1.375    | 1.00  | 2.50 | 2.69 | 6.44       |      |
|        | 2        | 2.500    | 1.63  | 3.13 | 3.31 | 7.06       |      |
|        | 3        | 1.750    | 1.25  | 2.75 | 2.94 | 6.69       |      |
|        | 4        | 2.000    | 1.38  | 2.88 | 3.06 | 6.81       |      |
|        | 7        | 1.000    | 0.75  | 2.25 | 2.44 | 6.19       |      |
|        | 5.00     | 1 (Std.) | 1.750 | 1.25 | 2.75 | 2.94       | 7.06 |
|        |          | 2        | 3.500 | 1.63 | 3.13 | 3.31       | 7.44 |
|        |          | 3        | 2.000 | 1.38 | 2.88 | 3.06       | 7.31 |
| 4      |          | 2.500    | 1.63  | 3.13 | 3.31 | 7.44       |      |
| 5      |          | 3.000    | 1.63  | 3.13 | 3.31 | 7.44       |      |
|        | 7        | 1.000    | 0.75  | 2.25 | 2.44 | 6.56       |      |
|        | 8        | 1.375    | 1.00  | 2.50 | 2.69 | 6.81       |      |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.  
<sup>2</sup> SAE straight thread ports are indicated by port number.  
<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.  
<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.  
<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

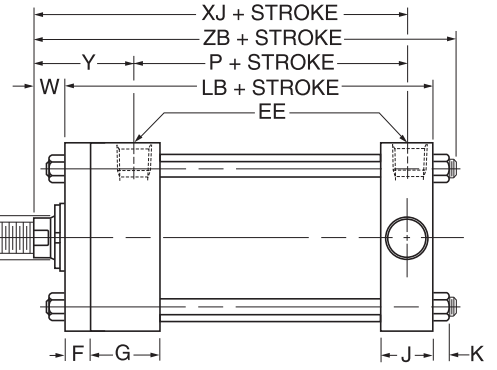
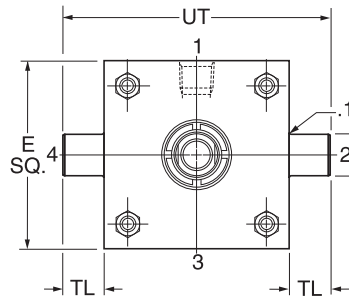
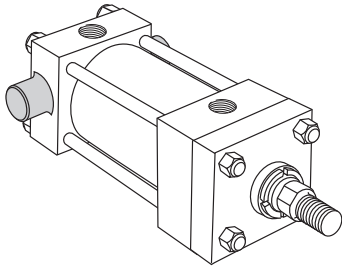


**Mounting Information – 1.00" to 5.00" Bore Series 3L**

**Cap Trunnion Mounting**

Style DB  
(NFPA Style MT2)

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø            | E    | EE                |                  | F    | G    | J    | K    | TD Ø<br>+.000<br>-.001 | TL   | UT   | Add Stroke |      |
|-------------------|------|-------------------|------------------|------|------|------|------|------------------------|------|------|------------|------|
|                   |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                        |      |      | LB         | P    |
| 1.00 <sup>3</sup> | 4    | 1/4 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.19 | 0.750                  | 0.75 | 3.00 | 3.88       | 2.13 |
| 1.50              | 2.00 | 3/8 <sup>5</sup>  | 6 <sup>6</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 1.000                  | 1.00 | 4.00 | 4.00       | 2.25 |
| 2.00              | 2.50 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                  | 1.00 | 4.50 | 4.00       | 2.25 |
| 2.50              | 3.00 | 3/8 <sup>5</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                  | 1.00 | 5.00 | 4.13       | 2.38 |
| 3.25              | 3.75 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                  | 1.00 | 5.75 | 4.88       | 2.63 |
| 4.00              | 4.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                  | 1.00 | 6.50 | 4.88       | 2.63 |
| 5.00              | 5.50 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 1.000                  | 1.00 | 7.50 | 5.13       | 2.88 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |        |
|--------|----------|----------|------|------|------------|--------|
|        |          |          |      |      | XJ         | ZB Max |
| 1.00   | 1 (Std.) | 0.500    | 0.63 | 1.94 | 4.00       | 5.00   |
|        | 2        | 0.625    | 0.63 | 1.94 | 4.00       | 5.00   |
| 1.50   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.13       | 5.06   |
|        | 2        | 1.000    | 1.00 | 2.31 | 4.50       | 5.44   |
| 2.00   | 1 (Std.) | 0.625    | 0.63 | 1.94 | 4.13       | 5.13   |
|        | 2        | 1.375    | 1.25 | 2.56 | 4.75       | 5.75   |
|        | 3        | 1.000    | 1.00 | 2.31 | 4.50       | 5.50   |
| 2.50   | 1 (Std.) | 1.000    | 1.00 | 2.31 | 4.63       | 5.63   |
|        | 2        | 1.750    | 1.50 | 2.81 | 5.13       | 6.13   |
|        | 3        | 1.375    | 1.25 | 2.56 | 4.88       | 5.88   |
|        | 7        | 0.625    | 0.63 | 1.94 | 4.25       | 5.25   |
| 3.25   | 1 (Std.) | 1.000    | 0.75 | 2.44 | 5.00       | 6.19   |
|        | 2        | 2.000    | 1.38 | 3.06 | 5.63       | 6.81   |
|        | 3        | 1.375    | 1.00 | 2.69 | 5.25       | 6.44   |
|        | 4        | 1.750    | 1.25 | 2.94 | 5.50       | 6.69   |

| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |        |
|--------|----------|----------|------|------|------------|--------|
|        |          |          |      |      | XJ         | ZB Max |
| 4.00   | 1 (Std.) | 1.375    | 1.00 | 2.69 | 5.25       | 6.44   |
|        | 2        | 2.500    | 1.63 | 3.31 | 5.88       | 7.06   |
|        | 3        | 1.750    | 1.25 | 2.94 | 5.50       | 6.69   |
|        | 4        | 2.000    | 1.38 | 3.06 | 5.63       | 6.81   |
| 5.00   | 7        | 1.000    | 0.75 | 2.44 | 5.00       | 6.19   |
|        | 1 (Std.) | 1.750    | 1.25 | 2.94 | 5.75       | 7.06   |
|        | 2        | 3.500    | 1.63 | 3.31 | 6.13       | 7.44   |
|        | 3        | 2.000    | 1.38 | 3.06 | 5.88       | 7.31   |
|        | 4        | 2.500    | 1.63 | 3.31 | 6.13       | 7.44   |
|        | 5        | 3.000    | 1.63 | 3.31 | 6.13       | 7.44   |
|        | 7        | 1.000    | 0.75 | 2.44 | 5.25       | 6.56   |
|        | 8        | 1.375    | 1.00 | 2.69 | 5.50       | 6.81   |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

<sup>3</sup> Cushion adjusting needle valve for 1.00" bore projects beyond sides of head and cap.

<sup>4</sup> 1.00" bore 3L heads are rectangular — see 1.00" bore mounting information page.

<sup>5</sup> On 1.00", 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.

<sup>6</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

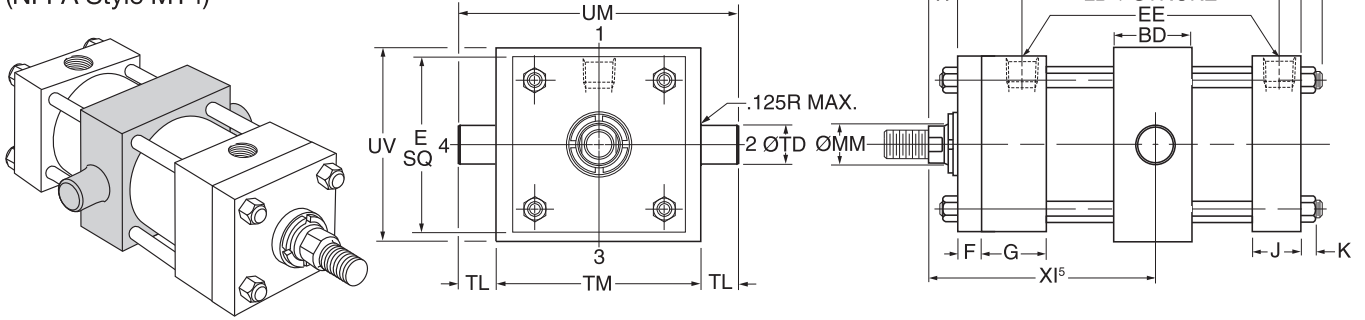




**Mounting Information – 1.50" to 5.00" Bore Series 3L**

**Intermediate Fixed Trunnion Mounting**

Style DD<sup>6</sup>  
(NFPA Style MT4)



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | BD   | EE                |                  | F    | G    | J    | K    | TD Ø<br>+0.000<br>-0.001 | TL   | TM   | UM   | UV   | Add Stroke |      |
|--------|------|------|-------------------|------------------|------|------|------|------|--------------------------|------|------|------|------|------------|------|
|        |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                          |      |      |      |      | LB         | P    |
| 1.50   | 2.00 | 1.25 | 3/8 <sup>3</sup>  | 6 <sup>4</sup>   | 0.38 | 1.50 | 1.00 | 0.25 | 1.000                    | 1.00 | 2.50 | 4.50 | 2.50 | 4.00       | 2.25 |
| 2.00   | 2.50 | 1.50 | 3/8 <sup>3</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                    | 1.00 | 3.00 | 5.00 | 3.00 | 4.00       | 2.25 |
| 2.50   | 3.00 | 1.50 | 3/8 <sup>3</sup>  | 6                | 0.38 | 1.50 | 1.00 | 0.31 | 1.000                    | 1.00 | 3.50 | 5.50 | 3.50 | 4.13       | 2.38 |
| 3.25   | 3.75 | 2.00 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                    | 1.00 | 4.50 | 6.50 | 4.25 | 4.88       | 2.63 |
| 4.00   | 4.50 | 2.00 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.38 | 1.000                    | 1.00 | 5.25 | 7.25 | 5.00 | 4.88       | 2.63 |
| 5.00   | 5.50 | 2.00 | 1/2               | 10               | 0.63 | 1.75 | 1.25 | 0.44 | 1.000                    | 1.00 | 6.25 | 8.25 | 6.00 | 5.13       | 2.88 |

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | W     | XI <sup>5</sup> Min. | Min. Stroke | Y    | Add Stroke |      |
|--------|----------|----------|-------|----------------------|-------------|------|------------|------|
|        |          |          |       |                      |             |      | ZB Max     |      |
| 1.50   | 1 (Std.) | 0.625    | 0.63  | 3.19                 | 0.25        | 1.94 | 5.06       |      |
|        | 2        | 1.000    | 1.00  | 3.56                 | 0.25        | 2.31 | 5.44       |      |
| 2.00   | 1 (Std.) | 0.625    | 0.63  | 3.31                 | 0.50        | 1.94 | 5.13       |      |
|        | 2        | 1.375    | 1.25  | 3.94                 | 0.50        | 2.56 | 5.75       |      |
|        | 3        | 1.000    | 1.00  | 3.69                 | 0.50        | 2.31 | 5.50       |      |
| 2.50   | 1 (Std.) | 1.000    | 1.00  | 3.69                 | 0.38        | 2.31 | 5.63       |      |
|        | 2        | 1.750    | 1.50  | 4.19                 | 0.38        | 2.81 | 6.13       |      |
|        | 3        | 1.375    | 1.25  | 3.94                 | 0.38        | 2.56 | 5.88       |      |
|        | 7        | 0.625    | 0.63  | 3.31                 | 0.38        | 1.94 | 5.25       |      |
| 3.25   | 1 (Std.) | 1.000    | 0.75  | 4.19                 | 0.88        | 2.44 | 6.19       |      |
|        | 2        | 2.000    | 1.38  | 4.81                 | 0.88        | 3.06 | 6.81       |      |
|        | 3        | 1.375    | 1.00  | 4.44                 | 0.88        | 2.69 | 6.44       |      |
|        | 4        | 1.750    | 1.25  | 4.69                 | 0.88        | 2.94 | 6.69       |      |
| 4.00   | 1 (Std.) | 1.375    | 1.00  | 4.44                 | 0.88        | 2.69 | 6.44       |      |
|        | 2        | 2.500    | 1.63  | 5.06                 | 0.88        | 3.31 | 7.06       |      |
|        | 3        | 1.750    | 1.25  | 4.69                 | 0.88        | 2.94 | 6.69       |      |
|        | 4        | 2.000    | 1.38  | 4.81                 | 0.88        | 3.06 | 6.81       |      |
|        | 7        | 1.000    | 0.75  | 4.19                 | 0.88        | 2.44 | 6.19       |      |
|        | 5.00     | 1 (Std.) | 1.750 | 1.25                 | 4.69        | 0.63 | 2.94       | 7.06 |
|        |          | 2        | 3.500 | 1.63                 | 5.06        | 0.63 | 3.31       | 7.44 |
|        |          | 3        | 2.000 | 1.38                 | 4.81        | 0.63 | 3.06       | 7.31 |
| 4      |          | 2.500    | 1.63  | 5.06                 | 0.63        | 3.31 | 7.44       |      |
| 5      |          | 3.000    | 1.63  | 5.06                 | 0.63        | 3.31 | 7.44       |      |
| 7      |          | 1.000    | 0.75  | 4.19                 | 0.63        | 2.44 | 6.56       |      |
| 8      |          | 1.375    | 1.00  | 4.44                 | 0.63        | 2.69 | 6.81       |      |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

<sup>3</sup> On 1.50", 2.00" and 2.50" bore sizes, the head end (only) pipe thread is not full depth on cylinders with No. 2 rods. Minimum of 3 full threads available.

<sup>4</sup> Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.

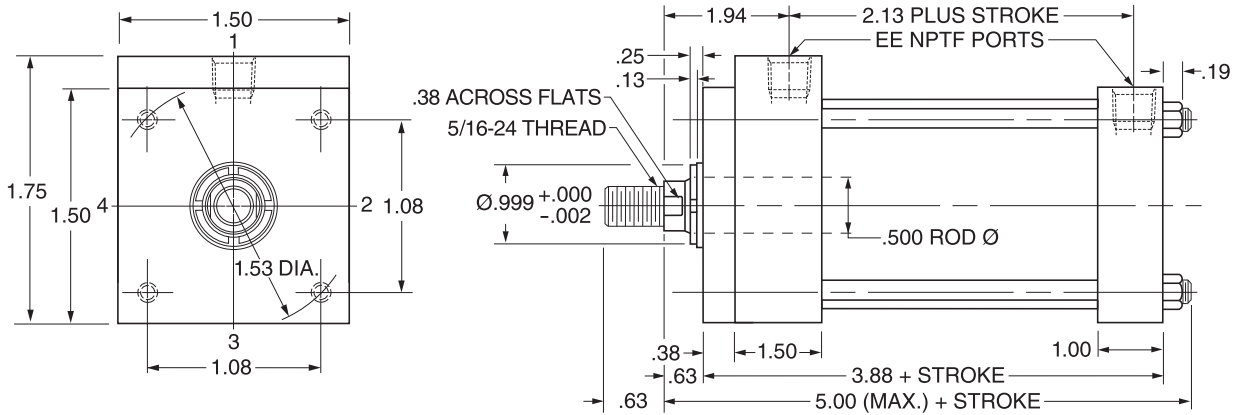
<sup>5</sup> Dimension XI to be specified by customer.

<sup>6</sup> Mounting style DD not available in 1.00" bore.

1.00" Drawings / 1.50" Port Adapters

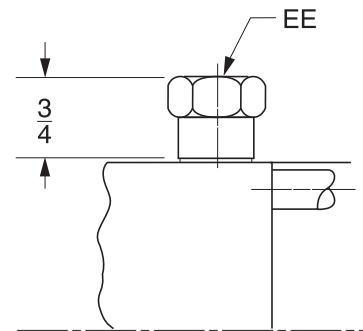
1.00" Bore Series 3L – Envelope and Head Dimensions

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1.50" Bore Series 3L – Straight Thread Port Adapters

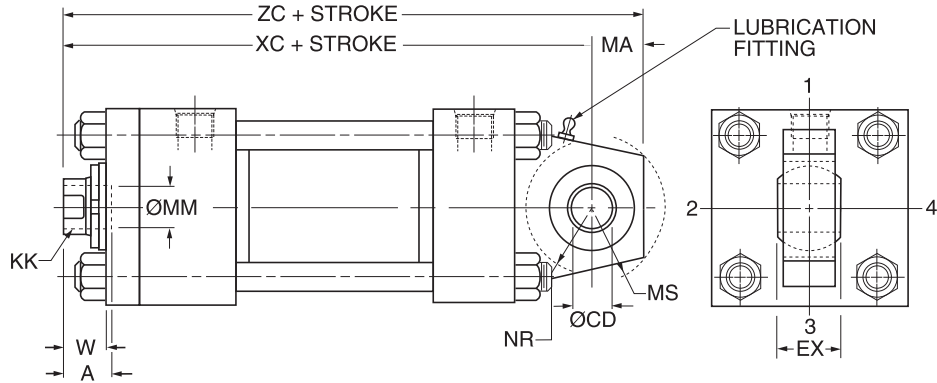
Straight thread ports on the cap end of 1.50" bore require an adapter fitting. An adapter fitting is also required on the head end of 1.50" bore with straight thread ports and Code 2 rod. Adapters are furnished as standard.



**Mounting Information – 1.50" to 5.00" Bore Series 3L**

**Spherical Bearing Mounting**  
Style SB

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**Table 1 – Dimensional and Mounting Data**

| Bore Ø | Rod No. | MM Rod Ø | Thread Style 7 KK <sup>1</sup> | Thread Style 9 KK <sup>1</sup> | A    | CD <sup>2</sup> Ø | EX   | MA   | MS   | NR   | W    | Add Stroke |      | Max. Oper. PSI <sup>3</sup> |      |
|--------|---------|----------|--------------------------------|--------------------------------|------|-------------------|------|------|------|------|------|------------|------|-----------------------------|------|
|        |         |          |                                |                                |      |                   |      |      |      |      |      | XC         | ZC   |                             |      |
| 1.50   | 1 (Std) | 0.625    | –                              | 7/16-20                        | 0.75 | -.0005<br>.5000   | 0.44 | 0.75 | 0.94 | 0.63 | 0.63 | 5.38       | 6.13 | 1500                        |      |
|        | 2       | 1.000    | 7/16-20                        | –                              | 0.75 |                   |      |      |      |      |      | 1.00       | 5.75 |                             | 6.50 |
| 2.00   | 1 (Std) | 0.625    | –                              | 7/16-20                        | 0.75 | -.0005<br>.5000   | 0.44 | 0.75 | 0.94 | 0.63 | 0.63 | 5.38       | 6.13 | 980                         |      |
|        | 2       | 1.375    | 7/16-20                        | –                              | 0.75 |                   |      |      |      |      |      | 1.25       | 6.00 |                             | 6.75 |
|        | 3       | 1.000    | 7/16-20                        | –                              | 0.75 |                   |      |      |      |      |      | 1.00       | 5.75 |                             | 6.50 |
| 2.50   | 1 (Std) | 1.000    | 7/16-20                        | –                              | 0.75 | -.0005<br>.5000   | 0.44 | 0.75 | 0.94 | 0.63 | 1.00 | 5.88       | 6.63 | 630                         |      |
|        | 2       | 1.750    | 7/16-20                        | –                              | 0.75 |                   |      |      |      |      |      | 1.50       | 6.38 |                             | 7.13 |
|        | 3       | 1.375    | 7/16-20                        | –                              | 0.75 |                   |      |      |      |      |      | 1.25       | 6.13 |                             | 6.88 |
|        | 7       | 0.625    | –                              | 7/16-20                        | 0.75 |                   |      |      |      |      |      | 0.63       | 5.50 |                             | 6.25 |
| 3.25   | 1 (Std) | 1.000    | –                              | 3/4-16                         | 1.13 | -.0005<br>.7500   | 0.66 | 1.00 | 1.38 | 1.00 | 0.75 | 6.88       | 7.88 | 830                         |      |
|        | 2       | 2.000    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.38       | 7.50 |                             | 8.50 |
|        | 3       | 1.375    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.00       | 7.13 |                             | 8.13 |
|        | 4       | 1.750    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.25       | 7.38 |                             | 8.38 |
| 4.00   | 1 (Std) | 1.375    | 3/4-16                         | –                              | 1.13 | -.0005<br>.7500   | 0.66 | 1.00 | 1.38 | 1.00 | 1.00 | 7.13       | 8.13 | 550                         |      |
|        | 2       | 2.500    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.63       | 7.75 |                             | 8.75 |
|        | 3       | 1.750    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.25       | 7.38 |                             | 8.38 |
|        | 4       | 2.000    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.38       | 7.50 |                             | 8.50 |
|        | 7       | 1.000    | –                              | 3/4-16                         | 1.13 |                   |      |      |      |      |      | 0.75       | 6.88 |                             | 7.88 |
| 5.00   | 1 (Std) | 1.750    | 3/4-16                         | –                              | 1.13 | -.0005<br>.7500   | 0.66 | 1.00 | 1.38 | 1.00 | 1.00 | 7.63       | 8.63 | 350                         |      |
|        | 2       | 3.500    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.63       | 8.00 |                             | 9.00 |
|        | 3       | 2.000    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.38       | 7.75 |                             | 8.75 |
|        | 4       | 2.500    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.63       | 8.00 |                             | 9.00 |
|        | 5       | 3.000    | 3/4-16                         | –                              | 1.13 |                   |      |      |      |      |      | 1.63       | 8.00 |                             | 9.00 |
|        | 7       | 1.000    | –                              | 3/4-16                         | 1.13 |                   |      |      |      |      |      | 0.75       | 7.13 |                             | 8.13 |
|        | 8       | 1.375    | 3/4-16                         | –                              | 1.13 | 1.00              | 7.38 | 8.38 |      |      |      |            |      |                             |      |

<sup>1</sup> Threads listed are also for a spherical rod eye which match style 9 or style 7. The spherical rod eye pin diameter matches the cap pin and (if required) needs to be purchased separately. See 3L Mounting Accessories for detailed information.

<sup>2</sup> Dimension CD is hole diameter.

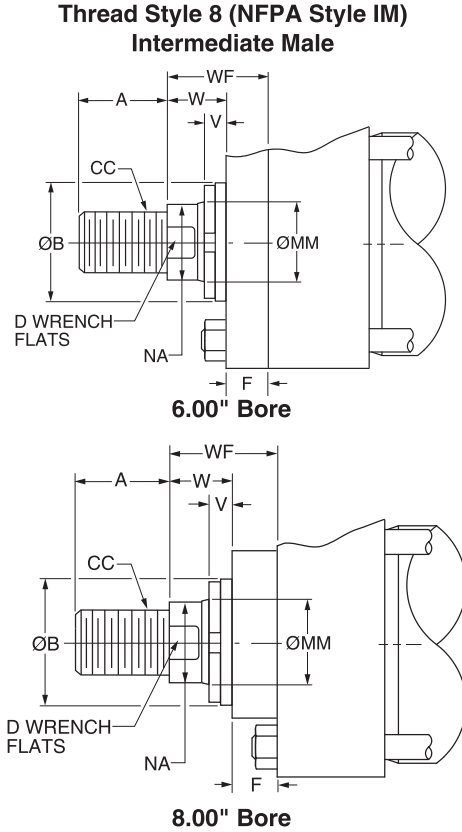
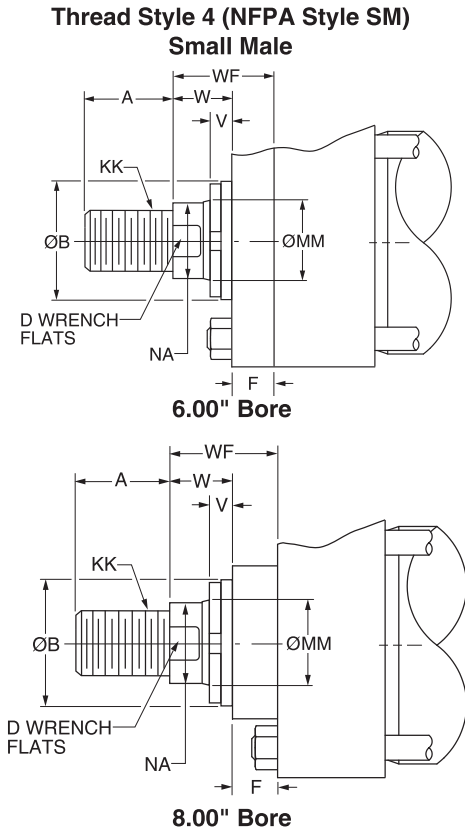
<sup>3</sup> Maximum operating pressure at 4:1 design factor is based on tensile strength of material.

Note: For additional dimensions, see Series 3L Style BB Mount.



**Rod End Dimensions**

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**Rod End Dimensions**

| Bore Ø | Rod No.  | MM Rod Ø | Thread        |               | A     | B Ø<br>+.000<br>-.002 | D              | F    | NA   | V    | W    | WF   |
|--------|----------|----------|---------------|---------------|-------|-----------------------|----------------|------|------|------|------|------|
|        |          |          | Style 8<br>CC | Style 4<br>KK |       |                       |                |      |      |      |      |      |
| 6.00   | 1 (Std.) | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00  | 2.374                 | 1.50           | 0.75 | 1.69 | 0.38 | 1.13 | 1.88 |
|        | 2        | 4.000    | 3 3/4-12      | 3-12          | 4.00  | 4.749                 | 3.38           | 0.75 | 3.88 | 0.50 | 1.50 | 2.25 |
|        | 3        | 2.000    | 1 3/4-12      | 1 1/2-12      | 2.25  | 2.624                 | 1.69           | 0.75 | 1.94 | 0.38 | 1.25 | 2.00 |
|        | 4        | 2.500    | 2 1/4-12      | 1 7/8-12      | 3.00  | 3.124                 | 2.06           | 0.75 | 2.38 | 0.50 | 1.50 | 2.25 |
|        | 5        | 3.000    | 2 3/4-12      | 2 1/4-12      | 3.50  | 3.749                 | 2.63           | 0.75 | 2.88 | 0.50 | 1.50 | 2.25 |
|        | 6        | 3.500    | 3 1/4-12      | 2 1/2-12      | 3.50  | 4.249                 | 3.00           | 0.75 | 3.38 | 0.50 | 1.50 | 2.25 |
|        | 7        | 1.375    | 1 1/4-12      | 1-14          | 1.63  | 1.999                 | 1.13           | 0.75 | 1.31 | 0.25 | 0.88 | 1.63 |
| 8.00   | 1 (Std.) | 2.000    | 1 3/4-12      | 1 1/2-12      | 2.25  | 2.624                 | 1.69           | 0.75 | 1.94 | 0.38 | 1.25 | 2.00 |
|        | 2        | 5.500    | 5 1/4-12      | 4-12          | 5.50  | 6.249                 | - <sup>1</sup> | 0.75 | 5.38 | 0.50 | 1.50 | 2.25 |
|        | 3        | 2.500    | 2 1/4-12      | 1 7/8-12      | 3.00  | 3.124                 | 2.06           | 0.75 | 2.38 | 0.50 | 1.50 | 2.25 |
|        | 4        | 3.000    | 2 3/4-12      | 2 1/4-12      | 3.50  | 3.749                 | 2.63           | 0.75 | 2.88 | 0.50 | 1.50 | 2.25 |
|        | 5        | 3.500    | 3 1/4-12      | 2 1/2-12      | 3.50  | 4.249                 | 3.00           | 0.75 | 3.38 | 0.50 | 1.50 | 2.25 |
|        | 6        | 4.000    | 3 3/4-12      | 3-12          | 4.00  | 4.749                 | 3.38           | 0.75 | 3.88 | 0.50 | 1.50 | 2.25 |
|        | 7        | 1.375    | 1 1/4-12      | 1-14          | 1.63  | 1.999                 | 1.13           | 0.75 | 1.31 | 0.25 | 0.88 | 1.63 |
|        | 8        | 1.750    | 1 1/2-12      | 1 1/4-12      | 2.00  | 2.374                 | 1.50           | 0.75 | 1.69 | 0.38 | 1.13 | 1.88 |
|        | 9        | 4.500    | 4 1/4-12      | 3 1/4-12      | 4.50  | 5.249                 | - <sup>1</sup> | 0.75 | 4.38 | 0.50 | 1.50 | 2.25 |
| 0      | 5.000    | 4 3/4-12 | 3 1/2-12      | 5.00          | 5.749 | - <sup>1</sup>        | 0.75           | 4.88 | 0.50 | 1.50 | 2.25 |      |

**“Special” Thread Style 3**

Special thread, extension, rod eye, blank, etc., are also available.

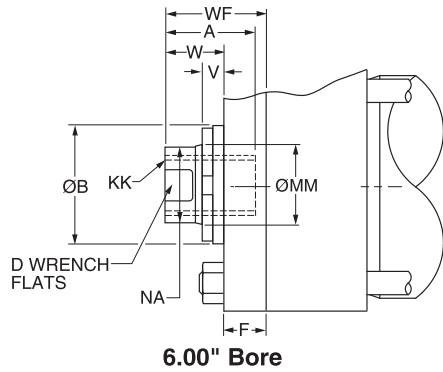
To order, specify “Style 3” and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

<sup>1</sup> These piston rod numbers will have 4 spanner wrench holes (.515 Dia. X .75 Deep) instead of wrench flats.



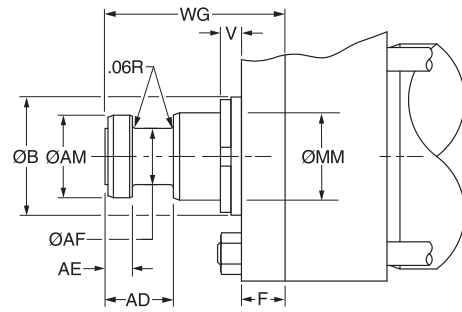
**Rod End Dimensions**

**Thread Style 9<sup>2</sup> (NFPA Style SF)  
Small Female**

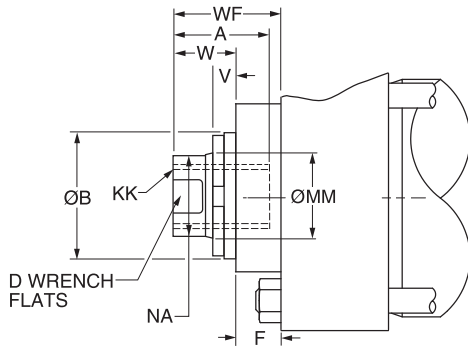


**6.00" Bore**

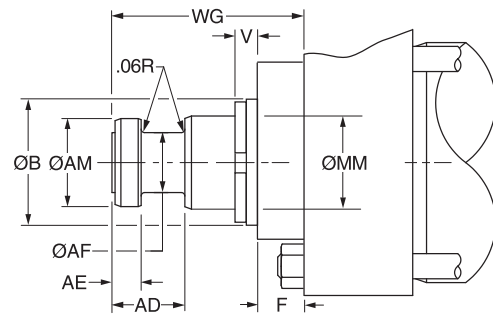
**Style 55<sup>1</sup>  
Flanged Rod End**



**6.00" Bore**



**8.00" Bore**



**8.00" Bore**

**Rod End Dimensions**

| Bore Ø | Rod No.  | MM Rod Ø | Thread   | A    | AD   | AE<br>+.001<br>-.001 | AF   | AM   | B Ø<br>+.000<br>-.002 | D              | F    | NA   | V    | W    | WF   | WG   |
|--------|----------|----------|----------|------|------|----------------------|------|------|-----------------------|----------------|------|------|------|------|------|------|
|        |          |          | Style 9  |      |      |                      |      |      |                       |                |      |      |      |      |      |      |
| 6.00   | 1 (Std.) | 1.750    | 1 1/4-12 | 2.00 | 1.31 | 0.499                | 1.13 | 1.70 | 2.374                 | 1.50           | 0.75 | 1.69 | 0.38 | 1.13 | 1.88 | 3.13 |
|        | 2        | 4.000    | 3-12     | 4.00 | 2.69 | 0.999                | 3.00 | 3.95 | 4.749                 | 3.38           | 0.75 | 3.88 | 0.50 | 1.50 | 2.25 | 5.75 |
|        | 3        | 2.000    | 1 1/2-12 | 2.25 | 1.69 | 0.624                | 1.38 | 1.95 | 2.624                 | 1.69           | 0.75 | 1.94 | 0.38 | 1.25 | 2.00 | 3.75 |
|        | 4        | 2.500    | 1 7/8-12 | 3.00 | 1.94 | 0.749                | 1.75 | 2.45 | 3.124                 | 2.06           | 0.75 | 2.38 | 0.50 | 1.50 | 2.25 | 4.50 |
|        | 5        | 3.000    | 2 1/4-12 | 3.50 | 2.44 | 0.874                | 2.25 | 2.95 | 3.749                 | 2.63           | 0.75 | 2.88 | 0.50 | 1.50 | 2.25 | 4.88 |
|        | 6        | 3.500    | 2 1/2-12 | 3.50 | 2.69 | 0.999                | 2.50 | 3.45 | 4.249                 | 3.00           | 0.75 | 3.38 | 0.50 | 1.50 | 2.25 | 5.63 |
|        | 7        | 1.375    | 1-14     | 1.63 | 1.06 | 0.374                | 0.88 | 1.32 | 1.999                 | 1.13           | 0.75 | 1.31 | 0.25 | 0.88 | 1.63 | 2.75 |
| 8.00   | 1 (Std.) | 2.000    | 1 1/2-12 | 2.25 | 1.69 | 0.624                | 1.38 | 1.95 | 2.624                 | 1.69           | 0.75 | 1.94 | 0.38 | 1.25 | 2.00 | 3.75 |
|        | 2        | 5.500    | 4-12     | 5.50 | 3.94 | 1.874                | 4.38 | 5.45 | 6.249                 | - <sup>3</sup> | 0.75 | 5.38 | 0.50 | 1.50 | 2.25 | 7.50 |
|        | 3        | 2.500    | 1 7/8-12 | 3.00 | 1.94 | 0.749                | 1.75 | 2.45 | 3.124                 | 2.06           | 0.75 | 2.38 | 0.50 | 1.50 | 2.25 | 4.50 |
|        | 4        | 3.000    | 2 1/4-12 | 3.50 | 2.44 | 0.874                | 2.25 | 2.95 | 3.749                 | 2.63           | 0.75 | 2.88 | 0.50 | 1.50 | 2.25 | 4.88 |
|        | 5        | 3.500    | 2 1/2-12 | 3.50 | 2.69 | 0.999                | 2.50 | 3.45 | 4.249                 | 3.00           | 0.75 | 3.38 | 0.50 | 1.50 | 2.25 | 5.63 |
|        | 6        | 4.000    | 3-12     | 4.00 | 2.69 | 0.999                | 3.00 | 3.95 | 4.749                 | 3.38           | 0.75 | 3.88 | 0.50 | 1.50 | 2.25 | 5.75 |
|        | 7        | 1.375    | 1-14     | 1.63 | 1.06 | 0.374                | 0.88 | 1.32 | 1.999                 | 1.13           | 0.75 | 1.31 | 0.25 | 0.88 | 1.63 | 2.75 |
|        | 8        | 1.750    | 1 1/4-12 | 2.00 | 1.31 | 0.499                | 1.13 | 1.70 | 2.374                 | 1.50           | 0.75 | 1.69 | 0.38 | 1.13 | 1.88 | 3.13 |
|        | 9        | 4.500    | 3 1/4-12 | 4.50 | 3.19 | 1.499                | 3.50 | 4.45 | 5.249                 | - <sup>3</sup> | 0.75 | 4.38 | 0.50 | 1.50 | 2.25 | 6.50 |
|        | 0        | 5.000    | 3 1/2-12 | 5.00 | 3.19 | 1.499                | 3.88 | 4.95 | 5.749                 | - <sup>3</sup> | 0.75 | 4.88 | 0.50 | 1.50 | 2.25 | 6.63 |

**"Special" Thread Style 3**

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style 3" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

<sup>1</sup> For special WG dimension, specify "Style 3" and give desired dimension for WG. For other changes, place "S" in the model code, and describe rod end with dimensioned sketch.

<sup>2</sup> Style 9 stroke restrictions may apply. See Style 9 Minimum Stroke Table on How to Order page for details.

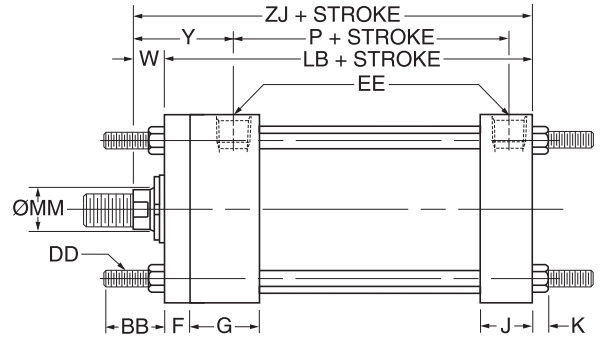
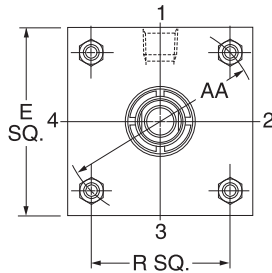
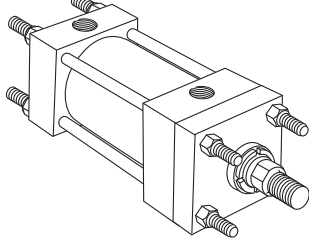
<sup>3</sup> These piston rod numbers will have 4 spanner wrench holes (.515 Dia. X .75 Deep) instead of wrench flats.



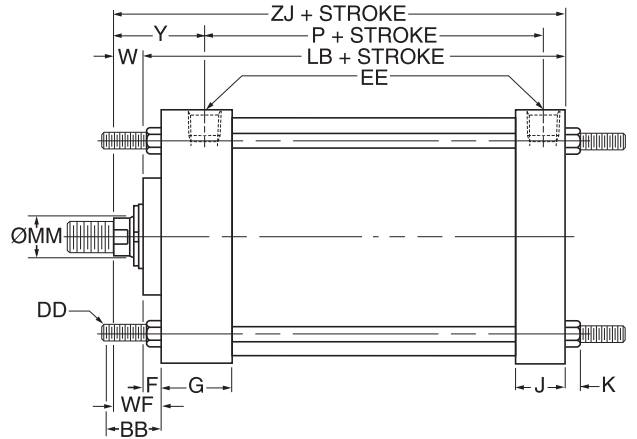
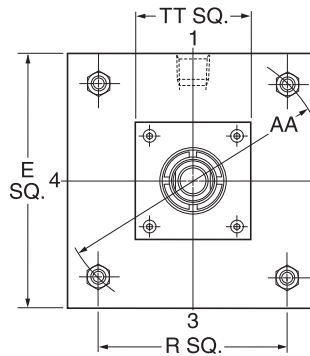
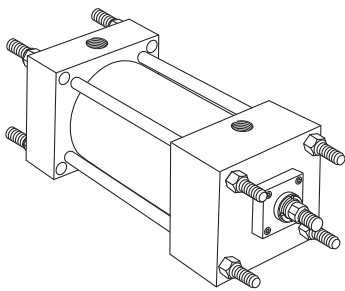
**Tie Rods Extended Both Ends Mounting**

Style TD  
(NFPA Style MX3)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | AA   | BB   | DD     | E    | EE                |                  | F    | G    | J    | K    | R    | Add Stroke |      |
|--------|------|------|--------|------|-------------------|------------------|------|------|------|------|------|------------|------|
|        |      |      |        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      | LB         | P    |
| 6.00   | 6.90 | 1.81 | 1/2-20 | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 4.88 | 5.75       | 3.13 |
| 8.00   | 9.10 | 2.31 | 5/8-18 | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 6.44 | 5.88       | 3.25 |

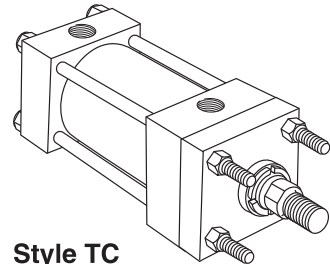
<sup>1</sup> NPTF Ports will be furnished as standard unless SAE Straight Thread Ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

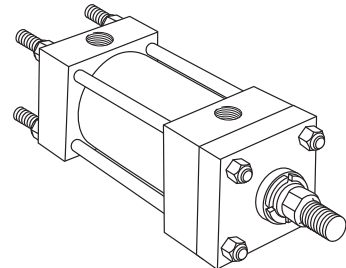
**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | WF   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------|------------|
|        |          |          |      |      |      |      | ZJ         |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | –    | 3.06 | 6.88       |
|        | 2        | 4.000    | –    | 1.50 | –    | 3.44 | 7.25       |
|        | 3        | 2.000    | –    | 1.25 | –    | 3.19 | 7.00       |
|        | 4        | 2.500    | –    | 1.50 | –    | 3.44 | 7.25       |
|        | 5        | 3.000    | –    | 1.50 | –    | 3.44 | 7.25       |
|        | 6        | 3.500    | –    | 1.50 | –    | 3.44 | 7.25       |
|        | 7        | 1.375    | –    | 0.88 | –    | 2.81 | 6.63       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 2.00 | 3.19 | 7.13       |
|        | 2        | 5.500    | 7.00 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 3        | 2.500    | 4.00 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 4        | 3.000    | 5.50 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 5        | 3.500    | 5.50 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 6        | 4.000    | 5.50 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 7        | 1.375    | 4.00 | 0.88 | 1.63 | 2.81 | 6.75       |
|        | 8        | 1.750    | 4.00 | 1.13 | 1.88 | 3.06 | 7.00       |
|        | 9        | 4.500    | 7.00 | 1.50 | 2.25 | 3.44 | 7.38       |
|        | 0        | 5.000    | 7.00 | 1.50 | 2.25 | 3.44 | 7.38       |

**Style TB**



**Style TC**



Style TD (NFPA MX3) Both Ends Tie Rods Extended, illustrated: Style TC (NFPA MX2), Cap Tie Rods Extended; and Style TB (NFPA MX1), Head Tie Rods Extended are also available.

Basic Mounting (T) — NFPA MX0 — no tie rods extended can be supplied upon request.

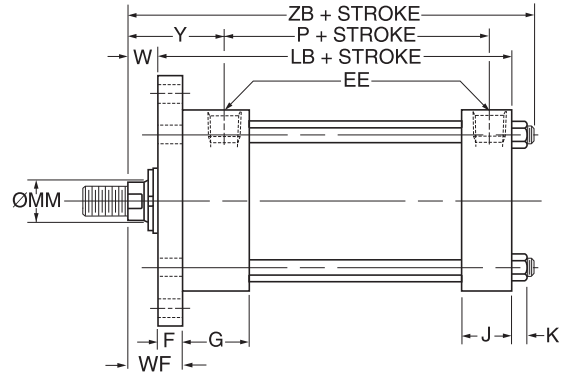
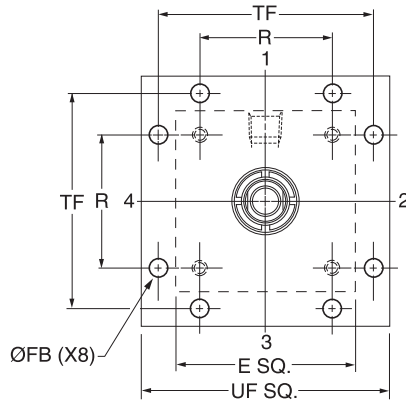
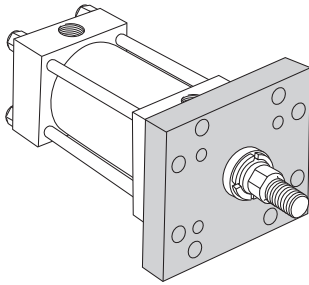


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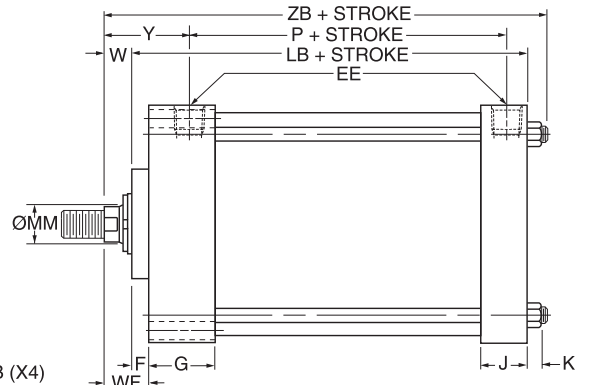
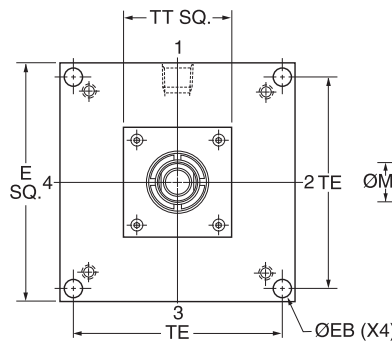
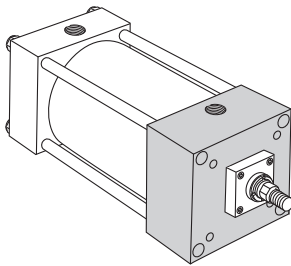
**Mounting Information – 6.00" & 8.00" Bore Series 3L**

**Head Square Flange Mounting Style JB**

**6.00" Bore (NFFA Style MF5)**



**8.00" Bore (NFFA Style ME3)**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EB Ø | EE                |                  | F    | FB Ø | G    | J    | K    | R    | TE   | TF   | UF   | Add Stroke |      |
|--------|------|------|-------------------|------------------|------|------|------|------|------|------|------|------|------|------------|------|
|        |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      |      | LB         | P    |
| 6.00   | 6.50 | –    | 3/4               | 12               | 0.75 | 0.56 | 2.00 | 1.50 | 0.44 | 4.88 | –    | 7.63 | 8.63 | 5.75       | 3.13 |
| 8.00   | 8.50 | 0.69 | 3/4               | 12               | 0.75 | 0.56 | 2.00 | 1.50 | 0.56 | –    | 7.57 | –    | –    | 5.88       | 3.25 |

<sup>1</sup> NPTF Ports will be furnished as standard unless SAE Straight Thread Ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

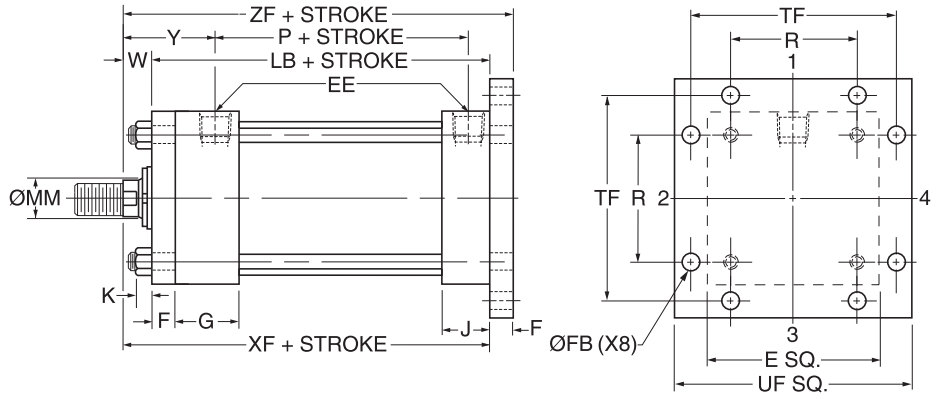
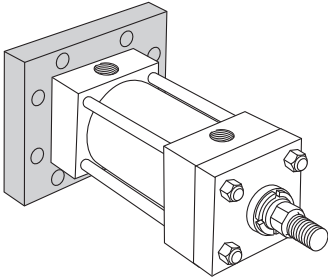
| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | WF   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------|------------|
|        |          |          |      |      |      |      | ZB Max.    |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 1.88 | 3.06 | 7.56       |
|        | 2        | 4.000    | –    | 1.50 | 2.25 | 3.44 | 7.94       |
|        | 3        | 2.000    | –    | 1.25 | 2.00 | 3.19 | 7.69       |
|        | 4        | 2.500    | –    | 1.50 | 2.25 | 3.44 | 7.94       |
|        | 5        | 3.000    | –    | 1.50 | 2.25 | 3.44 | 7.94       |
|        | 6        | 3.500    | –    | 1.50 | 2.25 | 3.44 | 7.94       |
|        | 7        | 1.375    | –    | 0.88 | 1.63 | 2.81 | 7.31       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 2.00 | 3.19 | 7.94       |
|        | 2        | 5.500    | 7.00 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 3        | 2.500    | 4.00 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 4        | 3.000    | 5.50 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 5        | 3.500    | 5.50 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 6        | 4.000    | 5.50 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 7        | 1.375    | 4.00 | 0.88 | 1.63 | 2.81 | 7.56       |
|        | 8        | 1.750    | 4.00 | 1.13 | 1.88 | 3.06 | 7.81       |
|        | 9        | 4.500    | 7.00 | 1.50 | 2.25 | 3.44 | 8.19       |
|        | 0        | 5.000    | 7.00 | 1.50 | 2.25 | 3.44 | 8.19       |



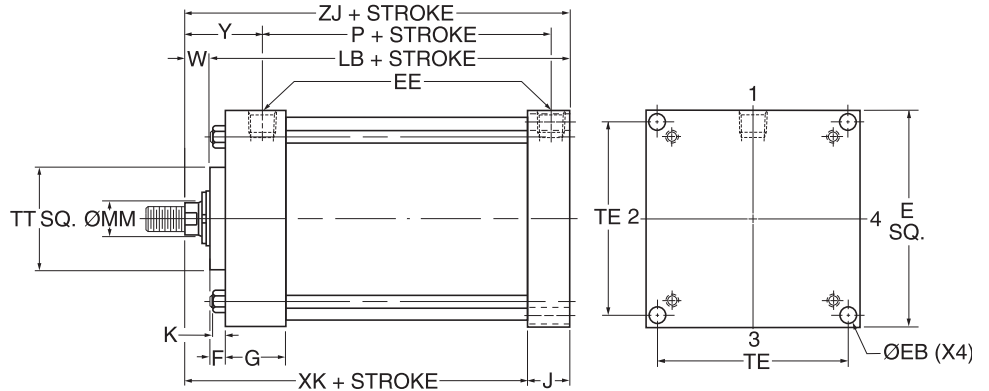
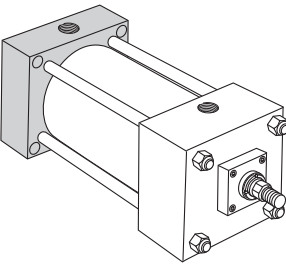
**Mounting Information – 6.00" & 8.00" Bore Series 3L**

**Cap Square Flange Mounting Style HB**

**6.00" Bore (NFPA Style MF6)**



**8.00" Bore (NFPA Style ME4)**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EB Ø | EE                |                  | F    | FB Ø | G    | J    | K    | R    | TE   | TF   | UF   | Add Stroke |      |
|--------|------|------|-------------------|------------------|------|------|------|------|------|------|------|------|------|------------|------|
|        |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      |      | LB         | P    |
| 6.00   | 6.50 | –    | 3/4               | 12               | 0.75 | 0.56 | 2.00 | 1.50 | 0.44 | 4.88 | –    | 7.63 | 8.63 | 5.75       | 3.13 |
| 8.00   | 8.50 | 0.69 | 3/4               | 12               | 0.75 | –    | 2.00 | 1.50 | 0.56 | –    | 7.57 | –    | –    | 5.88       | 3.25 |

<sup>1</sup> NPTF Ports will be furnished as standard unless SAE Straight Thread Ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | Y    | Add Stroke |      |      |      |
|--------|----------|----------|------|------|------|------------|------|------|------|
|        |          |          |      |      |      | XF         | XK   | ZF   | ZJ   |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 3.06 | 6.88       | –    | 7.63 | –    |
|        | 2        | 4.000    | –    | 1.50 | 3.44 | 7.25       | –    | 8.00 | –    |
|        | 3        | 2.000    | –    | 1.25 | 3.19 | 7.00       | –    | 7.75 | –    |
|        | 4        | 2.500    | –    | 1.50 | 3.44 | 7.25       | –    | 8.00 | –    |
|        | 5        | 3.000    | –    | 1.50 | 3.44 | 7.25       | –    | 8.00 | –    |
|        | 6        | 3.500    | –    | 1.50 | 3.44 | 7.25       | –    | 8.00 | –    |
|        | 7        | 1.375    | –    | 0.88 | 2.81 | 6.63       | –    | 7.38 | –    |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 3.19 | –          | 5.63 | –    | 7.13 |
|        | 2        | 5.500    | 7.00 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
|        | 3        | 2.500    | 4.00 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
|        | 4        | 3.000    | 5.50 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
|        | 5        | 3.500    | 5.50 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
|        | 6        | 4.000    | 5.50 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
|        | 7        | 1.375    | 4.00 | 0.88 | 2.81 | –          | 5.25 | –    | 6.75 |
|        | 8        | 1.750    | 4.00 | 1.13 | 3.06 | –          | 5.50 | –    | 7.00 |
|        | 9        | 4.500    | 7.00 | 1.50 | 3.44 | –          | 5.88 | –    | 7.38 |
| 0      | 5.000    | 7.00     | 1.50 | 3.44 | –    | 5.88       | –    | 7.38 |      |



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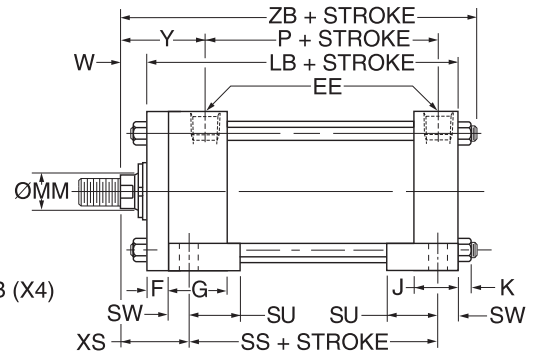
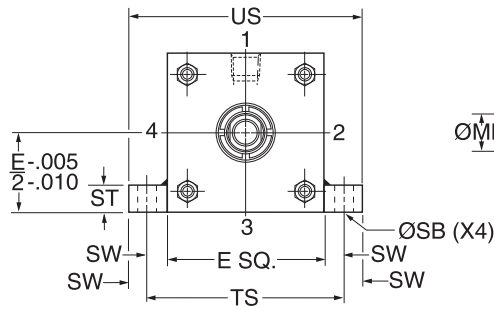
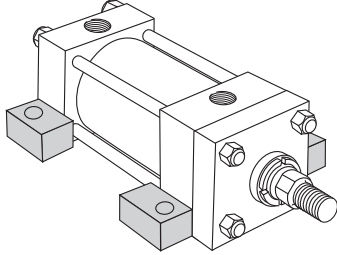


**Mounting Information – 6.00" & 8.00" Bore Series 3L**

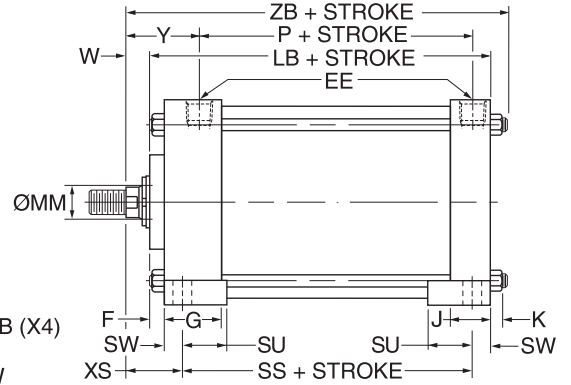
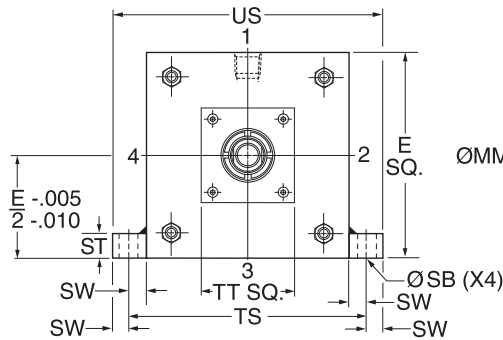
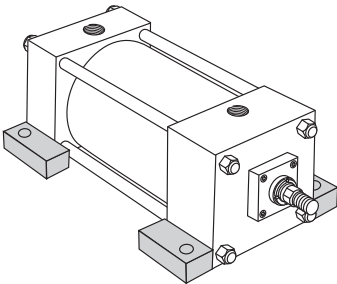
**Side Lug Mounting**

Style C  
(NFPA Style MS2)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EE                |                  | F    | G    | J    | K    | SB Ø | ST   | SU   | SW   | TS   | US    | Add Stroke |      |      |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|------|------|-------|------------|------|------|
|        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      |      |      |       | LB         | P    | SS   |
| 6.00   | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 0.81 | 1.00 | 1.56 | 0.69 | 7.88 | 9.25  | 5.75       | 3.13 | 3.63 |
| 8.00   | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 0.81 | 1.00 | 1.56 | 0.69 | 9.88 | 11.25 | 5.88       | 3.25 | 3.75 |

<sup>1</sup> NPTF Ports will be furnished as standard unless SAE Straight Thread Ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | XS   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------|------------|
|        |          |          |      |      |      |      | ZB Max.    |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 2.56 | 3.06 | 7.56       |
|        | 2        | 4.000    | –    | 1.50 | 2.94 | 3.44 | 7.94       |
|        | 3        | 2.000    | –    | 1.25 | 2.69 | 3.19 | 7.69       |
|        | 4        | 2.500    | –    | 1.50 | 2.94 | 3.44 | 7.94       |
|        | 5        | 3.000    | –    | 1.50 | 2.94 | 3.44 | 7.94       |
|        | 6        | 3.500    | –    | 1.50 | 2.94 | 3.44 | 7.94       |
|        | 7        | 1.375    | –    | 0.88 | 2.56 | 2.81 | 7.31       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 2.69 | 3.19 | 7.94       |
|        | 2        | 5.500    | 7.00 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 3        | 2.500    | 4.00 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 4        | 3.000    | 5.50 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 5        | 3.500    | 5.50 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 6        | 4.000    | 5.50 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 7        | 1.375    | 4.00 | 0.88 | 2.31 | 2.81 | 7.56       |
|        | 8        | 1.750    | 4.00 | 1.13 | 2.56 | 3.06 | 7.81       |
|        | 9        | 4.500    | 7.00 | 1.50 | 2.94 | 3.44 | 8.19       |
|        | 0        | 5.000    | 7.00 | 1.50 | 2.94 | 3.44 | 8.19       |

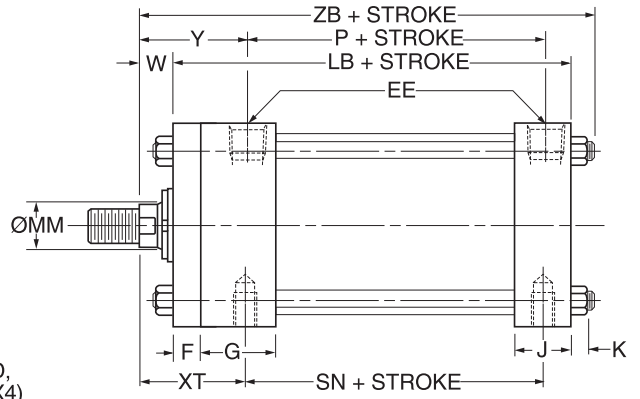
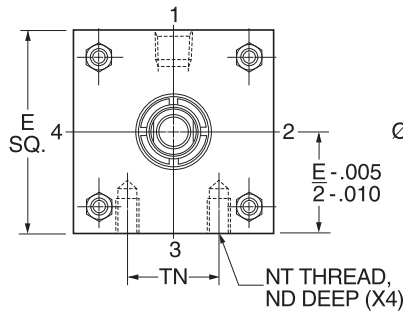
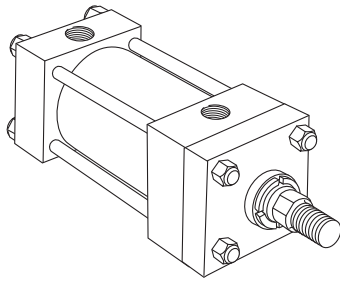


**Mounting Information – 6.00" & 8.00" Bore Series 3L**

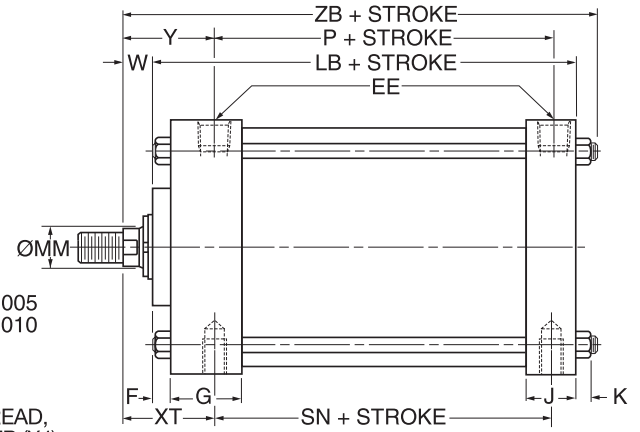
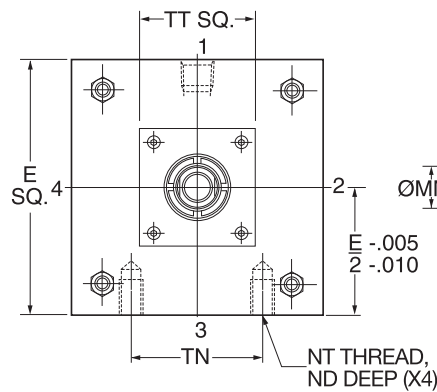
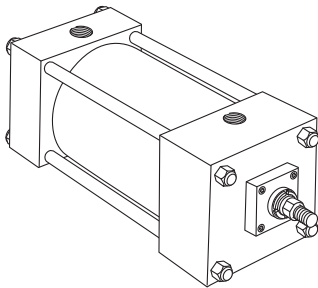
**Side Tapped Mounting**

Style F  
(NFPA Style MS4)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EE                |                  | F    | G    | J    | K    | ND   | NT     | TN   | Add Stroke |      |      |
|--------|------|-------------------|------------------|------|------|------|------|------|--------|------|------------|------|------|
|        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |        |      | LB         | P    | SN   |
| 6.00   | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 0.88 | 3/4-10 | 3.25 | 5.75       | 3.13 | 3.13 |
| 8.00   | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 1.13 | 3/4-10 | 4.50 | 5.88       | 3.25 | 3.25 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | XT   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------|------------|
|        |          |          |      |      |      |      | ZB Max.    |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 3.06 | 3.06 | 7.56       |
|        | 2        | 4.000    | –    | 1.50 | 3.44 | 3.44 | 7.94       |
|        | 3        | 2.000    | –    | 1.25 | 3.19 | 3.19 | 7.69       |
|        | 4        | 2.500    | –    | 1.50 | 3.44 | 3.44 | 7.94       |
|        | 5        | 3.000    | –    | 1.50 | 3.44 | 3.44 | 7.94       |
|        | 6        | 3.500    | –    | 1.50 | 3.44 | 3.44 | 7.94       |
|        | 7        | 1.375    | –    | 0.88 | 2.81 | 2.81 | 7.31       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 3.19 | 3.19 | 7.94       |
|        | 2        | 5.500    | 7.00 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 3        | 2.500    | 4.00 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 4        | 3.000    | 5.50 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 5        | 3.500    | 5.50 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 6        | 4.000    | 5.50 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 7        | 1.375    | 4.00 | 0.88 | 2.81 | 2.81 | 7.56       |
|        | 8        | 1.750    | 4.00 | 1.13 | 3.06 | 3.06 | 7.81       |
|        | 9        | 4.500    | 7.00 | 1.50 | 3.44 | 3.44 | 8.19       |
|        | 0        | 5.000    | 7.00 | 1.50 | 3.44 | 3.44 | 8.19       |



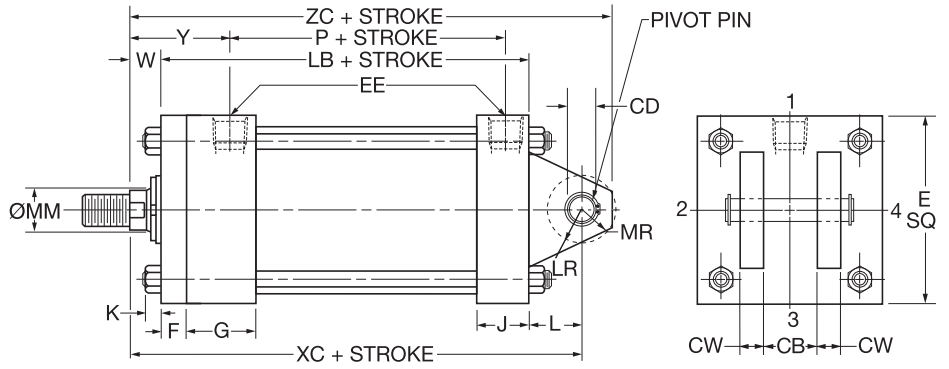
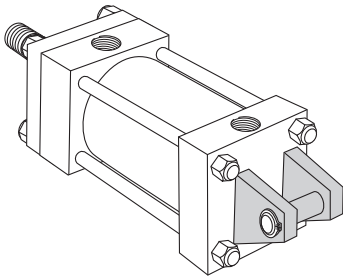
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**Mounting Information – 6.00" & 8.00" Bore Series 3L**

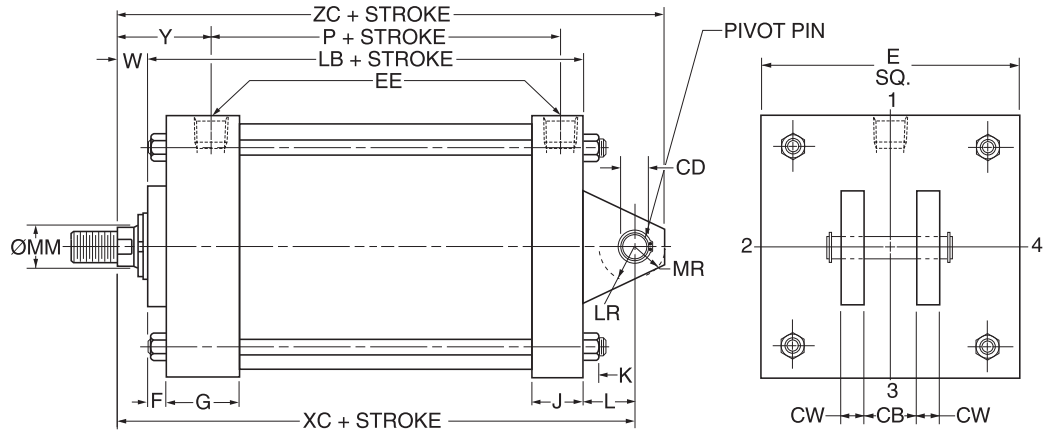
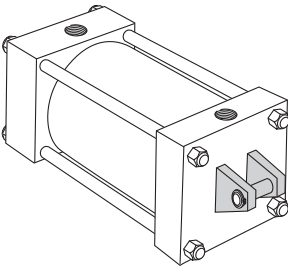
**Cap Fixed Clevis Mounting**

Style BB  
(NFA Style MP1)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | CB   | CD <sup>3</sup> Ø<br>+.000<br>-.002 | CW   | E    | EE                |                  | F    | G    | J    | K    | L    | LR   | MR   | Add Stroke |      |
|--------|------|-------------------------------------|------|------|-------------------|------------------|------|------|------|------|------|------|------|------------|------|
|        |      |                                     |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |      |      |      | LB         | P    |
| 6.00   | 1.50 | 1.001                               | 0.75 | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 1.50 | 1.25 | 1.19 | 5.75       | 3.13 |
| 8.00   | 1.50 | 1.001                               | 0.75 | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 1.50 | 1.25 | 1.19 | 5.88       | 3.25 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

<sup>3</sup> Dimension CD is pin diameter.

**Table 2 – Dimensional and Mounting Data**

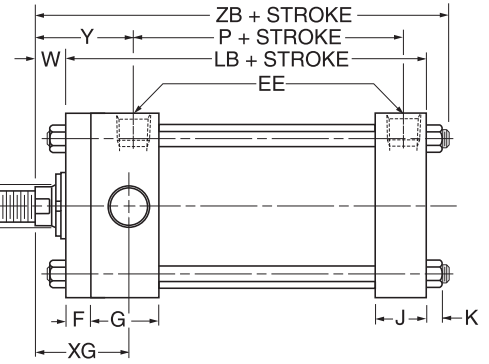
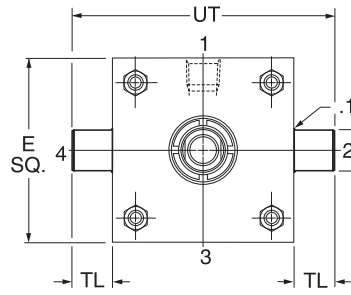
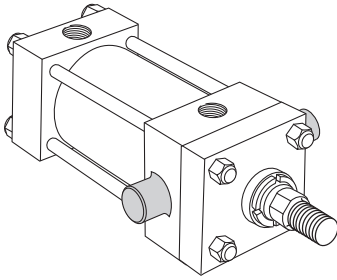
| Bore Ø | Rod No.  | MM Rod Ø | W    | Y    | Add Stroke |      |
|--------|----------|----------|------|------|------------|------|
|        |          |          |      |      | XC         | ZC   |
| 6.00   | 1 (Std.) | 1.750    | 1.13 | 3.06 | 8.38       | 9.38 |
|        | 2        | 4.000    | 1.50 | 3.44 | 8.75       | 9.75 |
|        | 3        | 2.000    | 1.25 | 3.19 | 8.50       | 9.50 |
|        | 4        | 2.500    | 1.50 | 3.44 | 8.75       | 9.75 |
|        | 5        | 3.000    | 1.50 | 3.44 | 8.75       | 9.75 |
|        | 6        | 3.500    | 1.50 | 3.44 | 8.75       | 9.75 |
|        | 7        | 1.375    | 0.88 | 2.81 | 8.13       | 9.13 |
| 8.00   | 1 (Std.) | 2.000    | 1.25 | 3.19 | 8.63       | 9.63 |
|        | 2        | 5.500    | 1.50 | 3.44 | 8.88       | 9.88 |
|        | 3        | 2.500    | 1.50 | 3.44 | 8.88       | 9.88 |
|        | 4        | 3.000    | 1.50 | 3.44 | 8.88       | 9.88 |
|        | 5        | 3.500    | 1.50 | 3.44 | 8.88       | 9.88 |
|        | 6        | 4.000    | 1.50 | 3.44 | 8.88       | 9.88 |
|        | 7        | 1.375    | 0.88 | 2.81 | 8.25       | 9.25 |
|        | 8        | 1.750    | 1.13 | 3.06 | 8.50       | 9.50 |
|        | 9        | 4.500    | 1.50 | 3.44 | 8.88       | 9.88 |
| 0      | 5.000    | 1.50     | 3.44 | 8.88 | 9.88       |      |



Head Trunnion Mounting

Style D  
(NFPA Style MT1)

6.00" Bore



8.00" Bore

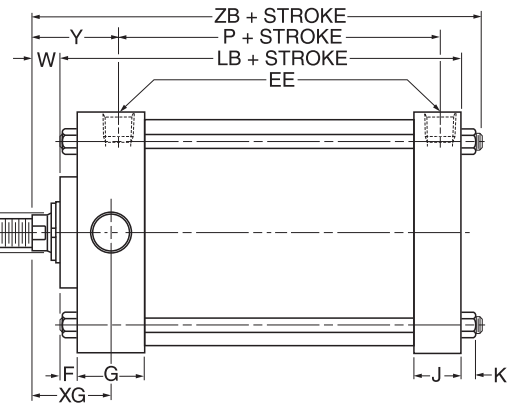
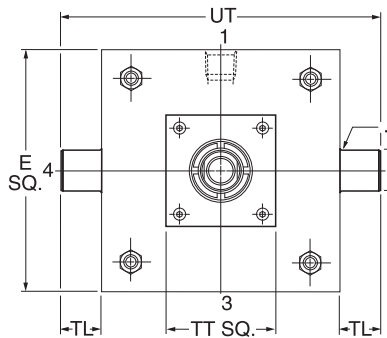
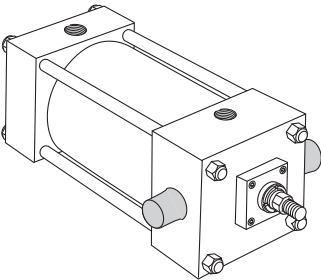


Table 1 – Dimensional and Mounting Data

| Bore Ø | E    | EE                |                  | F    | G    | J    | K    | TD Ø<br>+.000<br>-.001 | TL   | UT    | Add Stroke |      |
|--------|------|-------------------|------------------|------|------|------|------|------------------------|------|-------|------------|------|
|        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                        |      |       | LB         | P    |
| 6.00   | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 1.375                  | 1.38 | 9.25  | 5.75       | 3.13 |
| 8.00   | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 1.375                  | 1.38 | 11.25 | 5.88       | 3.25 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

Table 2 – Dimensional and Mounting Data

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | XG   | Y    | Add Stroke |
|--------|----------|----------|------|------|------|------|------------|
|        |          |          |      |      |      |      | ZB Max.    |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 2.88 | 3.06 | 7.56       |
|        | 2        | 4.000    | –    | 1.50 | 3.25 | 3.44 | 7.94       |
|        | 3        | 2.000    | –    | 1.25 | 3.00 | 3.19 | 7.69       |
|        | 4        | 2.500    | –    | 1.50 | 3.25 | 3.44 | 7.94       |
|        | 5        | 3.000    | –    | 1.50 | 3.25 | 3.44 | 7.94       |
|        | 6        | 3.500    | –    | 1.50 | 3.25 | 3.44 | 7.94       |
|        | 7        | 1.375    | –    | 0.88 | 2.63 | 2.81 | 7.31       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 3.00 | 3.19 | 7.94       |
|        | 2        | 5.500    | 7.00 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 3        | 2.500    | 4.00 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 4        | 3.000    | 5.50 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 5        | 3.500    | 5.50 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 6        | 4.000    | 5.50 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 7        | 1.375    | 4.00 | 0.88 | 2.63 | 2.81 | 7.56       |
|        | 8        | 1.750    | 4.00 | 1.13 | 2.88 | 3.06 | 7.81       |
|        | 9        | 4.500    | 7.00 | 1.50 | 3.25 | 3.44 | 8.19       |
|        | 0        | 5.000    | 7.00 | 1.50 | 3.25 | 3.44 | 8.19       |



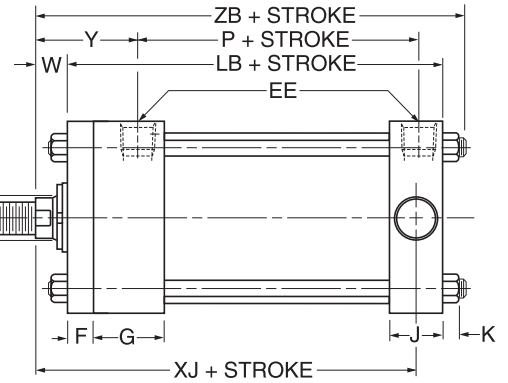
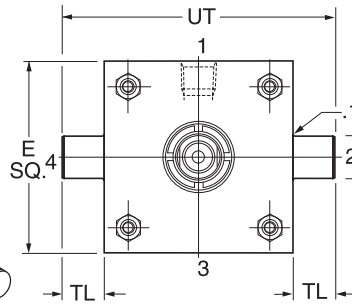
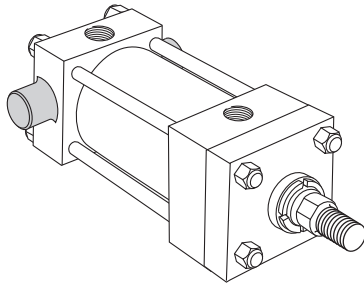
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**Mounting Information – 6.00" & 8.00" Bore Series 3L**

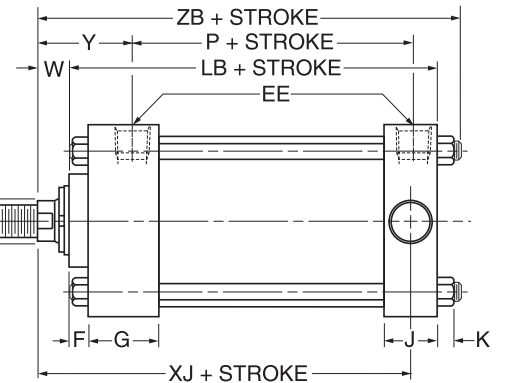
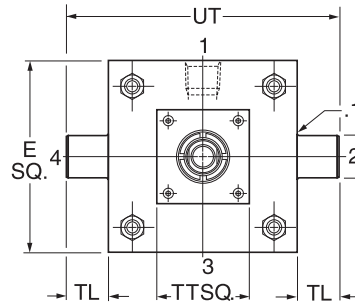
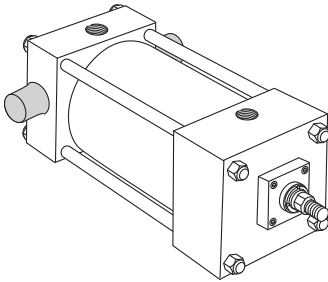
**Cap Trunnion Mounting**

Style DB  
(NPTA Style MT2)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | E    | EE                |                  | F    | G    | J    | K    | TD Ø<br>+.000<br>-.001 | TL   | UT    | Add Stroke |      |
|--------|------|-------------------|------------------|------|------|------|------|------------------------|------|-------|------------|------|
|        |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                        |      |       | LB         | P    |
| 6.00   | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 1.375                  | 1.38 | 9.25  | 5.75       | 3.13 |
| 8.00   | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 1.375                  | 1.38 | 11.25 | 5.88       | 3.25 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | Y    | Add Stroke |         |
|--------|----------|----------|------|------|------|------------|---------|
|        |          |          |      |      |      | XJ         | ZB Max. |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 3.06 | 6.13       | 7.56    |
|        | 2        | 4.000    | –    | 1.50 | 3.44 | 6.50       | 7.94    |
|        | 3        | 2.000    | –    | 1.25 | 3.19 | 6.25       | 7.69    |
|        | 4        | 2.500    | –    | 1.50 | 3.44 | 6.50       | 7.94    |
|        | 5        | 3.000    | –    | 1.50 | 3.44 | 6.50       | 7.94    |
|        | 6        | 3.500    | –    | 1.50 | 3.44 | 6.50       | 7.94    |
|        | 7        | 1.375    | –    | 0.88 | 2.81 | 5.88       | 7.31    |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 3.19 | 6.38       | 7.94    |
|        | 2        | 5.500    | 7.00 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 3        | 2.500    | 4.00 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 4        | 3.000    | 5.50 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 5        | 3.500    | 5.50 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 6        | 4.000    | 5.50 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 7        | 1.375    | 4.00 | 0.88 | 2.81 | 6.00       | 7.56    |
|        | 8        | 1.750    | 4.00 | 1.13 | 3.06 | 6.25       | 7.81    |
|        | 9        | 4.500    | 7.00 | 1.50 | 3.44 | 6.63       | 8.19    |
|        | 0        | 5.000    | 7.00 | 1.50 | 3.44 | 6.63       | 8.19    |

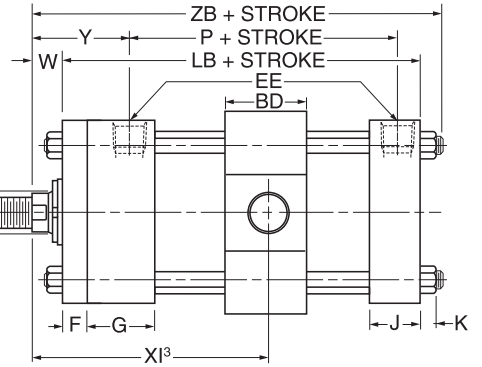
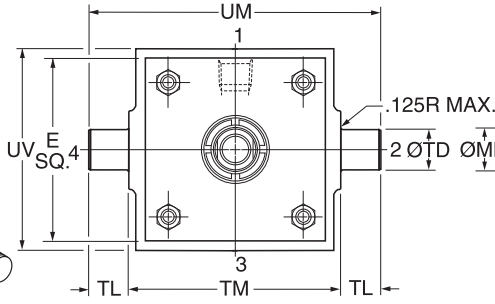
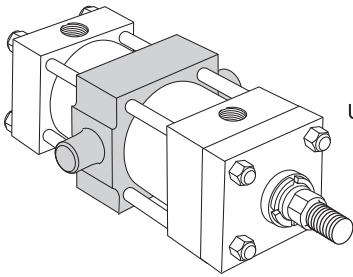


**Mounting Information – 6.00" & 8.00" Bore Series 3L**

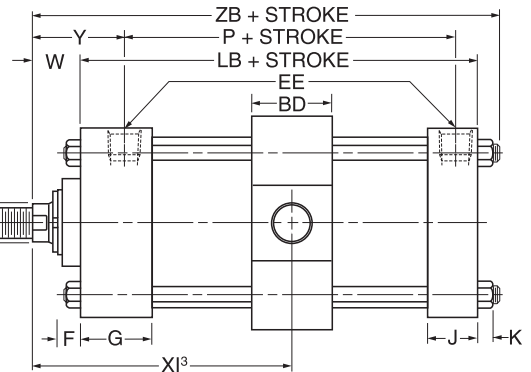
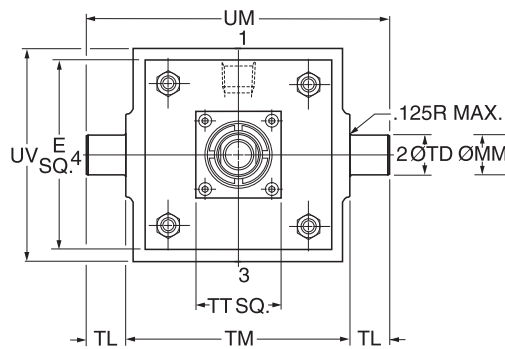
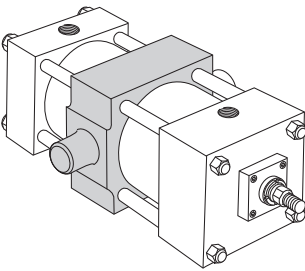
**Intermediate Fixed Trunnion Mounting**

Style DD  
(NPTA Style MT4)

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | BD   | E    | EE                |                  | F    | G    | J    | K    | TD Ø +.000 - .001 | TL   | TM   | UM    | UV   | Add Stroke |      |
|--------|------|------|-------------------|------------------|------|------|------|------|-------------------|------|------|-------|------|------------|------|
|        |      |      | NPTF <sup>1</sup> | SAE <sup>2</sup> |      |      |      |      |                   |      |      |       |      | LB         | P    |
| 6.00   | 2.50 | 6.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.44 | 1.375             | 1.38 | 7.63 | 10.38 | 7.00 | 5.75       | 3.13 |
| 8.00   | 2.50 | 8.50 | 3/4               | 12               | 0.75 | 2.00 | 1.50 | 0.56 | 1.375             | 1.38 | 9.75 | 12.50 | 9.50 | 5.88       | 3.25 |

<sup>1</sup> NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

<sup>2</sup> SAE straight thread ports are indicated by port number.

**Table 2 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | TT   | W    | Min. <sup>3</sup> XI | Min. Stroke | Y    | Add Stroke |
|--------|----------|----------|------|------|----------------------|-------------|------|------------|
|        |          |          |      |      |                      |             |      | ZB Max.    |
| 6.00   | 1 (Std.) | 1.750    | –    | 1.13 | 5.19                 | 0.88        | 3.06 | 7.56       |
|        | 2        | 4.000    | –    | 1.50 | 5.56                 | 0.88        | 3.44 | 7.94       |
|        | 3        | 2.000    | –    | 1.25 | 5.31                 | 0.88        | 3.19 | 7.69       |
|        | 4        | 2.500    | –    | 1.50 | 5.56                 | 0.88        | 3.44 | 7.94       |
|        | 5        | 3.000    | –    | 1.50 | 5.56                 | 0.88        | 3.44 | 7.94       |
|        | 6        | 3.500    | –    | 1.50 | 5.56                 | 0.88        | 3.44 | 7.94       |
|        | 7        | 1.375    | –    | 0.88 | 4.94                 | 0.88        | 2.81 | 7.31       |
| 8.00   | 1 (Std.) | 2.000    | 4.00 | 1.25 | 5.31                 | 0.75        | 3.19 | 7.94       |
|        | 2        | 5.500    | 7.00 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
|        | 3        | 2.500    | 4.00 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
|        | 4        | 3.000    | 5.50 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
|        | 5        | 3.500    | 5.50 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
|        | 6        | 4.000    | 5.50 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
|        | 7        | 1.375    | 4.00 | 0.88 | 4.94                 | 0.75        | 2.81 | 7.56       |
|        | 8        | 1.750    | 4.00 | 1.13 | 5.19                 | 0.75        | 3.06 | 7.81       |
|        | 9        | 4.500    | 7.00 | 1.50 | 5.56                 | 0.75        | 3.44 | 8.19       |
| 0      | 5.000    | 7.00     | 1.50 | 5.56 | 0.75                 | 3.44        | 8.19 |            |

<sup>3</sup> Dimension XI to be specified by customer.

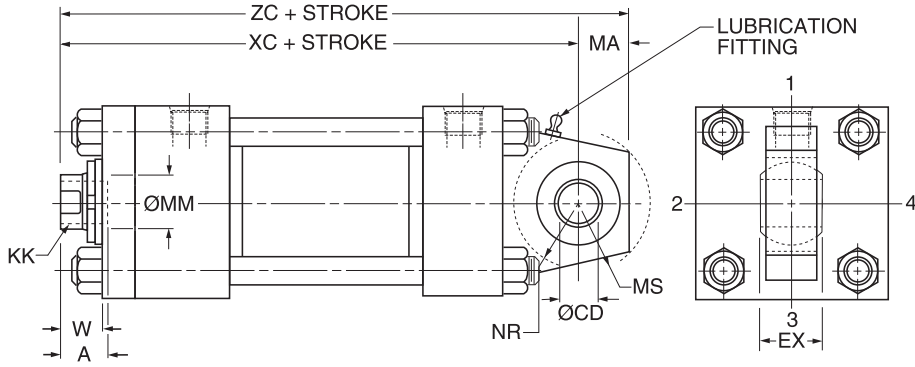


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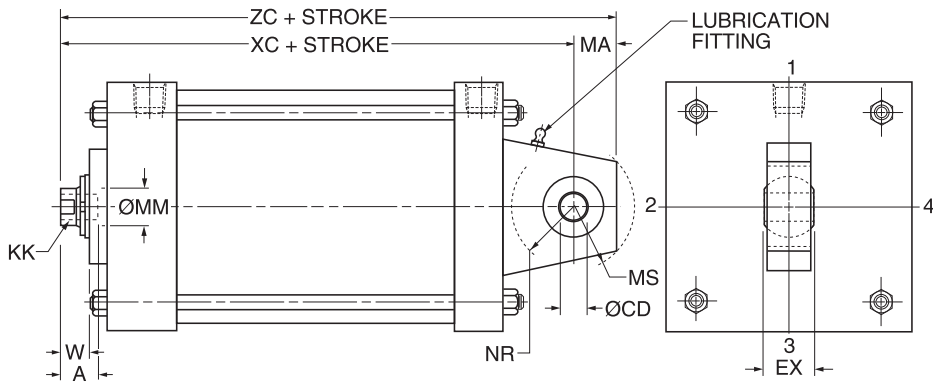
**Spherical Bearing Mounting**

Style SB

**6.00" Bore**



**8.00" Bore**



**Table 1 – Dimensional and Mounting Data**

| Bore Ø | Rod No.  | MM Rod Ø | Rod End Thread          |                         | A    | CD <sup>2</sup> Ø | EX   | MA   | MS   | NR   | W    | Add Stroke |       | Max. Oper. psi <sup>3</sup> |
|--------|----------|----------|-------------------------|-------------------------|------|-------------------|------|------|------|------|------|------------|-------|-----------------------------|
|        |          |          | Style 7 KK <sup>1</sup> | Style 9 KK <sup>1</sup> |      |                   |      |      |      |      |      | XC         | ZC    |                             |
| 6.00   | 1 (Std.) | 1.750    | 1-14                    | –                       | 1.63 | -.0005<br>1.0000  | 0.88 | 1.25 | 1.69 | 1.25 | 1.13 | 8.38       | 9.63  | 440                         |
|        | 2        | 4.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.75       | 10.00 |                             |
|        | 3        | 2.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.25 | 8.50       | 9.75  |                             |
|        | 4        | 2.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.75       | 10.00 |                             |
|        | 5        | 3.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.75       | 10.00 |                             |
|        | 6        | 3.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.75       | 10.00 |                             |
|        | 7        | 1.375    | –                       | 1-14                    | 1.63 |                   |      |      |      |      | 0.88 | 8.13       | 9.38  |                             |
| 8.00   | 1 (Std.) | 2.000    | 1-14                    | –                       | 1.63 | -.0005<br>1.0000  | 0.88 | 1.25 | 1.69 | 1.25 | 1.25 | 8.63       | 9.88  | 250                         |
|        | 2        | 5.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 3        | 2.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 4        | 3.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 5        | 3.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 6        | 4.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 7        | 1.375    | –                       | 1-14                    | 1.63 |                   |      |      |      |      | 0.88 | 8.25       | 9.50  |                             |
|        | 8        | 1.750    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.13 | 8.50       | 9.75  |                             |
|        | 9        | 4.500    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |
|        | 0        | 5.000    | 1-14                    | –                       | 1.63 |                   |      |      |      |      | 1.50 | 8.88       | 10.13 |                             |

<sup>1</sup> Threads listed are also for a spherical rod eye which match style 9 or style 7. The spherical rod eye pin diameter matches the cap pin and (if required) needs to be purchased separately. See 3L Mounting Accessories for detailed information.

<sup>2</sup> Dimension CD is hole diameter.

<sup>3</sup> Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.

Note: For additional dimensions see Series 3L, Style BB mount.

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Double Rod Models – 1.00" to 8.00" Bore

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| Mounting Styles for Single Rod Models | Mounting Styles for Corresponding Double Rod Models <sup>1</sup> | Dimensions Shown on This Page Supplement Dimensions on Pages Listed Below |                              |
|---------------------------------------|--|---|------------------------------|
|                                       |  | 1.00" - 5.00" Bores Page No.  | 6.00" & 8.00" Bores Page No. |
| T                                     | KT   | 12  | 28                           |
| TB                                    | KTB  | 12  | 28                           |
| TD                                    | KTD  | 12  | 28                           |
| J                                     | KJ   | 13  | 13 <sup>3</sup>              |
| JB                                    | KJB  | 14  | 29                           |
| JJ                                    | KJJ  | 15  | –                            |
| C                                     | KC   | 18  | 31                           |
| F                                     | KF   | 19  | 32                           |
| D                                     | KD   | 21  | 34                           |
| DD                                    | KDD <sup>2</sup>   | 23  | 36                           |

<sup>1</sup> If only one end of these Double Rod Cylinders is to be cushioned, be sure to specify clearly which end this will be.

<sup>2</sup> Specify XI dimension from rod end #1.

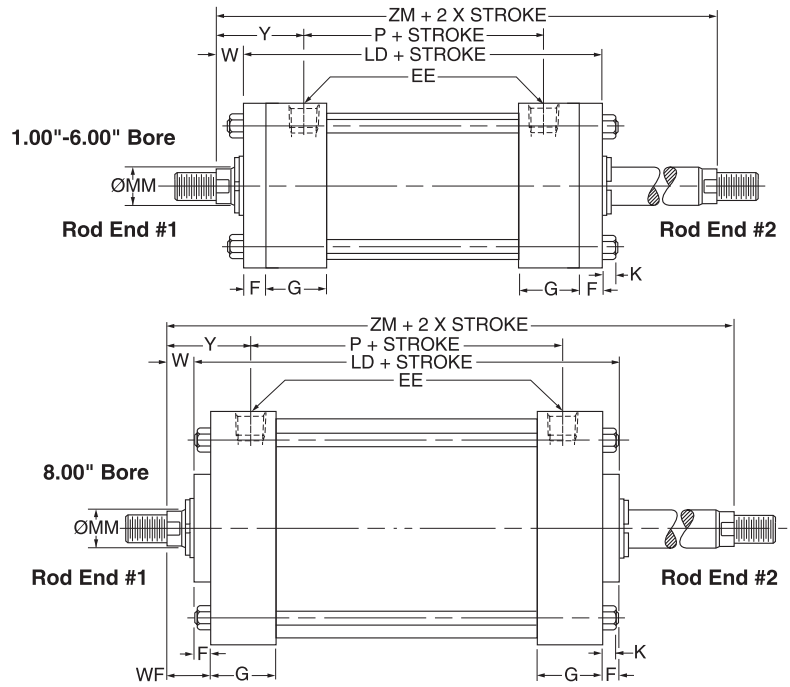
<sup>3</sup> 6.00" bore only.

How to Use Double Rod Cylinder Dimension Drawings

| Bore Ø                                  | Rod No.  | MM Rod Ø | Add Stroke      |      |      | Add 2X Stroke   |
|---|----------|----------|-----------------|------|------|-----------------|
|   |          |          | LD              | SNK  | SSK  | ZM              |
| 1.00                                    | 1 (Std.) | 0.500    | 4.75            | 2.13 | 3.38 | 6.00            |
|   | 2        | 0.625    | 4.75            | 2.13 | 3.38 | 6.00            |
| 1.50                                    | 1 (Std.) | 0.625    | 4.88            | 2.25 | 3.38 | 6.13            |
|   | 2        | 1.000    | 4.88            | 2.25 | 3.38 | 6.88            |
| 2.00                                    | 1 (Std.) | 0.625    | 4.88            | 2.25 | 3.38 | 6.13            |
|   | 2        | 1.375    | 4.88            | 2.25 | 3.38 | 7.38            |
| 2.50                                    | 1 (Std.) | 1.000    | 5.00            | 2.38 | 3.50 | 7.00            |
|   | 2        | 1.750    | 5.00            | 2.38 | 3.50 | 8.00            |
|   | 3        | 1.375    | 5.00            | 2.38 | 3.50 | 7.50            |
|   | 7        | 0.625    | 5.00            | 2.38 | 3.50 | 6.25            |
| 3.25                                    | 1 (Std.) | 1.000    | 6.00            | 2.63 | 3.75 | 7.50            |
|   | 2        | 2.000    | 6.00            | 2.63 | 3.75 | 8.75            |
|   | 3        | 1.375    | 6.00            | 2.63 | 3.75 | 8.00            |
| Replaces On single rod mounting styles: |          |          | LB              | SN   | SS   | –               |
|   |          |          | All Mtg. Styles | F    | C    | All Mtg. Styles |

To determine dimensions for a double rod cylinder, first refer to the desired single rod mounting style cylinder shown on preceding pages of this catalog. (See table above.) After selecting necessary dimensions from that drawing, return to this page and supplement the single rod dimensions with those shown on drawings above and dimension table below. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replaces LB. The double rod dimensions differ from, or are in addition to those for single rod cylinders shown on preceding pages and provide the information needed to completely dimension a double rod cylinder.

On a double rod cylinder where the two rod ends are different, be sure to clearly state which rod end is to be assembled at which end. Port position 1 is standard. If other than standard, specify pos. 2, 3 or 4 when viewed from rod end #1 only. (See port position information in Section D.)



| Bore Ø                                  | Rod No.  | MM Rod Ø | Add Stroke      |      |      | Add 2X Stroke   |
|---|----------|----------|-----------------|------|------|-----------------|
|   |          |          | LD              | SNK  | SSK  | ZM              |
| 4.00                                    | 1 (Std.) | 1.375    | 6.00            | 2.63 | 3.75 | 8.00            |
|   | 2        | 2.500    | 6.00            | 2.63 | 3.75 | 9.25            |
|   | 3        | 1.750    | 6.00            | 2.63 | 3.75 | 8.50            |
|   | 4        | 2.000    | 6.00            | 2.63 | 3.75 | 8.75            |
| 5.00                                    | 7        | 1.000    | 6.00            | 2.63 | 3.75 | 7.50            |
|   | 1 (Std.) | 1.750    | 6.25            | 2.88 | 3.63 | 8.75            |
|   | 2        | 3.500    | 6.25            | 2.88 | 3.63 | 9.50            |
|   | 3        | 2.000    | 6.25            | 2.88 | 3.63 | 9.00            |
|   | 4        | 2.500    | 6.25            | 2.88 | 3.63 | 9.50            |
|   | 5        | 3.000    | 6.25            | 2.88 | 3.63 | 9.50            |
|   | 7        | 1.000    | 6.25            | 2.88 | 3.63 | 7.75            |
|   | 8        | 1.375    | 6.25            | 2.88 | 3.63 | 8.25            |
| 6.00                                    | 1 (Std.) | 1.750    | 7.00            | 3.13 | 4.13 | 9.25            |
|   | 2        | 4.000    | 7.00            | 3.13 | 4.13 | 10.00           |
|   | 3        | 2.000    | 7.00            | 3.13 | 4.13 | 9.50            |
|   | 4        | 2.500    | 7.00            | 3.13 | 4.13 | 10.00           |
|   | 5        | 3.000    | 7.00            | 3.13 | 4.13 | 10.00           |
|   | 6        | 3.500    | 7.00            | 3.13 | 4.13 | 10.00           |
|   | 7        | 1.375    | 7.00            | 3.13 | 4.13 | 8.75            |
| 8.00                                    | 1 (Std.) | 2.000    | 7.13            | 3.25 | 4.25 | 9.63            |
|   | 2        | 5.500    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 3        | 2.500    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 4        | 3.000    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 5        | 3.500    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 6        | 4.000    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 7        | 1.375    | 7.13            | 3.25 | 4.25 | 8.88            |
|   | 8        | 1.750    | 7.13            | 3.25 | 4.25 | 9.38            |
|   | 9        | 4.500    | 7.13            | 3.25 | 4.25 | 10.13           |
|   | 0        | 5.000    | 7.13            | 3.25 | 4.25 | 10.13           |
| Replaces On single rod mounting styles: |          |          | LB              | SN   | SS   | –               |
|   |          |          | All Mtg. Styles | F    | C    | All Mtg. Styles |





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## **Section B**

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### **Cylinder Accessories and Replacement Parts**

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**Mounting Accessories**

**Cylinder Accessories**

Parker offers a complete range of cylinder accessories to assure flexibility and versatility in present or future cylinder applications.

**Rod End Accessories**

Accessories offered for the rod end of the cylinder include: Rod Clevis, Eye Bracket, Knuckle, Clevis Bracket and Pivot Pin. To select the proper part number for any desired accessory, refer to Chart A below and look opposite the thread size of the rod end as indicated in the first column. The Pivot Pins, Eye Brackets and Clevis Brackets are listed opposite the thread size which their mating Knuckles or Clevises fit.



**Accessory Load Capacity**

The various accessories on this and the following pages have been load rated for your convenience. The load capacity shown in lbs. is the recommended maximum load for that accessory based on a 4:1 design factor in tension. (Pivot Pin is rated in shear.) Before specifying,

compare the actual load or the tension (pull) force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

**Chart A**

| Thread Size | Pin Ø | Rod Clevis              |                    | Mounting Plate or Eye Bracket     |                    | Pivot Pin   |                     |
|-------------|-------|-------------------------|--------------------|-----------------------------------|--------------------|-------------|---------------------|
|             |       | Part Number             | Load Capacity (lb) | Forged Steel or Cast Ductile Iron |                    | Part Number | Shear Capacity (lb) |
|             |       |                         |                    | Part Number                       | Load Capacity (lb) |             |                     |
| 5/16-24     | 0.312 | 0512210000 <sup>1</sup> | 2600               | 0959810031                        | 1850               | -           | -                   |
| 7/16-20     | 0.500 | 0509400000              | 4250               | 0959810050 <sup>2</sup>           | 4620               | 0683680000  | 8600                |
| 1/2-20      | 0.500 | 0509410000              | 4900               | 0959810050 <sup>2</sup>           | 4620               | 0683680000  | 8600                |
| 3/4-16      | 0.750 | 0509420000              | 11200              | 0959810075 <sup>2</sup>           | 12370              | 0683690000  | 19300               |
| 3/4-16      | 0.750 | 1332840000              | 11200              | 0959810075 <sup>2</sup>           | 12370              | 0683690000  | 19300               |
| 7/8-14      | 1.000 | 0509430000              | 18800              | 0959810100 <sup>2</sup>           | 20450              | 0683700000  | 34300               |
| 1-14        | 1.000 | 0509440000              | 19500              | 0959810100 <sup>2</sup>           | 20450              | 0683700000  | 34300               |
| 1-14        | 1.000 | 1332850000              | 19500              | 0959810100 <sup>2</sup>           | 20450              | 0683700000  | 34300               |
| 1 1/4-12    | 1.375 | 0509450000              | 33500              | 0959810138                        | 33500              | 0683710000  | 65000               |
| 1 1/4-12    | 1.375 | 1332860000              | 33500              | 0959810138                        | 33500              | 0683710000  | 65000               |
| 1 1/2-12    | 1.750 | 0509460000              | 45600              | 0959810175                        | 49480              | 0683720000  | 105200              |
| 1 3/4-12    | 2.000 | 0509470000              | 65600              | 0959810200 <sup>2</sup>           | 70100              | 0683730000  | 137400              |
| 1 7/8-12    | 2.000 | 0509480000              | 65600              | 0959810200 <sup>2</sup>           | 70100              | 0683730000  | 137400              |
| 2 1/4-12    | 2.500 | 0509490000              | 98200              | 0959810250 <sup>2</sup>           | 98200              | 0683740000  | 214700              |
| 2 1/2-12    | 3.000 | 0509500000              | 98200              | 0959810300 <sup>2</sup>           | 121940             | 0683750000  | 309200              |
| 2 3/4-12    | 3.000 | 0509510000              | 98200              | 0959810300 <sup>2</sup>           | 121940             | 0683750000  | 309200              |
| 3 1/4-12    | 3.500 | 0509520000              | 156700             | 0959810350                        | 187910             | 0735450000  | 420900              |
| 3 1/2-12    | 4.000 | 0509530000              | 193200             | 0959810400                        | 268000             | 0735470000  | 565800              |
| 4-12        | 4.000 | 0509540000              | 221200             | 0959810400                        | 268000             | 0735470000  | 565800              |

<sup>1</sup> Includes pivot pin.

<sup>2</sup> Cylinder accessory dimensions conform to ANSI/NFPA/T3.6.8 R3-2010.

**Mounting Plates**

Mounting Plates for Style BB (clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B at right.

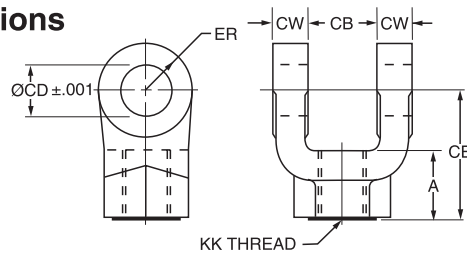
**Chart B**

| Series 3L                  |                   |
|----------------------------|-------------------|
| Mounting Plate Part Number | Bore Ø            |
| 0960160044                 | 1.00              |
| 0959810050                 | 1.50 , 2.00, 2.50 |
| 0959810075                 | 3.25, 4.00, 5.00  |
| 0959810100                 | 6.00, 8.00        |

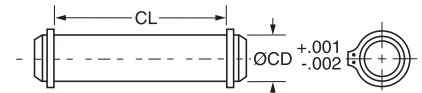


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Rod Clevis Dimensions



Pivot Pin Dimensions



| Part Number <sup>1</sup> | Pin Ø | A                 | CB   | CD Ø  | CE   | CW   | ER   | KK Thread |
|--------------------------|-------|-------------------|------|-------|------|------|------|-----------|
| 0512210000 <sup>2</sup>  | 0.310 | 0.81              | 0.34 | 0.314 | 2.25 | 0.20 | 0.30 | 5/16-24   |
| 0509400000               | 0.500 | 0.75              | 0.77 | 0.503 | 1.50 | 0.49 | 0.50 | 7/16-20   |
| 0509410000               | 0.500 | 0.75              | 0.77 | 0.503 | 1.50 | 0.49 | 0.50 | 1/2-20    |
| 0509420000               | 0.750 | 1.13              | 1.27 | 0.753 | 2.13 | 0.62 | 0.75 | 3/4-16    |
| 1332840000               | 0.750 | 1.13              | 1.27 | 0.753 | 2.38 | 0.62 | 0.75 | 3/4-16    |
| 0509430000               | 1.000 | 1.63              | 1.52 | 1.003 | 2.94 | 0.74 | 1.00 | 7/8-14    |
| 0509440000               | 1.000 | 1.63              | 1.52 | 1.003 | 2.94 | 0.74 | 1.00 | 1-14      |
| 1332850000               | 1.000 | 1.63              | 1.52 | 1.003 | 3.13 | 0.74 | 1.00 | 1-14      |
| 0509450000               | 1.375 | 1.88              | 2.04 | 1.378 | 3.75 | 0.99 | 1.38 | 1 1/4-12  |
| 1332860000               | 1.375 | 2.00              | 2.04 | 1.378 | 4.13 | 0.99 | 1.38 | 1 1/4-12  |
| 0509460000               | 1.750 | 2.25              | 2.54 | 1.753 | 4.50 | 1.24 | 1.75 | 1 1/2-12  |
| 0509470000               | 2.000 | 3.00              | 2.54 | 2.003 | 5.50 | 1.24 | 2.00 | 1 3/4-12  |
| 0509480000               | 2.000 | 3.00              | 2.54 | 2.003 | 5.50 | 1.24 | 2.00 | 1 7/8-12  |
| 0509490000               | 2.500 | 3.50              | 3.04 | 2.503 | 6.50 | 1.49 | 2.50 | 2 1/4-12  |
| 0509500000               | 3.000 | 3.50              | 3.04 | 3.003 | 6.75 | 1.49 | 2.75 | 2 1/2-12  |
| 0509510000               | 3.000 | 3.50              | 3.04 | 3.003 | 6.75 | 1.49 | 2.75 | 2 3/4-12  |
| 0509520000               | 3.500 | 3.50 <sup>3</sup> | 4.04 | 3.503 | 7.75 | 1.98 | 3.50 | 3 1/4-12  |
| 0509530000               | 4.000 | 4.00 <sup>3</sup> | 4.54 | 4.003 | 8.81 | 2.23 | 4.00 | 3 1/2-12  |
| 0509540000               | 4.000 | 4.00 <sup>3</sup> | 4.54 | 4.003 | 8.81 | 2.23 | 4.00 | 4-12      |

| Part Number             | CD Ø  | CL   |
|-------------------------|-------|------|
| 0683680000              | 0.500 | 1.88 |
| 0683690000              | 0.750 | 2.63 |
| 0683700000              | 1.000 | 3.13 |
| 0683710000              | 1.375 | 4.19 |
| 0683720000              | 1.750 | 5.19 |
| 0683730000              | 2.000 | 5.19 |
| 0683740000              | 2.500 | 6.19 |
| 0683750000              | 3.000 | 6.25 |
| 0735450000              | 3.500 | 8.25 |
| 0735470000 <sup>4</sup> | 4.000 | 9.00 |

<sup>4</sup> This size supplied with cotter pins.

Notes:

- Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
- Pivot Pins are furnished with (2) Retainer Rings.
- Pivot Pins must be ordered as a separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.

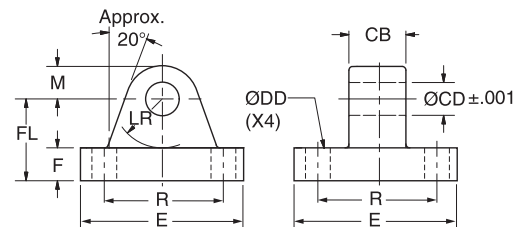
<sup>1</sup> Rod Clevises with pin diameters 0.312 thru 1.375 are forged steel. Rod Clevises with 1.750 pin diameter and larger are cast ductile iron.

<sup>2</sup> Includes Pivot Pin

<sup>3</sup> Consult appropriate cylinder rod end dimensions for compatibility.

Forged Steel or Cast Ductile Iron  
Mounting Plate or Eye Bracket Dimensions<sup>5</sup>

Note: Cast ductile iron eye brackets must not be welded in place.



| Cast or Forged <sup>6</sup><br>Part Number | Pin Ø | CB   | CD Ø  | DD Ø | E (As Cast) | F                 | FL                | LR   | M (As Cast) | R     |
|--|-------|------|-------|------|-------------|-------------------|-------------------|------|-------------|-------|
| 0959810031                                 | 0.312 | 0.31 | 0.314 | 0.27 | 2.25        | 0.38              | 1.00              | 0.59 | 0.38        | 1.75  |
| 0959810050                                 | 0.500 | 0.75 | 0.503 | 0.41 | 2.50        | 0.38              | 1.13              | 0.69 | 0.50        | 1.63  |
| 0959810075                                 | 0.750 | 1.25 | 0.753 | 0.53 | 3.50        | 0.63              | 1.88              | 1.13 | 0.75        | 2.55  |
| 0959810100                                 | 1.000 | 1.50 | 1.003 | 0.66 | 4.50        | 0.88              | 2.38              | 1.37 | 1.00        | 3.25  |
| 0959810138                                 | 1.375 | 2.00 | 1.378 | 0.66 | 5.00        | 1.00 <sup>7</sup> | 3.00              | 1.88 | 1.38        | 3.82  |
| 0959810175                                 | 1.750 | 2.50 | 1.753 | 0.91 | 6.50        | 1.25 <sup>7</sup> | 3.38              | 2.13 | 1.75        | 4.95  |
| 0959810200                                 | 2.000 | 2.50 | 2.003 | 1.06 | 7.50        | 1.50              | 4.00              | 2.38 | 2.00        | 5.73  |
| 0959810250                                 | 2.500 | 3.00 | 2.503 | 1.19 | 8.50        | 1.75              | 4.75              | 2.88 | 2.50        | 6.58  |
| 0959810300                                 | 3.000 | 3.00 | 3.003 | 1.31 | 9.50        | 2.00              | 5.25              | 3.13 | 3.00        | 7.50  |
| 0959810350                                 | 3.500 | 4.00 | 3.503 | 1.81 | 12.63       | 2.50 <sup>8</sup> | 6.50 <sup>8</sup> | 3.88 | 3.50        | 9.62  |
| 0959810400                                 | 4.000 | 4.50 | 4.003 | 2.06 | 14.88       | 3.00 <sup>8</sup> | 7.50 <sup>8</sup> | 4.38 | 4.06        | 11.45 |

<sup>5</sup> When used to mate with the Rod Clevis, select by pin diameter in the table above.

<sup>6</sup> Eye Brackets with pin diameters 0.500 thru 1.375 are forged steel. Eye Brackets with 0.312 and 1.750 pin diameter and larger are cast ductile iron.

<sup>7</sup> These dimensions vary from NFPA standard. F is increased by 0.13. Sufficient LR clearance remains for full swing arc with Parker cap clevis cylinders and rod clevises.

<sup>8</sup> Mounting base thickness dimension F is increased on these sizes to provide greater load capacity than the former fabricated steel design. Cast ductile iron dimensions F and FL are 0.81 larger for 3.500 pin diameter and 1.06 larger for 4.000 pin diameter.



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**Rod End Accessories**

Accessories offered for the rod end of the cylinder include Rod Clevis, Eye Bracket, Knuckle, Clevis Bracket, and Pivot Pin. To select the proper part number for any desired accessory, refer to the table below or on the opposite page and look in the row to the right of the rod thread in the first column. For economical accessory selection, it is recommended that rod end style 4 be specified on your cylinder order.

**Accessory Load Capacity**

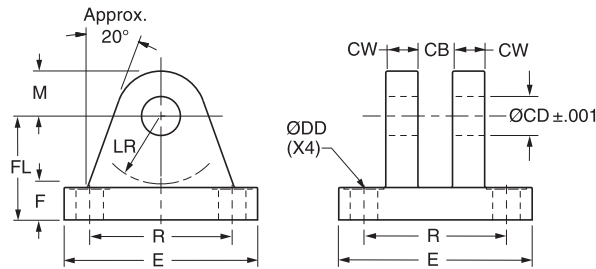
The various accessories have been load rated for your convenience. The load Capacity in lbs. is the recommended maximum load for that accessory based on a 4:1 design factor in tension. (Pivot Pin is rated in shear.) Before specifying, compare the actual load or the tension (pull) force at the maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

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| Thread Size | Pin Ø | Knuckle     |                    | Clevis Bracket                    |                    |                  |                    | Pivot Pin               |                     |
|-------------|-------|-------------|--------------------|-----------------------------------|--------------------|------------------|--------------------|-------------------------|---------------------|
|             |       | Part Number | Load Capacity (lb) | Forged Steel or Cast Ductile Iron |                    | Fabricated Steel |                    | Part Number             | Shear Capacity (lb) |
|             |       |             |                    | Part Number                       | Load Capacity (lb) | Part Number      | Load Capacity (lb) |                         |                     |
| 5/16-24     | 0.438 | 0740750000  | 3300               | 0960160044                        | 2830               | 0740760000       | 3600               | 0740780000              | 6600                |
| 7/16-20     | 0.500 | 0690890000  | 5000               | 0960160050                        | 7740               | 0692050000       | 7300               | 0683680000              | 8600                |
| 1/2-20      | 0.500 | 0690900000  | 5700               | 0960160050                        | 7740               | 0692050000       | 7300               | 0683680000              | 8600                |
| 3/4-16      | 0.750 | 0690910000  | 12100              | 0960160075                        | 13600              | 0692060000       | 10880              | 0683690000              | 19300               |
| 7/8-14      | 1.000 | 0690920000  | 13000              | 0960160100                        | 23000              | 0692070000       | 15180              | 0683700000              | 34300               |
| 1-14        | 1.000 | 0690930000  | 21700              | 0960160100                        | 23000              | 0692070000       | 15180              | 0683700000              | 34300               |
| 1 1/4-12    | 1.375 | 0690940000  | 33500              | 0960160138                        | 39500              | 0692080000       | 23560              | 0683710000              | 65000               |
| 1 1/2-12    | 1.750 | 0690950000  | 45000              | 0960160175                        | 49480              | 0692090000       | 21520              | 0683720000              | 105200              |
| 1 3/4-12    | 2.000 | 0690960000  | 53500              | 0960160200                        | 72400              | 0692100000       | 26000              | 0692150000              | 137400              |
| 1 7/8-12    | 2.000 | 0962160000  | 75000              | 0960160200                        | 72400              | 0692100000       | 26000              | 0692150000              | 137400              |
| 2 1/4-12    | 2.500 | 0962170000  | 98700              | 0960160250                        | 98700              | 0692110000       | 28710              | 0683740000              | 214700              |
| 2 1/2-12    | 3.000 | 0962180000  | 110000             | 0960160300                        | 123300             | 0692120000       | 28190              | 0683750000              | 309200              |
| 2 3/4-12    | 3.000 | 0962190000  | 123300             | N/A                               | N/A                | 0692130000       | 31390              | 0692160000              | 309200              |
| 3 1/4-12    | 3.500 | 0962200000  | 161300             | 0960160350                        | 200400             | 0735420000       | 80250              | 0735450000              | 420900              |
| 3 1/2-12    | 3.500 | 0962210000  | 217300             | 0960160350                        | 200400             | 0735420000       | 80250              | 0735450000              | 420900              |
| 4-12        | 4.000 | 0962220000  | 273800             | 0960160400                        | 292100             | 0735430000       | 98420              | 0821810000              | 565800              |
| N/A         | 4.000 | N/A         | N/A                | N/A                               | N/A                | N/A              | N/A                | 0735470000 <sup>1</sup> | 565800              |

<sup>1</sup> This size supplied with cotter pins.

**Forged Steel or Cast Ductile Iron Clevis Bracket Dimensions**

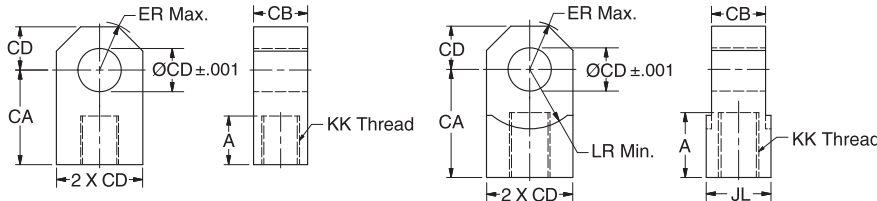


| Cast or Forged <sup>2</sup><br>Part Number | Pin Ø | CB   | CD Ø  | CW   | DD Ø | E<br>(As Cast) | F    | FL   | LR   | M<br>(As Cast) | R     |
|--|-------|------|-------|------|------|----------------|------|------|------|----------------|-------|
| 0960160044                                 | 0.438 | 0.46 | 0.440 | 0.37 | 0.27 | 2.25           | 0.38 | 1.00 | 0.56 | 0.44           | 1.75  |
| 0960160050                                 | 0.500 | 0.78 | 0.503 | 0.50 | 0.41 | 2.50           | 0.38 | 1.13 | 0.63 | 0.56           | 1.63  |
| 0960160075                                 | 0.750 | 1.28 | 0.753 | 0.63 | 0.53 | 3.50           | 0.63 | 1.88 | 1.06 | 0.75           | 2.56  |
| 0960160100                                 | 1.000 | 1.53 | 1.003 | 0.75 | 0.66 | 4.50           | 0.75 | 2.25 | 1.25 | 1.00           | 3.25  |
| 0960160138                                 | 1.375 | 2.03 | 1.378 | 1.00 | 0.66 | 5.00           | 0.88 | 3.00 | 1.94 | 1.38           | 3.81  |
| 0960160175                                 | 1.750 | 2.53 | 1.753 | 1.25 | 0.91 | 6.50           | 0.94 | 3.13 | 2.00 | 1.75           | 4.94  |
| 0960160200                                 | 2.000 | 2.53 | 2.003 | 1.25 | 1.06 | 7.50           | 1.38 | 3.75 | 2.25 | 2.00           | 5.75  |
| 0960160250                                 | 2.500 | 3.03 | 2.503 | 1.50 | 1.19 | 8.50           | 1.50 | 4.50 | 2.81 | 2.50           | 6.59  |
| 0960160300                                 | 3.000 | 3.03 | 3.003 | 1.50 | 1.31 | 9.50           | 1.88 | 5.38 | 3.31 | 3.00           | 7.50  |
| 0960160350                                 | 3.500 | 4.03 | 3.503 | 2.00 | 1.81 | 12.63          | 2.31 | 6.38 | 3.88 | 3.50           | 9.62  |
| 0960160400                                 | 4.000 | 4.53 | 4.003 | 2.25 | 2.06 | 14.88          | 2.88 | 7.50 | 4.50 | 4.00           | 11.50 |

<sup>2</sup> Clevis Brackets with pin diameters 0.500 thru 1.375 are forged steel. Clevis Brackets with 0.438 and 1.750 pin diameter and larger are cast ductile iron.



**Knuckle Dimensions**

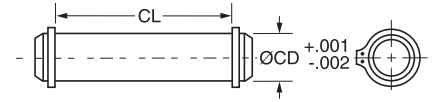


Thread Size thru 1 3/4-12

Thread Size 1 7/8-12 & Larger

| Part Number | Pin Ø | A    | CA   | CB   | CD Ø  | ER   | JL   | LR min | KK Thread |
|-------------|-------|------|------|------|-------|------|------|--------|-----------|
| 0740750000  | 0.438 | 0.75 | 1.50 | 0.43 | 0.440 | 0.53 | -    | -      | 5/16-24   |
| 0690890000  | 0.500 | 0.75 | 1.50 | 0.75 | 0.503 | 0.59 | -    | -      | 7/16-20   |
| 0690900000  | 0.500 | 0.75 | 1.50 | 0.75 | 0.503 | 0.59 | -    | -      | 1/2-20    |
| 0690910000  | 0.750 | 1.13 | 2.06 | 1.25 | 0.753 | 0.87 | -    | -      | 3/4-16    |
| 0690920000  | 1.000 | 1.13 | 2.38 | 1.50 | 1.003 | 1.15 | -    | -      | 7/8-14    |
| 0690930000  | 1.000 | 1.63 | 2.81 | 1.50 | 1.003 | 1.15 | -    | -      | 1-14      |
| 0690940000  | 1.375 | 2.00 | 3.44 | 2.00 | 1.378 | 1.55 | -    | -      | 1 1/4-12  |
| 0690950000  | 1.750 | 2.25 | 4.00 | 2.50 | 1.753 | 1.96 | -    | -      | 1 1/2-12  |
| 0690960000  | 2.000 | 2.25 | 4.38 | 2.50 | 2.003 | 2.24 | -    | -      | 1 3/4-12  |
| 0962160000  | 2.000 | 3.00 | 5.00 | 2.50 | 2.003 | 2.24 | 3.00 | 2.77   | 1 7/8-12  |
| 0962170000  | 2.500 | 3.50 | 5.81 | 3.00 | 2.503 | 2.76 | 3.50 | 3.09   | 2 1/4-12  |
| 0962180000  | 3.000 | 3.50 | 6.13 | 3.00 | 3.003 | 3.30 | 4.00 | 3.58   | 2 1/2-12  |
| 0962190000  | 3.000 | 3.63 | 6.50 | 3.50 | 3.003 | 3.30 | 4.00 | 3.58   | 2 3/4-12  |
| 0962200000  | 3.500 | 4.50 | 7.63 | 4.00 | 3.503 | 3.87 | 6.00 | 4.18   | 3 1/4-12  |
| 0962210000  | 3.500 | 5.00 | 7.63 | 4.00 | 3.503 | 3.87 | 6.00 | 4.18   | 3 1/2-12  |
| 0962220000  | 4.000 | 5.50 | 9.13 | 4.50 | 4.003 | 4.43 | 6.00 | 4.80   | 4-12      |

**Pivot Pin Dimensions**



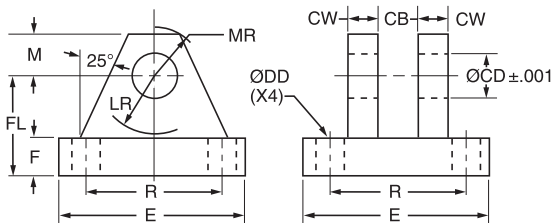
| Part Number             | CD Ø  | CL   |
|-------------------------|-------|------|
| 0740780000              | 0.438 | 1.31 |
| 0683680000              | 0.500 | 1.88 |
| 0683690000              | 0.750 | 2.63 |
| 0683700000              | 1.000 | 3.13 |
| 0683710000              | 1.375 | 4.19 |
| 0683720000              | 1.750 | 5.19 |
| 0692150000              | 2.000 | 5.69 |
| 0683740000              | 2.500 | 6.19 |
| 0683750000              | 3.000 | 6.25 |
| 0692160000              | 3.000 | 6.75 |
| 0735450000              | 3.500 | 8.25 |
| 0821810000              | 4.000 | 8.69 |
| 0735470000 <sup>1</sup> | 4.000 | 9.00 |

<sup>1</sup>This size supplied with cotter pins.

**Notes:**

- Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
- Pivot Pins are furnished with (2) Retainer Rings.
- Pivot Pins must be ordered as a separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.

**Fabricated Steel Clevis Bracket Dimensions**



| Fabricated Steel Part Number | Pin <sup>2</sup> Ø | CB   | CD Ø  | CW   | DD Ø | E     | F    | FL   | LR   | M    | MR   | R     |
|------------------------------|--------------------|------|-------|------|------|-------|------|------|------|------|------|-------|
| 0692050000                   | 0.500              | 0.80 | 0.503 | 0.50 | 0.41 | 3.50  | 0.50 | 1.50 | 0.75 | 0.50 | 0.63 | 2.55  |
| 0692060000                   | 0.750              | 1.30 | 0.753 | 0.63 | 0.53 | 5.00  | 0.63 | 1.88 | 1.19 | 0.75 | 0.91 | 3.82  |
| 0692070000                   | 1.000              | 1.59 | 1.003 | 0.75 | 0.66 | 6.50  | 0.75 | 2.25 | 1.50 | 1.00 | 1.25 | 4.95  |
| 0692080000                   | 1.375              | 2.09 | 1.378 | 1.00 | 0.66 | 7.50  | 0.88 | 3.00 | 2.00 | 1.38 | 1.66 | 5.73  |
| 0692090000                   | 1.750              | 2.59 | 1.753 | 1.25 | 0.91 | 9.50  | 0.88 | 3.63 | 2.75 | 1.75 | 2.22 | 7.50  |
| 0692100000                   | 2.000              | 2.59 | 2.003 | 1.50 | 1.06 | 12.75 | 1.00 | 4.25 | 3.19 | 2.25 | 2.78 | 9.40  |
| 0692110000                   | 2.500              | 3.09 | 2.503 | 1.50 | 1.19 | 12.75 | 1.00 | 4.50 | 3.50 | 2.50 | 3.13 | 9.40  |
| 0692120000                   | 3.000              | 3.09 | 3.003 | 1.50 | 1.31 | 12.75 | 1.00 | 6.00 | 4.25 | 3.00 | 3.59 | 9.40  |
| 0692130000                   | 3.000              | 3.59 | 3.003 | 1.50 | 1.31 | 12.75 | 1.00 | 6.00 | 4.25 | 3.00 | 3.59 | 9.40  |
| 0735420000                   | 3.500              | 4.09 | 3.503 | 2.00 | 1.81 | 15.50 | 1.69 | 6.69 | 5.00 | 3.50 | 4.13 | 12.00 |
| 0735430000                   | 4.000              | 4.59 | 4.003 | 2.00 | 2.06 | 17.50 | 1.94 | 7.69 | 5.75 | 4.00 | 4.88 | 13.75 |

<sup>2</sup> Clevis Bracket for 0.438 diameter pin is only available in cast ductile iron construction. See part number 0960160044 on previous page.

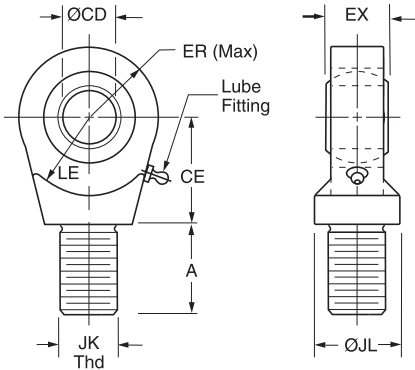


Parker offers a complete range of Cylinder Accessories to assure you of the greatest versatility in present or future cylinder applications. Accessories offered for spherical

bearing mount cylinders include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory refer to the tables below.

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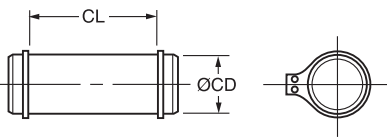
**Spherical Rod Eye Dimensions**



| Bore Ø           | Part Number | CD Ø                    | A    | CE   | EX   | ER   | LE   | JK Thread | JL Ø | Load Capacity (lb) |
|------------------|-------------|-------------------------|------|------|------|------|------|-----------|------|--------------------|
| 1.50, 2.00, 2.50 | 0961000050  | .5000 <sup>-0005</sup>  | 0.72 | 0.86 | 0.44 | 0.80 | 0.78 | 7/16-20   | 0.88 | 2644               |
| 3.25, 4.00, 5.00 | 0961000075  | .7500 <sup>-0005</sup>  | 1.02 | 1.25 | 0.66 | 1.14 | 1.06 | 3/4-16    | 1.31 | 9441               |
| 6.00, 8.00       | 0961000100  | 1.0000 <sup>-0005</sup> | 1.52 | 1.88 | 0.88 | 1.34 | 1.45 | 1-14      | 1.50 | 16860              |

Order to fit Piston Rod Thread Size.

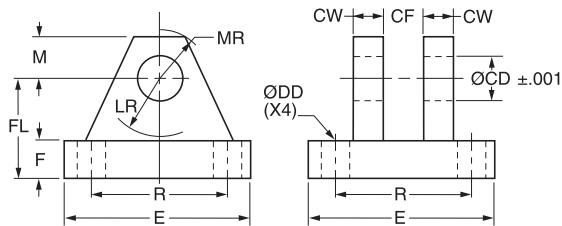
**Pivot Pin Dimensions**



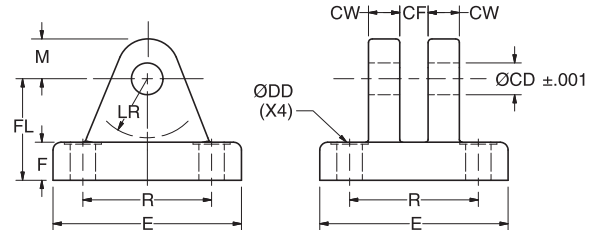
| Bore Ø           | Part Number | CD Ø                   | CL   | Shear Capacity (lb) |
|------------------|-------------|------------------------|------|---------------------|
| 1.50, 2.00, 2.50 | 0839620000  | .4997 <sup>-0004</sup> | 1.56 | 8600                |
| 3.25, 4.00, 5.00 | 0839630000  | .7497 <sup>-0005</sup> | 2.03 | 19300               |
| 6.00, 8.00       | 0839640000  | .9997 <sup>-0005</sup> | 2.50 | 34300               |

Pivot Pins are furnished with (2) Retainer Rings.

**Clevis Bracket Dimensions**



**Fabricated Steel**



**Cast Ductile Iron**

Order to fit Cylinder Cap or Rod Eye.

| Bore Ø           | Pin Ø | Cast Ductile Iron Part Number | Fabricated Steel Part Number | CD Ø  | CF   | CW   | DD Ø | E    | F    | FL   | LR   | M    | MR   | R    | Load Capacity (lb) |
|------------------|-------|-------------------------------|------------------------------|-------|------|------|------|------|------|------|------|------|------|------|--------------------|
| 1.50, 2.00, 2.50 | 0.500 | 0959450000                    | 0839470000                   | 0.503 | 0.45 | 0.50 | 0.41 | 3.00 | 0.50 | 1.50 | 0.94 | 0.50 | 0.63 | 2.05 | 5770               |
| 3.25, 4.00, 5.00 | 0.750 | 0959300000                    | 0839480000                   | 0.753 | 0.67 | 0.63 | 0.53 | 3.75 | 0.63 | 2.00 | 1.38 | 0.88 | 1.00 | 2.76 | 9450               |
| 6.00, 8.00       | 1.000 | 0959310000                    | 0839490000                   | 1.003 | 0.89 | 0.75 | 0.53 | 5.50 | 0.75 | 2.50 | 1.69 | 1.00 | 1.19 | 4.10 | 14300              |





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## Linear Alignment Couplers



- Simplify Cylinder Installation
- Reduce Assembly Time
- Increase Cylinder Bearing and Seal Life
- Reliable Performance In “Push” and “Pull” Applications

# Linear Alignment Couplers are available in 19 standard thread sizes...

## Cost Saving Features and Benefits Include...

- Maximum reliability for trouble-free operation, long life and lower operating costs
- Increased cylinder life by reducing wear on Piston and Rod bearings
- Simplifying Cylinder installation and reducing assembly costs
- Increase Rod Bearing and Rod Seal life for lower maintenance costs

## Alignment Coupler

See Table 1 for Part Numbers and Dimensions

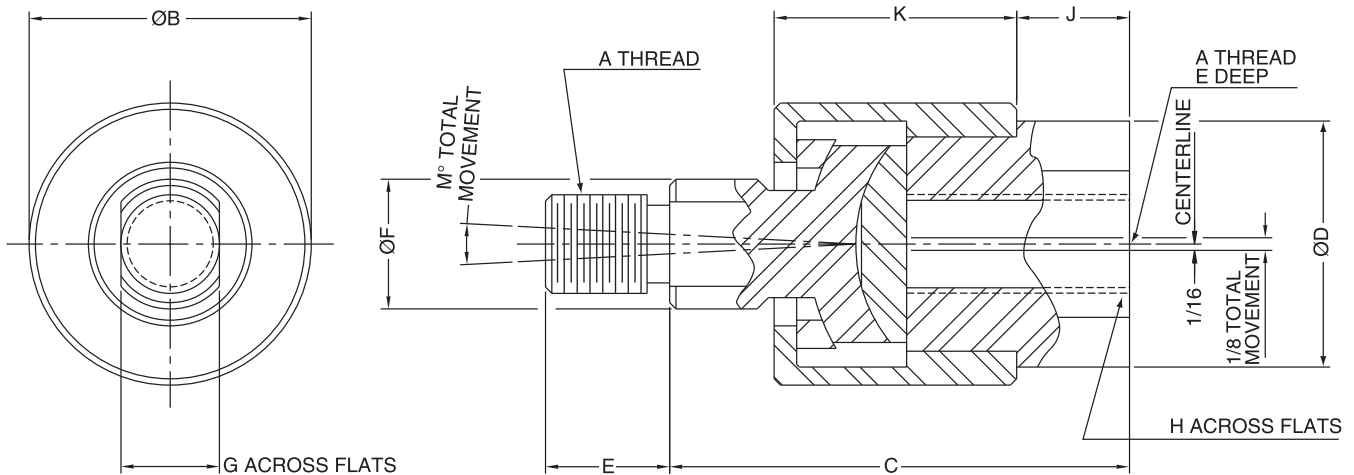


Table 1 — Part Numbers and Dimensions

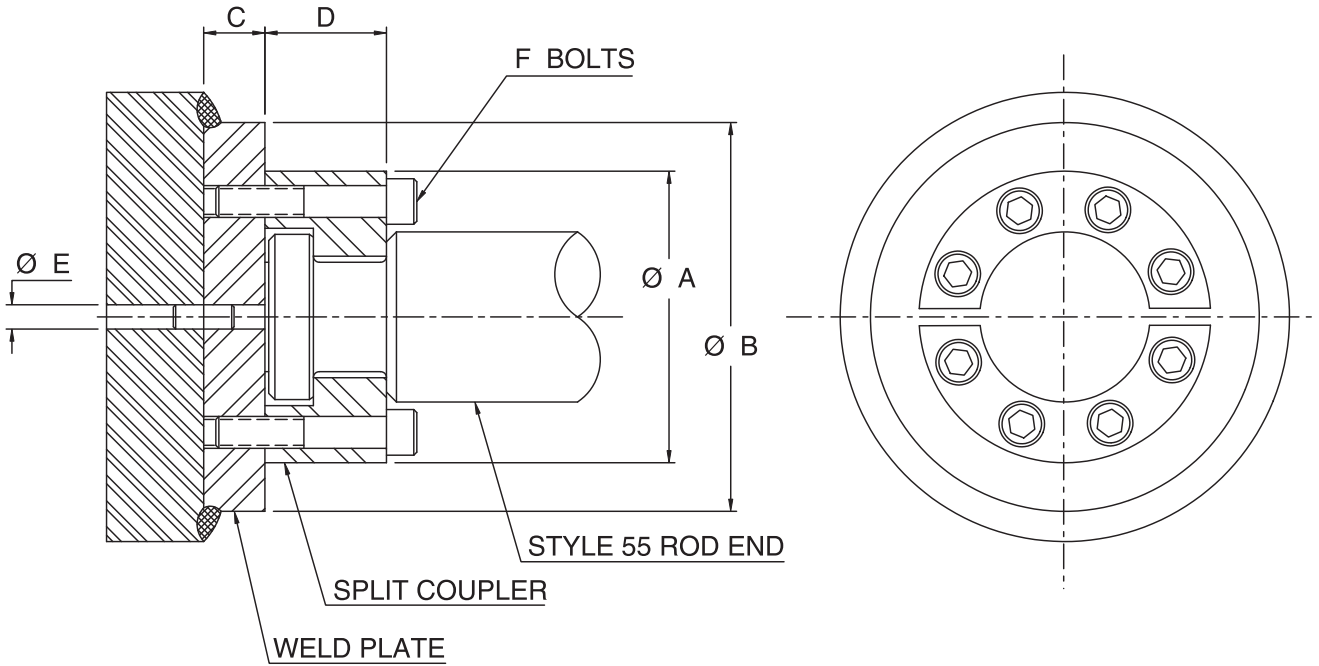
| Part Number | A        | B Ø   | C     | D Ø  | E    | F Ø  | G    | H    | J    | K    | M   | Max. Pull Load (lbs.) | Approx. Weight (lbs.) |
|-------------|----------|-------|-------|------|------|------|------|------|------|------|-----|-----------------------|-----------------------|
| 1347570031  | 5/16-24  | 1.13  | 1.75  | 0.94 | 0.50 | 0.50 | 0.38 | 0.75 | 0.38 | 0.94 | 6°  | 1200                  | .35                   |
| 1347570038  | 3/8-24   | 1.13  | 1.75  | 0.94 | 0.50 | 0.50 | 0.38 | 0.75 | 0.38 | 0.94 | 6°  | 2425                  | .35                   |
| 1347570044  | 7/16-20  | 1.38  | 2.00  | 1.13 | 0.75 | 0.63 | 0.50 | 0.88 | 0.38 | 1.09 | 6°  | 3250                  | .55                   |
| 1347570050  | 1/2-20   | 1.38  | 2.00  | 1.13 | 0.75 | 0.63 | 0.50 | 0.88 | 0.38 | 1.09 | 6°  | 4450                  | .55                   |
| 1347570063  | 5/8-18   | 1.38  | 2.00  | 1.13 | 0.75 | 0.63 | 0.50 | 0.88 | 0.38 | 1.09 | 6°  | 6800                  | .55                   |
| 1347570075  | 3/4-16   | 2.00  | 2.31  | 1.63 | 1.13 | 0.94 | 0.75 | 1.31 | 0.44 | 1.28 | 6°  | 9050                  | 1.4                   |
| 1347570088  | 7/8-14   | 2.00  | 2.31  | 1.63 | 1.13 | 0.94 | 0.75 | 1.31 | 0.44 | 1.28 | 6°  | 14450                 | 1.4                   |
| 1347570100  | 1-14     | 3.13  | 3.00  | 2.38 | 1.63 | 1.44 | 1.25 | 1.88 | 0.75 | 1.78 | 6°  | 19425                 | 4.8                   |
| 1347570125  | 1 1/4-12 | 3.13  | 3.00  | 2.38 | 1.63 | 1.44 | 1.25 | 1.88 | 0.75 | 1.78 | 6°  | 30500                 | 4.8                   |
| 1337390125  | 1 1/4-12 | 3.50  | 4.00  | 2.00 | 2.00 | 1.50 | 1.25 | 1.69 | 0.75 | 2.50 | 10° | 30500                 | 6.9                   |
| 1337390150  | 1 1/2-12 | 4.00  | 4.38  | 2.25 | 2.25 | 1.75 | 1.50 | 2.00 | 0.88 | 2.75 | 10° | 45750                 | 9.8                   |
| 1337390175  | 1 3/4-12 | 4.00  | 4.38  | 2.25 | 2.25 | 1.75 | 1.50 | 2.00 | 0.88 | 2.75 | 10° | 58350                 | 9.8                   |
| 1337390188  | 1 7/8-12 | 5.00  | 5.63  | 3.00 | 3.00 | 2.25 | 2.00 | 2.63 | 1.38 | 3.38 | 10° | 67550                 | 19.8                  |
| 1337390200  | 2-12     | 5.00  | 5.63  | 3.00 | 3.00 | 2.25 | 2.00 | 2.63 | 1.38 | 3.38 | 10° | 77450                 | 19.8                  |
| 1337390225  | 2 1/4-12 | 6.75  | 6.38  | 3.25 | 3.50 | 2.75 | 2.38 | 2.88 | 1.63 | 3.75 | 10° | 99250                 | 35.3                  |
| 1337390250  | 2 1/2-12 | 7.00  | 6.50  | 4.00 | 3.50 | 3.25 | 2.88 | 3.38 | 1.63 | 3.88 | 10° | 123750                | 45.3                  |
| 1337390275  | 2 3/4-12 | 7.00  | 6.50  | 4.00 | 3.50 | 3.25 | 2.88 | 3.38 | 1.63 | 3.88 | 10° | 150950                | 45.3                  |
| 1337390300  | 3-12     | 7.00  | 6.50  | 4.00 | 3.50 | 3.25 | 2.88 | 3.38 | 1.63 | 3.88 | 10° | 180850                | 45.3                  |
| 1337390325  | 3 1/4-12 | 9.25  | 8.50  | 5.25 | 4.50 | 4.00 | 3.38 | 4.50 | 2.00 | 5.50 | 10° | 213450                | —                     |
| 1337390425  | 4 1/4-12 | 12.88 | 11.25 | 7.75 | 4.50 | 5.50 | 4.88 | 7.00 | 1.50 | 8.75 | 10° | 370850                | —                     |

**How to Order Linear Alignment Couplers** — When ordering a cylinder with a threaded male rod end, specify the coupler of equal thread size by part number as listed in Table 1, i.e.; Piston Rod “KK” or “CC” dimension is 3/4” - 16”, specify coupler part number 1347570075.



# Parker “Style 55” Piston Rod End Split Couplers and Weld Plates

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**⚠ WARNING:** Piston rod separation from the machine member can result in severe personal injury or even death to nearby personnel. The cylinder user must make sure the weld holding the weld plate to the machine is of sufficient quality and size to hold the intended load. The cylinder user must also make sure the bolts holding split coupler to the weld plate are of sufficient strength to hold the intended load and installed in such a way that they will not become loose during the machine’s operation.

**Table 1 — Part Numbers and Dimensions**

| Rod Dia. | A Ø  | B Ø  | C    | D    | E Ø  | F  | Bolt Size         | Bolt Circle | Split Coupler Part Number | Weld Plate Part Number |
|----------|------|------|------|------|------|----|-------------------|-------------|---------------------------|------------------------|
| .625     | 1.50 | 2.00 | .50  | .56  | .250 | 4  | #10-24 x .94 LG   | 1.125       | 1472340062                | 1481740062             |
| 1.000    | 2.00 | 2.50 | .50  | .88  | .250 | 6  | .250-20 x 1.25 LG | 1.500       | 1472340100                | 1481740100             |
| 1.375    | 2.50 | 3.00 | .63  | 1.00 | .250 | 6  | .312-18 x 1.50 LG | 2.000       | 1472340138                | 1481740138             |
| 1.750    | 3.00 | 4.00 | .63  | 1.25 | .250 | 8  | .312-18 x 1.75 LG | 2.375       | 1472340175                | 1481740175             |
| 2.000    | 3.50 | 4.00 | .75  | 1.63 | .375 | 12 | .375-16 x 2.25 LG | 2.687       | 1472340200                | 1481740200             |
| 2.500    | 4.00 | 4.50 | .75  | 1.88 | .375 | 12 | .375-16 x 2.50 LG | 3.187       | 1472340250                | 1481740250             |
| 3.000    | 5.00 | 5.50 | 1.00 | 2.38 | .375 | 12 | .500-13 x 3.25 LG | 4.000       | 1472340300                | 1481740300             |
| 3.500    | 5.88 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 4.687       | 1472340350                | 1481740350             |
| 4.000    | 6.38 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 5.187       | 1472340400                | 1481740400             |
| 4.500    | 6.88 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 5.687       | 1472340450                | 1481740450             |
| 5.000    | 7.38 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 6.187       | 1472340500                | 1481740500             |
| 5.500    | 8.25 | 9.00 | 1.25 | 3.88 | .375 | 12 | .750-10 x 5.00 LG | 6.875       | 1472340550                | 1481740550             |

Note: Bolts are not included with split coupler or weld plate.



**Dual Axis Knuckle**

Using a Dual Axis Knuckle permits increased angular movement from the cylinder center line. Clevis or Eye mounted cylinders often require movement beyond the plane that two pivot pins allow. Spherical bearing mounts permit angular movement up to 4.5° within the pivoting plane. A Dual Axis Knuckle, with two pin holes 90° apart, installed at the cap and rod end of a mounting style BB cylinder adds two pivot points, thereby providing up to 30° movement in another plane at each end.

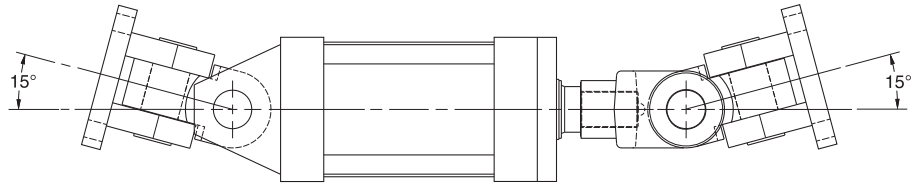
**Dual Axis Knuckle Benefits**

- Increased angular movement range compared to spherical bearing mount.
- Significantly higher dynamic load rating than spherical bearing mount.
- Reduced bearing loads and wear that results from misalignment.
- Allows faster assembly of pivoting cylinders to the machine.

**Maximum Achievable Angular Movement from Cylinder Centerline<sup>1</sup>**

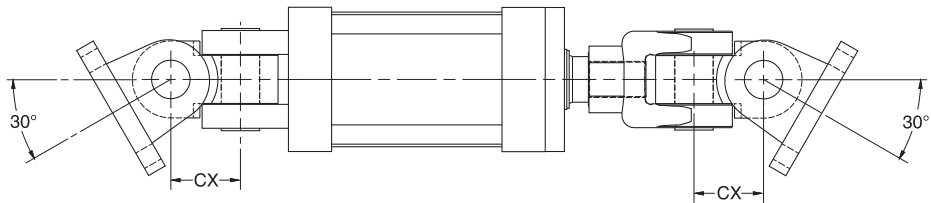
**Inboard Pin –**

15° maximum movement for cylinder misalignment only.



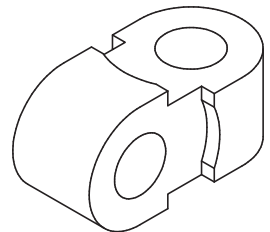
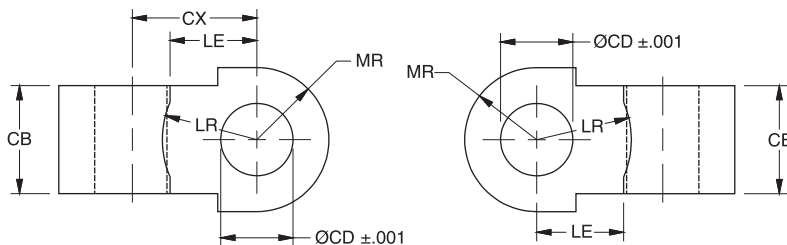
**Outboard Pin –**

30° maximum movement when applying force to a load moving in a curved plane.



<sup>1</sup>Maximum movement is achieved with cast clevis brackets. Movement is reduced when using fabricated clevis brackets.

**Dual Axis Knuckle Dimensions and Usage**



| Part Number | Pin Ø | Load Capacity (lb) | CB   | CD Ø  | CX   | LE   | LR   | MR   | Mating Parts   |                                    | BB Mount Usage by Series & Bore |
|-------------|-------|--------------------|------|-------|------|------|------|------|----------------|------------------------------------|---------------------------------|
|             |       |                    |      |       |      |      |      |      | Clevis Bracket | Rod Clevis                         |                                 |
| 0952670000  | 0.500 | 4380               | 0.75 | 0.503 | 0.88 | 0.54 | 0.63 | 0.50 | 0960160050     | 0509400000, 0509410000             | 1.50, 2.00, 2.50                |
| 0952680000  | 0.750 | 12370              | 1.25 | 0.753 | 1.19 | 0.80 | 0.94 | 0.75 | 0960160075     | 0509420000, 1332840000             | 3.25, 4.00, 5.00                |
| 0952690000  | 1.000 | 20500              | 1.50 | 1.003 | 1.69 | 1.05 | 1.22 | 1.00 | 0960160100     | 0509430000, 0509440000, 1332850000 | 6.00, 8.00                      |
| 0952700000  | 1.375 | 30500              | 2.00 | 1.378 | 2.38 | 1.44 | 1.69 | 1.38 | 0960160138     | 0509450000, 1332860000             | –                               |
| 0952710000  | 1.750 | 49500              | 2.50 | 1.753 | 3.06 | 1.81 | 2.19 | 1.75 | 0960160175     | 0509460000                         | –                               |
| 0952720000  | 2.000 | 68000              | 2.50 | 2.003 | 3.63 | 2.09 | 2.44 | 2.00 | 0960160200     | 0509470000, 0509480000             | –                               |

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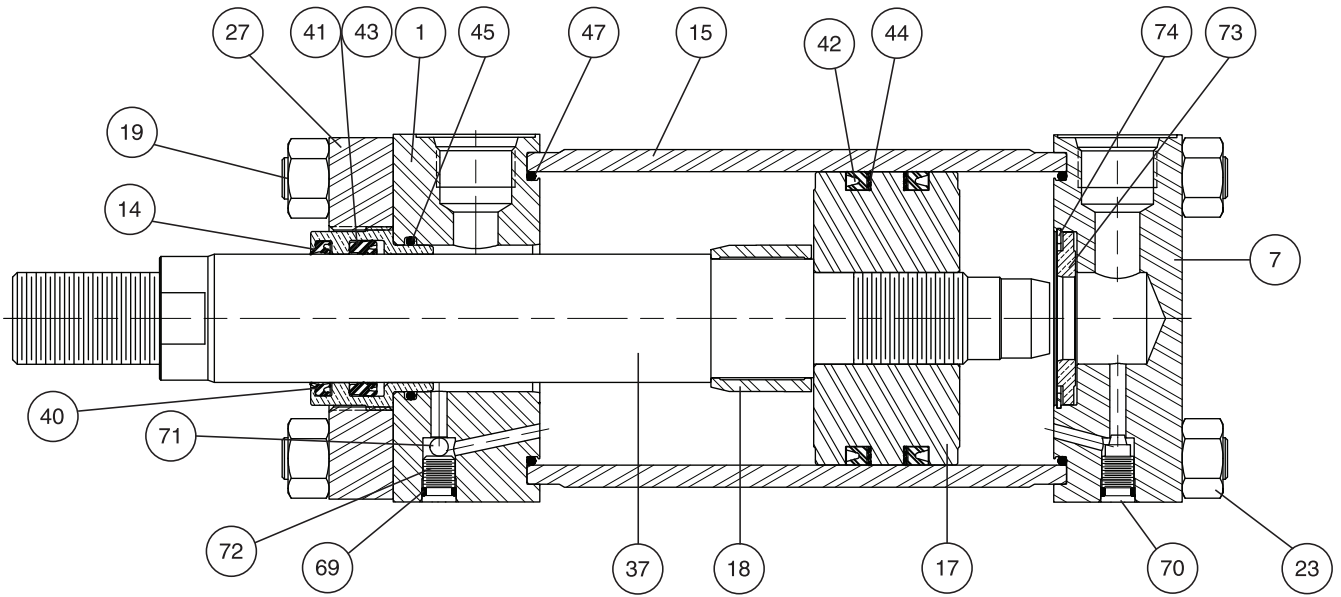
## Notes

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**B**

1.00" through 8.00" Bore

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Piston and Rod Assemblies

Factory assembled piston and rod assemblies (that include seals for piston type specified) are recommended.

Tie Rod Torque

| Bore Ø | Tie Rod Torque Series 3L |
|--------|--------------------------|
| 1.00   | 35-40 lb-in              |
| 1.50   | 60-70 lb-in              |
| 2.00   | 11-12 lb-ft              |
| 2.50   | 11-12 lb-ft              |
| 3.25   | 25-26 lb-ft              |
| 4.00   | 25-26 lb-ft              |
| 5.00   | 60-64 lb-ft              |
| 6.00   | 60-64 lb-ft              |
| 8.00   | 110-114 lb-ft            |

Note: The tie rod torque values are for cylinders rated at 1,000 psi. Consult factory for torque values for cylinders rated above 1,000 psi.

Parts List — 1.00" through 8.00" Bore

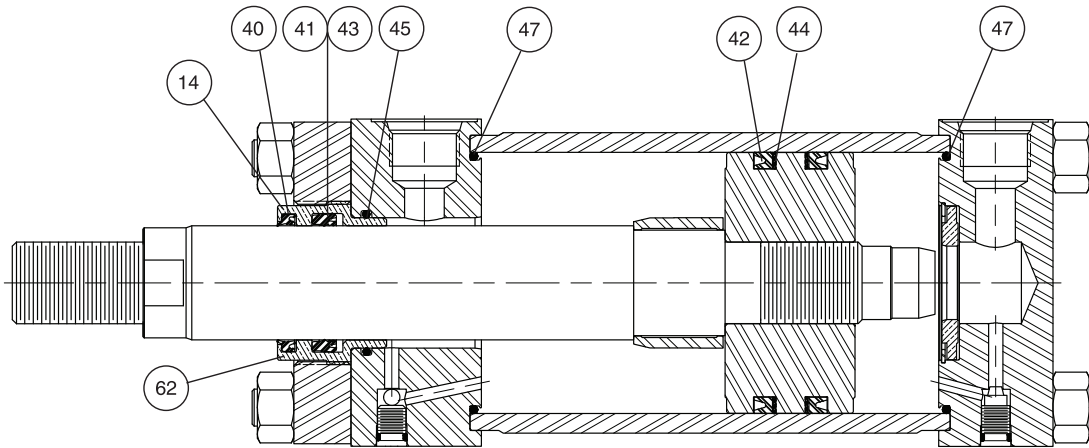
| Symbol | Description                      |
|--------|----------------------------------|
| 1      | Head                             |
| 7      | Cap                              |
| 14     | Rod Gland                        |
| 15     | Cylinder tube                    |
| 17     | Piston, lipseal type             |
| 18     | Cushion sleeve, rod head cushion |
| 19     | Tie rod                          |
| 23     | Tie rod nut                      |
| 27     | Retainer                         |
| 37     | Piston rod, single rod type      |
| 40     | Rod Wiper                        |
| 41     | Rod Seal                         |

| Symbol | Description   |
|--------|---|
| 42     | Lipseal, piston                                       |
| 43     | Back-up washer, rod seal                              |
| 44     | Back-up washer, piston                                |
| 45     | Gland O-ring  |
| 47     | O-ring, cylinder tube to head and cap seal            |
| 69     | O-ring, cushion adjustment and check valve plug screw |
| 70     | Needle, cushion adjustment valve                      |
| 71     | Ball, cushion check valve                             |
| 72     | Plug screw, cushion check valve                       |
| 73     | Bushing, float check, cushion on cap end              |
| 74     | Retaining ring, float check cushion bushing           |



1.00" through 8.00" Bore

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| Symbol | Description                      |
|--------|----------------------------------|
| 14     | Rod Gland                        |
| 40     | Rod Wiper                        |
| 41     | Rod Seal                         |
| 42     | Piston Lipseal                   |
| 43     | Rod Seal Back-up Washer          |
| 44     | Piston Seal Back-up Washer       |
| 45     | Gland to head o-ring             |
| 47     | End seal o-ring                  |
| 62     | Gland Cartridge Kit <sup>1</sup> |

<sup>1</sup>Gland Cartridge Kit contains: 14, 40, 41, 43 and 45.

Service Kit Numbers – Gland Cartridge Kits and Rod Seal Kits

| Rod<br>Ø | Seal Type                                   |                               |   |                               |
|----------|---|-------------------------------|---|-------------------------------|
|          | Class 1 Service<br>(Polyurethane & Nitrile) |                               | Class 2 Service <sup>2</sup><br>(Nitrile) |                               |
|          | Gland<br>Cartridge<br>Kits <sup>1</sup>     | Rod Seal<br>Kits <sup>3</sup> | Gland<br>Cartridge<br>Kits <sup>1</sup>   | Rod Seal<br>Kits <sup>3</sup> |
| 0.500    | RG2HLTS051                                  | RK2HLTS051                    | RG2AHL0051                                | RK2AHL0051                    |
| 0.625    | RG2HLTS061                                  | RK2HLTS061                    | RG2AHL0061                                | RK2AHL0061                    |
| 1.000    | RG2HLTS101                                  | RK2HLTS101                    | RG2AHL0101                                | RK2AHL0101                    |
| 1.375    | RG2HLTS131                                  | RK2HLTS131                    | RG2AHL0131                                | RK2AHL0131                    |
| 1.750    | RG2HLTS171                                  | RK2HLTS171                    | RG2AHL0171                                | RK2AHL0171                    |
| 2.000    | RG2HLTS201                                  | RK2HLTS201                    | RG2AHL0201                                | RK2AHL0201                    |
| 2.500    | RG2HLTS251                                  | RK2HLTS251                    | RG2AHL0251                                | RK2AHL0251                    |
| 3.000    | RG2HLTS301                                  | RK2HLTS301                    | RG2AHL0301                                | RK2AHL0301                    |
| 3.500    | RG2HLTS351                                  | RK2HLTS351                    | RG2AHL0351                                | RK2AHL0351                    |
| 4.000    | RG2HLTS401                                  | RK2HLTS401                    | RG2AHL0401                                | RK2AHL0401                    |
| 4.500    | RG2HLTS451                                  | RK2HLTS451                    | RG2AHL0451                                | RK2AHL0451                    |
| 5.000    | RG2HLTS501                                  | RK2HLTS501                    | RG2AHL0501                                | RK2AHL0501                    |
| 5.500    | RG2HLTS501                                  | RK2HLTS551                    | RG2AHL0551                                | RK2AHL0551                    |

<sup>2</sup> Series 3L rod gland cartridge kit rod seal kit, piston seal kit and body seal kit part numbers shown identify class 2 seals. To order class 5 or 6 seals substitute 5 or 6 as required for the last digit of the kit number.

<sup>3</sup> Rod Seal Kits contain items 40, 41, 45 (43 class 2, 5 & 6 only).

<sup>4</sup> Piston Lipseal Kits – (Includes Cylinder Body End Seals). Contain two each of items 47, 42, & 44.

Piston Seal Kits and Body Seal Kits

| Bore<br>Ø | Class 1 & 2 Service <sup>2</sup>    |                |
|-----------|-------------------------------------|----------------|
|           | Piston Lipseal<br>Kits <sup>4</sup> | Body Seal Kits |
| 1.00      | PK102HLL01                          | CB102HL001     |
| 1.50      | PK152HLL01                          | CB152HL001     |
| 2.00      | PK202HLL01                          | CB202HL001     |
| 2.50      | PK252HLL01                          | CB252HL001     |
| 3.25      | PK322HLL01                          | CB322HL001     |
| 4.00      | PK402HLL01                          | CB402HL001     |
| 5.00      | PK502HLL01                          | CB502HL001     |
| 6.00      | PK602HLL01                          | CB602HL001     |
| 8.00      | PK802HLL01                          | CB802HL001     |

Retainer Bolt Torque for Cylinders with Round Gland Retainers

Torque values are for bolts installed with lubrication.

| Screw Size | Torque        |
|------------|---------------|
| # 10       | 56 - 58 lb-in |
| 1/4"       | 11 - 12 lb-ft |
| 5/16"      | 23 - 24 lb-ft |
| 3/8"       | 41 - 43 lb-ft |
| 7/16"      | 65 - 68 lb-ft |



**Piston Seal Kits for Series 3L with  
Magnetic Piston Option**

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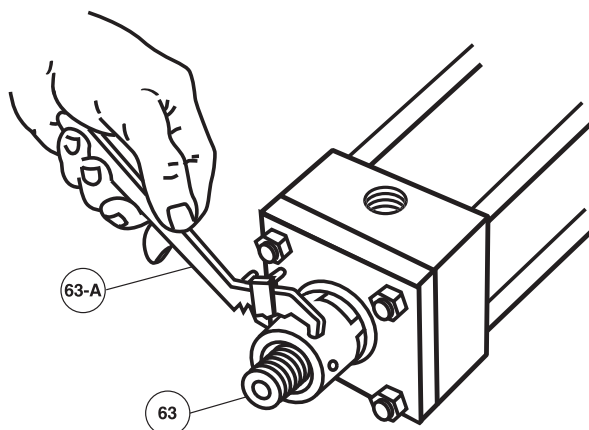
| Bore<br>Ø | Piston Seal Kit <sup>1</sup> for Magnetic Piston |                 |
|-----------|--|-----------------|
|           | Class 1 Service                                  | Class 5 Service |
| 1.00      | PK103LM001                                       | PK103LM005      |
| 1.50      | PK153LM001                                       | PK153LM005      |
| 2.00      | PK203LM001                                       | PK203LM005      |
| 2.50      | PK253LM001                                       | PK253LM005      |
| 3.25      | PK323LM001                                       | PK323LM005      |
| 4.00      | PK403LM001                                       | PK403LM005      |

<sup>1</sup> Kit includes 1 piece each of bi-directional piston seal, piston seal energizer o-ring (2 lipseals and no energizer ring in 1.00 inch bore), piston wear band and 2 pieces each of cylinder tube to head and cap o-ring seal.

**Gland Cartridge Wrenches**

Parker's exclusive gland cartridge design makes gland replacement only a minute's work...and the Gland Cartridge Wrench Set makes it even simpler. A specially designed face-type gland wrench with flared lugs slips into an exact, sure fit on the gland, while a self-locking spanner wrench grips the gland wrench securely. No fumbling for adjustment – no accidental scoring of the piston rod, the job is done quickly...easily...safely.

You can order the Cartridge Wrench or Spanner Wrench to fit the piston rod size used in your Parker Hannifin Cylinder.



| Rod<br>Ø | Gland Wrench<br>(Symbol 63) | Spanner Wrench<br>(Symbol 63-A) |
|----------|-----------------------------|---------------------------------|
| 0.625    | 0695900000                  | 0116760000                      |
| 1.000    | 0695910000                  |                                 |
| 1.375    | 0695920000                  | 0117030000                      |
| 1.750    | 0695930000                  | 0116770000                      |
| 2.000    | 0695940000                  |                                 |
| 2.500    | 0695950000                  | 0116770000                      |
| 3.000    | 0695960000                  |                                 |
| 3.500    | 0695970000                  |                                 |
| 4.000    | 0695980000                  | 0116780000                      |
| 4.500    | 0838770000                  |                                 |
| 5.000    | 0695990000                  |                                 |
| 5.500    | 0696000000                  |                                 |



## **Section C**

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### **Series 3L Custom Modifications**

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**Modifications:** The following modifications can be supplied on most Parker cylinders.

**Metallic Rod Wiper**

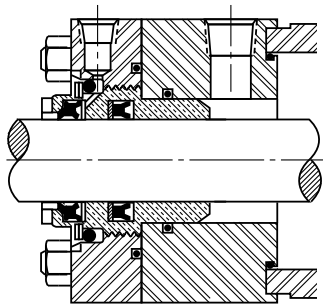
When specified metallic rod wipers can be supplied instead of the standard synthetic rubber wiperseal. Recommended in applications where contaminants tend to cling to the extended piston rod and would damage the synthetic rubber wiperseal. Installation of metallic rod wiper does not affect cylinder dimensions. It is available at extra cost.

**Gland Drain**

Hydraulic fluids tend to adhere to the piston rods, during the extend stroke, and an accumulation of fluid can collect in the cavity behind the gland wiperseal on long stroke cylinders.

A 1/8" NPTF gland drain port can be provided in the gland retainer. A passage in the gland between the wiperseal and lipseal is provided to drain off any accumulation of fluid between the seals. See drawing below.

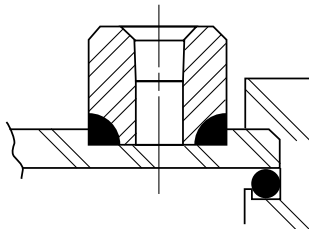
It is recommended that the gland drain port be piped back to the fluid reservoir and that the reservoir be located below the level of the head of the cylinder.



**Air Bleeds**

In most hydraulic circuits, cylinders are considered self-bleeding when cycled full stroke. If air bleeds are required and specified, 1/8" NPTF Air Bleed Ports for venting air can be provided at both ends of the cylinder body, or on the head or cap. To order, specify "Bleed Port", and indicate position desired.

**Air Bleed Port**



**Rod End Boots**

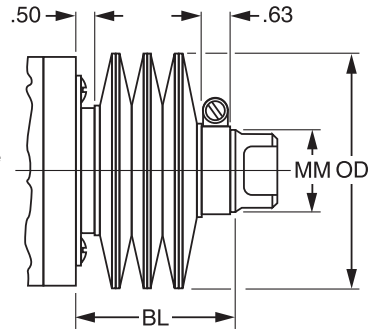
Cylinders have a hardened bearing surface on the piston rod to resist external damage, and are equipped with the high efficiency "Wiperseal" to remove external dust and dirt. Exposed piston rods that are subjected to contaminants with air hardening properties, such as paint, should be protected. In such applications, the use

of a collapsing cover should be considered. This is commonly referred to as a "boot". Calculate the longer rod end required to accommodate the collapsed length of the boot from the following data.

|    |      |      |       |       |       |       |       |       |       |       |       |       |
|----|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LF | .13  | .13  | .13   | .13   | .13   | .13   | .13   | .10   | .10   | .10   | .10   | .10   |
| OD | 2.25 | 2.25 | 2.63  | 3.00  | 3.38  | 3.75  | 4.38  | 5.13  | 5.63  | 6.25  | 7.00  | 7.50  |
| MM | .500 | .625 | 1.000 | 1.380 | 1.750 | 2.000 | 2.500 | 3.000 | 3.500 | 4.000 | 5.000 | 5.500 |

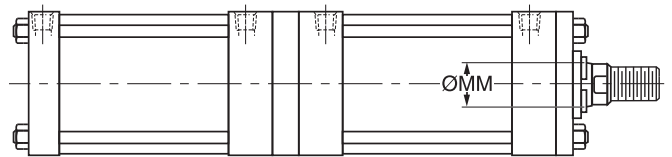
To determine extra length of piston rod required to accommodate boot, calculate  
 $BL = \text{Stroke} \times LF + 1.125"$   
 $BL + \text{Std. W} + A = \text{length of piston rod to extend beyond the retainer.}$

NOTE: Check all Boot O.D's against std. "E" dimension from catalog. This may be critical on foot mounted cylinders.



**Tandem Cylinders**

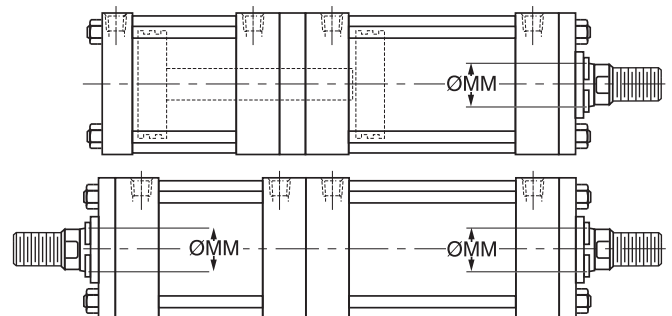
A tandem cylinder is made up of two cylinders mounted in line with pistons connected by a common piston rod and rod seals installed between the cylinders to permit double acting operation of each. Tandem cylinders allow increased output force when mounting width or height are restricted.



Reduced operating pressure is required for this construction. Please contact the factory.

**Duplex Cylinders**

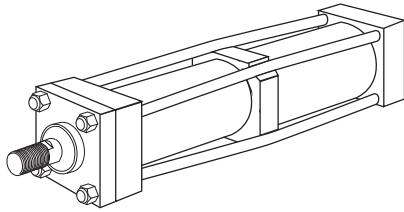
A duplex cylinder is made up of two cylinders mounted in line with pistons not connected and with rod seals installed between the cylinders to permit double acting operation of each. Cylinders may be mounted with piston rod to piston (as shown) or back to back and are generally used to provide three position operation.



Reduced operating pressure is required for this construction. Please contact the factory.

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**Tie Rod Supports**

**Rigidity of Envelope** – The pre-stressed tie rod construction of Parker cylinders has advantages in rigidity within the limits of the cylinder tube to resist buckling. For long stroke cylinders within practical limits, Parker provides exclusive TIE ROD SUPPORTS (see table below) which move the tie rod centerlines radially outward.

Standard tie rod supports are kept within the envelope dimensions of the head and cap, and generally do not interfere with mounting a long cylinder.

| Number of Supports Required | Bore Ø | Stroke (Inches) |    |    |    |                 |    |     |     |     |     |     |     |  |
|-----------------------------|--------|-----------------|----|----|----|-----------------|----|-----|-----|-----|-----|-----|-----|--|
|                             |        | 36              | 48 | 60 | 72 | 84              | 96 | 108 | 120 | 132 | 144 | 156 | 168 |  |
| 1.00                        | —      | 1               | 1  | 1  | 2  | Consult Factory |    |     |     |     |     |     |     |  |
| 1.50                        | —      | —               | 1  | 1  | 1  | 2               | 2  | 3   | 3   | 3   | 3   | 4   |     |  |
| 2.00                        | —      | —               | —  | 1  | 1  | 1               | 1  | 2   | 2   | 2   | 2   | 3   |     |  |
| 2.50                        | —      | —               | —  | —  | —  | 1               | 1  | 1   | 1   | 1   | 2   | 2   |     |  |
| 3.25                        | —      | —               | —  | —  | —  | —               | —  | 1   | 1   | 1   | 1   | 1   |     |  |
| 4.00                        | —      | —               | —  | —  | —  | —               | —  | —   | —   | 1   | 1   | 1   |     |  |

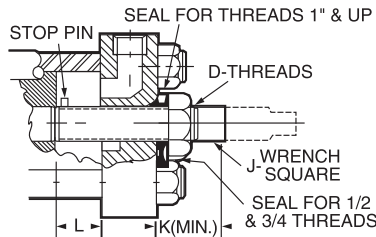
Note: 5.00" through 8.00" bore sizes — no supports required.

**Stroke Adjusters**

For the requirement where adjusting the stroke is specified. Parker has several designs to offer, one of which is illustrated below. This is suitable for infrequent adjustment and is economical<sup>1</sup>.

| Bore Ø Series 3L | D          | J    | K    | L (Max.) |
|------------------|------------|------|------|----------|
| 1.50, 2.00       | 1/2 - 20   | 0.31 | 0.94 | 5.00     |
| 2.50, 3.25, 4.00 | 3/4 - 16   | 0.44 | 1.25 | 8.00     |
| 5.00, 6.00       | 1 - 14     | 0.63 | 1.69 | 9.00     |
| 8.00             | 1 1/2 - 12 | 0.94 | 2.13 | 18.00    |

Here a "retracting stroke adjuster" must be called for in specifications, and the length of the adjustment must be specified.

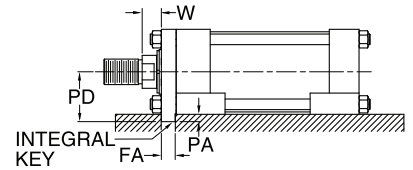


Where frequent adjustment or cushions at the cap end are required, other designs are available according to application needs.

<sup>1</sup>Infrequent is defined by positioning the retract stroke in a couple of attempts at original machine set up. The frequent stroke adjuster is recommended for adjustments required after the original equipment has been adjusted by the original machine manufacturer.

**Thrust Key Mountings**

Thrust key mountings eliminate the need of using fitted bolts or external keys on side mounted cylinders. Parker cylinders in mounting styles CP and FP can be provided with the gland retainer plate extended below the mounting side of the cylinder (see illustration below). This extended retainer plate can then be fitted into a keyway milled into the mounting surface of the machine member. This is referred to as the "P" Modification of any side mounting style.



| Bore Ø | FA                | PA   | PD Mtg. Styles CP & FP |
|--------|-------------------|------|------------------------|
| 1.00   | .312 -0.002 +.000 | 0.19 | 0.94                   |
| 1.50   | .312 -0.002 +.000 | 0.19 | 1.19                   |
| 2.00   | .312 -0.002 +.000 | 0.19 | 1.44                   |
| 2.50   | .312 -0.002 +.000 | 0.19 | 1.69                   |
| 3.25   | .562 -0.002 +.000 | 0.31 | 2.19                   |
| 4.00   | .562 -0.002 +.000 | 0.31 | 2.56                   |
| 5.00   | .562 -0.002 +.000 | 0.31 | 3.06                   |
| 6.00   | .687 -0.002 +.000 | 0.38 | 3.63                   |

**Metric Piston Rod Thread**

The table below lists the standard thread supplied when Piston Rod Thread type M is specified in the cylinder model code.

| MM Rod Ø | Thread            |             | A    |
|----------|-------------------|-------------|------|
|          | Styles 4M & 9M KK | Style 8M CC |      |
| 0.625    | M10x1.5           | M12x1.5     | 0.75 |
| 1.000    | M20x1.5           | M22x1.5     | 1.13 |
| 1.375    | M26x1.5           | M30x2       | 1.63 |
| 1.750    | M33x2             | M39x2       | 2.00 |
| 2.000    | M39x2             | M45x2       | 2.25 |
| 2.500    | M48x2             | M56x2       | 3.00 |
| 3.000    | M58x2             | M68x2       | 3.50 |
| 3.500    | M64x2             | M76x2       | 3.50 |
| 4.000    | M76x2             | M95x2       | 4.00 |
| 4.500    | M80x2             | M110x2      | 4.50 |
| 5.000    | M90x2             | M110x2      | 5.00 |
| 5.500    | M100x2            | M130x2      | 5.50 |



## Cylinder End-of-Stroke Proximity Switches

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**“EPS” Style Inductive Sensors**  
For General Industrial AC and DC Applications

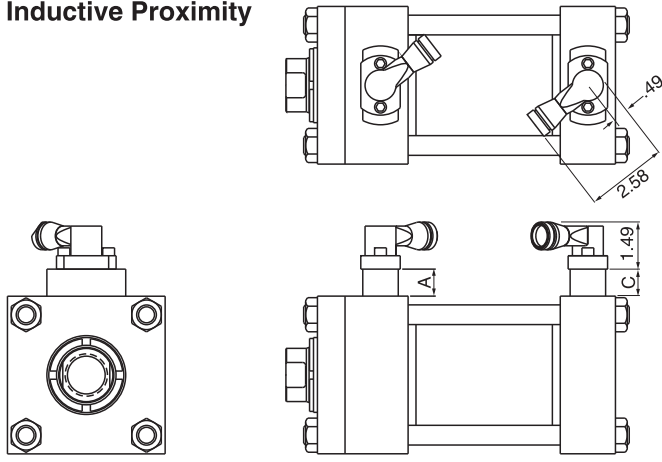
**“CLS” Style Magnetic Sensors**  
Including Extreme Temperature Applications

All Sensors Are:  
Non-Contacting  
Water Resistant  
Weld-Field Immune  
Shock and Vibration Resistant  
Flange-Mounted to Cylinder End Caps

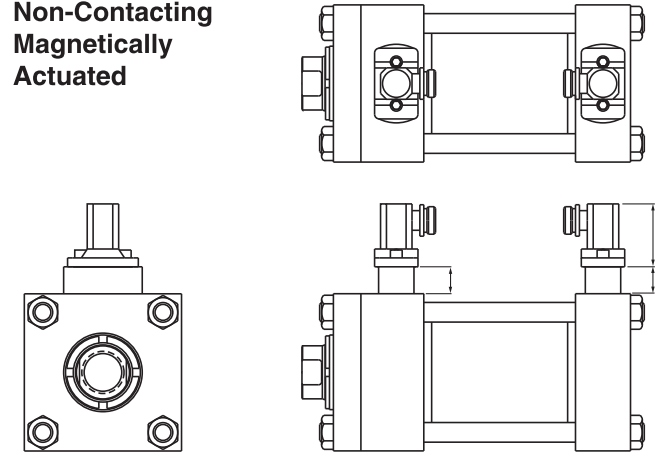
**Sensors**

**EPS 7 & 6 Sensors  
Inductive Proximity**

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**CLS 1 & 4 Sensors  
Non-Contacting  
Magnetically  
Actuated**



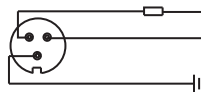
**Spacer Height  
EPS & CLS Sensors**

| A max. | C max. |
|--------|--------|
| 1.55   | 1.05   |

For exact dimensions, see Bulletin 0840-G-E1.

**Connector Pin Numbering**

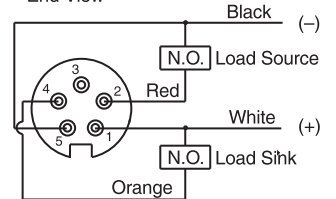
**3-Pin Mini**



**EPS-7**

**5-Pin Mini**

Male Receptacle  
End View



**EPS-6**

**Series and Parallel Wiring**

When Parker EPS-6 or 7 sensors are used as inputs to programmable controllers the preferred practice is to connect each sensor to a separate input channel of the PLC. Series or parallel operations may then be accomplished by the internal PLC programming.

EPS-6 or 7 sensors may be hard wired for series operation, but the voltage drop through the sensors (see specifications) must not reduce the available voltage below what is needed to actuate the load.

EPS-6 or 7 sensors may also be hard wired for parallel operation. However, the leakage current of each sensor will pass through the load. The total of all leakage currents must not exceed the current required to actuate the load. When wiring EPS-6 sensors in parallel it is recommended that decoupling diodes be used.

**Minimum Stroke**

The minimum stroke for EPS-6 or 7 and CLS-1 or 4 sensors, utilizing standard components, is the cushion sleeve or spear length for the cylinder series in which the sensor is installed. See the individual Industrial Cylinder series catalog for cushion length details. Contact the factory if a shorter stroke is required.



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| <b>Specifications</b>                  |   |   |   |   |
|--|---|---|---|---|
| <b>Style:</b>                          | <b>EPS-7</b>  | <b>EPS-6</b>  | <b>CLS-1</b>  | <b>CLS-4</b>  |
| <b>Code Designator:</b>                | H   | D   | F   | B   |
| <b>Description:</b>                    | Economical, General Purpose, 2 wire device, primarily for AC applications. (Not suitable for 3 wire 24 volt Sinking or Sourcing applications.) Also for automotive industry applications. | Economical, General Purpose, 3 wire, DC sensor, dual output: sinking and sourcing   | Functional replacement for AB (Mechanical) Limit Switches in many applications, or where customer needs NC contacts, zero leakage, zero voltage drop, higher or lower load current than EPS-style | Functional replacement for AB (Mechanical) Limit Switches in many High Temperature applications, or where customer needs NC contacts, zero leakage, zero voltage drop, higher or lower load current than EPS-style. |
| <b>Supply Voltage:</b>                 | 20 to 250 VAC/DC  | 10 to 30 VDC  | 24 to 240 VAC/DC  | 24 to 240 VAC/DC  |
| <b>Load Current, min:</b>              | 8 mA  | N/A   | NA  | NA  |
| <b>Load Current, max:</b>              | 300 mA  | 200 mA  | 4 AMPS @ 120 VAC<br>3 AMPS @ 24VDC  | 4 AMPS @ 120 VAC<br>3 AMPS @ 24 VDC   |
| <b>Leakage Current:</b>                | 1.7 mA, max.  | 10 micro amps max   | –   | –   |
| <b>Voltage Drop:</b>                   | 7 V, max.   | 2 VDC max.  | N/A   | NA  |
| <b>Operating Temperature:</b>          | -14° to +158° F   | -14° to +158°F  | -40°F to +221°F   | -40°F to +400°F   |
| <b>Sensor Type:</b>                    | Inductive proximity   | Inductive proximity   | non-contacting magnetically actuated  | non-contacting magnetically actuated  |
| <b>Part Number:</b>                    | 148897 <sup>1</sup>   | 148896 <sup>1</sup>   | 148275 <sup>1</sup>   | 149109 <sup>1</sup>   |
| <b>Part Number Suffix<sup>1</sup>:</b> | <b><sup>1</sup>4-digit suffix indicates probe length: 0125=1.25", 0206=2.06", 0288=2.875", 0456=4.562"</b>  |   |   |   |
| <b>Connection:</b>                     | 3 pin mini  | 5 pin mini  | 3 pin mini  | 144" PTFE Coated Flying Leads with 1/2" conduit hub   |
| <b>Enclosure Rating:</b>               | IEC IP67  | IEC IP67  | NEMA 1, 2, 3, 4, 4x, 5, 6, 6P, 11, 12, 12K, 13  | NEMA 1, 2, 3, 4, 4x, 5  |
| <b>LED indication:</b>                 | Yes   | Yes   | Yes   | No  |
| <b>Short Circuit Protection:</b>       | Yes   | Yes   | No  | No  |
| <b>Weld Field Immunity:</b>            | Yes   | Yes   | Yes   | Yes   |
| <b>Output:</b>                         | 2 wire, Normally Open with leakage current  | Dual Output: DC Sinking and DC Sourcing, user selectable via wiring   | SPDT (Single Pole Double Throw), Normally Open/Normally Closed, Form C  | SPDT (Single Pole Double Throw), Normally Open/Normally Closed, Form C  |
| <b>Approvals/Marks:</b>                | CE, UL, CSA   | CE, UL, CSA   | UL or CSA <sup>2</sup>  | UL or CSA <sup>2</sup>  |
| <b>Make/Break Location:</b>            | <b>0.13" from end of stroke, typical. Tolerance is +0"/-0.13"</b>   |   |   |   |
| <b>Wiring Instructions:</b>            | Pin 1: AC Ground (Green)<br>Pin 2: Output (Black)<br>Pin 3: AC Line (White)   | Pin 1: +10 to 30 VDC (White)<br>Pin 2: Sourcing Output (Red)<br>Pin 3: Grounded (not connected or required)<br>Pin 4: Sinking Output (Orange)<br>Pin 5: DC Common (Black) | Pin 1: Common (Green)<br>Pin 2: Normally Closed (Black)<br>Pin 3: Normally Open (White)   | Common: (Black)<br>Normally Open: (Blue)<br>Normally Closed: (Red)  |
| <b>Cable: 6'</b>                       | 0853550006  | 0859170006  | 0853550006  | –   |
| <b>Cable: 12'</b>                      | 0853550012  | 0859170012  | 0853550012  | –   |
| <b>Cable: 6', Right Angle</b>          | 0875470006  | –   | 0875470006  | –   |

<sup>2</sup>CSA available upon request – contact factory.



**How to Order**

**How to Specify EPS Proximity Switches**

Parker EPS proximity switches may be ordered on Series 3L cylinders as follows:

- 1) Complete the basic cylinder model number.
- 2) Place an "S" in the model number to denote switches and/or special features.
- 3) Mounting styles D, DB, JJ, J, or H should be used with caution because of possible mounting interferences. Consult bulletin 0840-G-E1 for additional information.
- 4) Special modifications to cylinders other than switches must have a written description.

5) Specify letter prefix "H" for EPS-7, "D" for EPS-6, and "F" for CLS-1, or "B" for CLS-4, then fill in the four blanks specifying port location, switch orientation and actuation point for both head and cap. If only one switch is used, place "XXXX" in the unused blanks.

Example = H13AGG-XXXX denotes a switch on the head end only, EPS-7

Example = XXXX-H42AGG denotes a switch on the cap end only, EPS-7

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**Head End**

| <b>H</b>  | <b>1</b>                       | <b>3</b>                         | <b>A</b>   | <b>GG</b>  |
|---|--------------------------------|----------------------------------|--|--|
| Specify:<br>"H" = EPS-7<br>"D" = EPS-6<br>"F" = CLS-1 <sup>1</sup><br>"B" = CLS-4 <sup>1</sup><br>"N" = Prep for EPS-6 and EPS-7 switches<br>"P" = Prep for CLS-1 and CLS-4 switches<br>"T" = Prep for CLS-2 switch | Port Location<br>See Figure 1. | Switch Location<br>See Figure 1. | Switch Orientation<br>See Figure 2 for CLS-1, CLS-4, EPS-6 and EPS-7 only. | Actuation Point<br>GG = End of Stroke<br>FF = Stroke to Go;<br>See Bulletins 0840-G-E1, 2 or 3 for stroke remaining. |

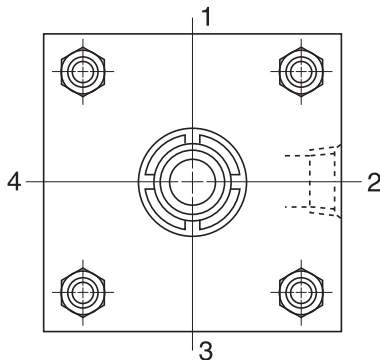
**Cap End**

| <b>H</b>  | <b>4</b>                       | <b>2</b>                         | <b>A</b>   | <b>GG</b>  |
|---|--------------------------------|----------------------------------|--|--|
| Specify:<br>"H" = EPS-7<br>"D" = EPS-6<br>"F" = CLS-1 <sup>1</sup><br>"B" = CLS-4 <sup>1</sup><br>"N" = Prep for EPS-6 and EPS-7 switches<br>"P" = Prep for CLS-1 and CLS-4 switches<br>"T" = Prep for CLS-2 switch | Port Location<br>See Figure 1. | Switch Location<br>See Figure 1. | Switch Orientation<br>See Figure 2 for CLS-1, CLS-4, EPS-6 and EPS-7 only. | Actuation Point<br>GG = End of Stroke<br>FF = Stroke to Go;<br>See Bulletins 0840-G-E1, 2 or 3 for stroke remaining. |

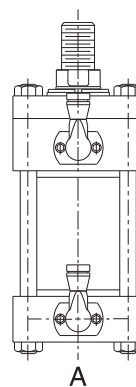
Note: All specified switch and port locations are as seen from rod end of cylinder.

<sup>1</sup> CLS-1 and CLS-4 proximity switches are not available on the head end of 1.50" bore with 1.00" rod and 2.00" bore with 1.375" rod

**Figure 1**



**Figure 2**



## Notes

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## **Section D**

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**Theoretical Push Forces for Hydraulic Cylinders**

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| Bore<br>Ø | Piston Area<br>(Sq. In.) | Cylinder Push Stroke Force in Pounds at Various Pressures |       |       |       |       |        |
|-----------|--------------------------|---|-------|-------|-------|-------|--------|
|           |                          | 100   | 250   | 500   | 1000  | 1500  | 2000   |
| 1.00      | 0.79                     | 79  | 196   | 392   | 785   | 1178  | 1570   |
| 1.50      | 1.767                    | 177   | 443   | 885   | 1770  | 2651  | 3540   |
| 2.00      | 3.14                     | 314   | 785   | 1570  | 3140  | 4712  | 6280   |
| 2.50      | 4.91                     | 491   | 1228  | 2455  | 4910  | 7363  | 9820   |
| 3.25      | 8.30                     | 830   | 2075  | 4150  | 8300  | 12444 | 16600  |
| 4.00      | 12.57                    | 1257  | 3143  | 6285  | 12570 | 18850 | 25140  |
| 5.00      | 19.64                    | 1964  | 4910  | 9820  | 19640 | 29453 | 39280  |
| 6.00      | 28.27                    | 2827  | 7068  | 14135 | 28270 | 42412 | 56540  |
| 8.00      | 50.27                    | 5027  | 12568 | 25135 | 50270 | 75398 | 100540 |

**General Formula**

The cylinder output forces are derived from the formula:

$$F = P \times A$$

Where F = Force in pounds.

P = Pressure at the cylinder in  
pounds per square inch, gauge.

A = Effective area of cylinder piston  
in square inches.



**Theoretical Pull Forces for Hydraulic Cylinders**

| Bore Ø | Piston Rod Ø | Piston Rod Area (Sq. In.) | Cylinder Pull Force in Pounds at Various Pressures |       |       |       |       |       |
|--------|--------------|---------------------------|--|-------|-------|-------|-------|-------|
|        |              |                           | 100  | 250   | 500   | 1000  | 1500  | 2000  |
| 1.00   | 0.500        | 0.196                     | 59   | 149   | 297   | 594   | 891   | 1188  |
|        | 0.625        | 0.307                     | 48   | 121   | 242   | 483   | 725   | 966   |
| 1.50   | 0.625        | 0.307                     | 146  | 365   | 730   | 1460  | 2190  | 2920  |
|        | 1.000        | 0.785                     | 98   | 245   | 491   | 982   | 1473  | 1964  |
| 2.00   | 0.625        | 0.307                     | 283  | 708   | 1417  | 2833  | 4250  | 5666  |
|        | 1.375        | 1.48                      | 166  | 415   | 830   | 1660  | 2490  | 3320  |
|        | 1.000        | 0.785                     | 236  | 589   | 1178  | 2355  | 3533  | 4710  |
| 2.50   | 1.000        | 0.785                     | 413  | 1031  | 2063  | 4125  | 6188  | 8250  |
|        | 1.750        | 2.41                      | 250  | 625   | 1250  | 2500  | 3750  | 5000  |
|        | 1.375        | 1.48                      | 343  | 858   | 1715  | 3430  | 5145  | 6860  |
|        | 0.625        | 0.307                     | 460  | 1151  | 2302  | 4603  | 6905  | 9206  |
| 3.25   | 1.000        | 0.785                     | 752  | 1879  | 3758  | 7515  | 11273 | 15030 |
|        | 2.000        | 3.14                      | 516  | 1290  | 2580  | 5160  | 7740  | 10320 |
|        | 1.375        | 1.48                      | 682  | 1705  | 3410  | 6820  | 10230 | 13640 |
|        | 1.750        | 2.41                      | 589  | 1473  | 2945  | 5890  | 8835  | 11780 |
| 4.00   | 1.375        | 1.48                      | 1109   | 2773  | 5545  | 11090 | 16635 | 22180 |
|        | 2.500        | 4.91                      | 766  | 1915  | 3830  | 7660  | 11490 | 15320 |
|        | 1.750        | 2.41                      | 1016   | 2540  | 5080  | 10160 | 15240 | 20320 |
|        | 2.000        | 3.14                      | 943  | 2358  | 4715  | 9430  | 14145 | 18860 |
|        | 1.000        | 0.785                     | 1179   | 2946  | 5893  | 11785 | 17678 | 23570 |
| 5.00   | 1.750        | 2.41                      | 1723   | 4308  | 8615  | 17230 | 25845 | 34460 |
|        | 3.500        | 9.62                      | 1002   | 2505  | 5010  | 10020 | 15030 | 20040 |
|        | 2.000        | 3.14                      | 1650   | 4125  | 8250  | 16500 | 24750 | 33000 |
|        | 2.500        | 4.91                      | 1473   | 3683  | 7365  | 14730 | 22095 | 29460 |
|        | 3.000        | 7.07                      | 1257   | 3143  | 6285  | 12570 | 18855 | 25140 |
|        | 1.000        | 0.785                     | 1886   | 4714  | 9428  | 18855 | 28283 | 37710 |
|        | 1.375        | 1.48                      | 1816   | 4540  | 9080  | 18160 | 27240 | 36320 |
| 6.00   | 1.750        | 2.41                      | 2586   | 6465  | 12930 | 25860 | 38790 | 51720 |
|        | 4.000        | 12.57                     | 1570   | 3925  | 7850  | 15700 | 23550 | 31400 |
|        | 2.000        | 3.14                      | 2513   | 6283  | 12565 | 25130 | 37695 | 50260 |
|        | 2.500        | 4.91                      | 2336   | 5840  | 11680 | 23360 | 35040 | 46720 |
|        | 3.000        | 7.07                      | 2120   | 5300  | 10600 | 21200 | 31800 | 42400 |
|        | 3.500        | 9.62                      | 1865   | 4663  | 9325  | 18650 | 27975 | 37300 |
|        | 1.375        | 1.48                      | 2679   | 6698  | 13395 | 26790 | 40185 | 53580 |
| 8.00   | 2.000        | 3.14                      | 4713   | 11783 | 23565 | 47130 | 70695 | 94260 |
|        | 5.500        | 23.76                     | 2651   | 6628  | 13255 | 26510 | 39765 | 53020 |
|        | 2.500        | 4.91                      | 4536   | 11340 | 22680 | 45360 | 68040 | 90720 |
|        | 3.000        | 7.07                      | 4320   | 10800 | 21600 | 43200 | 64800 | 86400 |
|        | 3.500        | 9.62                      | 4065   | 10163 | 20325 | 40650 | 60975 | 81300 |
|        | 4.000        | 12.57                     | 3770   | 9425  | 18850 | 37700 | 56550 | 75400 |
|        | 1.375        | 1.48                      | 4879   | 12198 | 24395 | 48790 | 73185 | 97580 |
|        | 1.750        | 2.41                      | 4786   | 11965 | 23930 | 47860 | 71790 | 95720 |
|        | 4.500        | 15.90                     | 3437   | 8593  | 17185 | 34370 | 51555 | 68740 |
|        | 5.000        | 19.63                     | 3064   | 7660  | 15320 | 30640 | 45960 | 61280 |

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The weights shown below are for standard Series 3L hydraulic cylinders equipped with various diameter piston rods. To determine the net weights of a cylinder, first select the proper basic weight for zero stroke, then calculate the weight of the cylinder stroke and add the result to the basic weight. For extra rod extension use

piston rod weights per inch shown in Table B. Weights of cylinders with intermediate rods may be estimated from table below by taking the difference between the piston rod weights per inch and adding it to the Code 1 weight for the cylinder bore size involved.

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**Table A** Cylinder Weights, in pounds, for Series 3L hydraulic cylinders

| Bore Ø | Rod Ø | Single Rod Cylinders<br>Basic Wt. Zero Stroke |                             | Add Per<br>Inch of<br>Stroke | Double Rod Cylinders<br>Basic Wt. Zero Stroke |                     | Add Per<br>Inch of<br>Stroke |
|--------|-------|---|-----------------------------|------------------------------|---|---------------------|------------------------------|
|        |       | F, H, J, T,<br>TB, TC, TD                     | BB, C, D, DB,<br>DD, HB, JB |                              | KJ, KF, KT,<br>KTD, KTB                       | KJB, KC,<br>KD, KDD |                              |
| 1.00   | 0.500 | 2.5   | 2.9                         | 0.20                         | 4.7   | 5.5                 | 0.40                         |
|        | 0.625 | 2.6   | 3.0                         | 0.23                         | 4.9   | 5.7                 | 0.46                         |
| 1.50   | 0.625 | 3.7   | 4.3                         | 0.3                          | 4.2   | 4.8                 | 0.6                          |
|        | 1.000 | 4.5   | 5.1                         | 0.4                          | 5.8   | 6.7                 | 0.8                          |
| 2.00   | 0.625 | 6.5   | 6.9                         | 0.5                          | 8.2   | 8.6                 | 1.0                          |
|        | 1.000 | 7.0   | 7.5                         | 0.63                         | 9.0   | 9.5                 | 1.3                          |
|        | 1.375 | 8.5   | 8.9                         | 0.8                          | 11.2  | 11.6                | 1.6                          |
| 2.50   | 0.625 | 9.0   | 9.7                         | 0.6                          | 11.4  | 12.1                | 1.2                          |
|        | 1.000 | 9.5   | 10.0                        | 0.73                         | 12.0  | 12.5                | 1.5                          |
|        | 1.750 | 13.2  | 13.6                        | 1.1                          | 19.8  | 20.5                | 2.2                          |
| 3.25   | 1.000 | 16.5  | 17.5                        | 0.8                          | 22.0  | 23.0                | 1.6                          |
|        | 1.375 | 17.0  | 18.0                        | 1.0                          | 22.5  | 23.5                | 2.0                          |
|        | 2.000 | 27.0  | 28.0                        | 1.4                          | 43.0  | 44.0                | 2.8                          |
| 4.00   | 1.000 | 26.0  | 31.0                        | 1.0                          | 33.0  | 38.0                | 2.0                          |
|        | 1.375 | 26.5  | 31.5                        | 1.2                          | 33.5  | 38.5                | 2.5                          |
|        | 2.500 | 36.0  | 42.0                        | 2.0                          | 53.0  | 58.0                | 4.0                          |
| 5.00   | 1.000 | 39.0  | 46.0                        | 1.1                          | 48.0  | 55.0                | 2.2                          |
|        | 1.375 | 39.5  | 46.5                        | 1.3                          | 48.5  | 55.5                | 2.6                          |
|        | 3.500 | 63.0  | 66.0                        | 3.6                          | 96.0  | 103.0               | 7.2                          |
| 6.00   | 1.375 | 68.0  | 77.0                        | 1.5                          | 80.0  | 89.0                | 3.0                          |
|        | 4.000 | 100.0   | 102.0                       | 4.5                          | 144.0   | 153.0               | 9.0                          |
| 8.00   | 1.375 | 94.0  | 99.0                        | 2.0                          | 108.0   | 113.0               | 4.0                          |
|        | 5.500 | 168.0   | 172.0                       | 8.0                          | 256.0   | 261.0               | 16.0                         |

**Table B** Piston Rod Weights, in pounds, for Series 3L hydraulic cylinders

| Rod Ø | Piston Rod Wt. Per Inch | Rod Ø | Piston Rod Wt. Per Inch | Rod Ø | Piston Rod Wt. Per Inch |
|-------|-------------------------|-------|-------------------------|-------|-------------------------|
| 0.625 | 0.09                    | 2.000 | 0.89                    | 4.000 | 3.56                    |
| 1.000 | 0.22                    | 2.500 | 1.40                    | 4.500 | 4.51                    |
| 1.375 | 0.42                    | 3.000 | 2.00                    | 5.000 | 5.56                    |
| 1.750 | 0.68                    | 3.500 | 2.72                    | 5.500 | 6.72                    |



**Operating Fluids and Temperature Range**

Fluidpower cylinders are designed for use with pressurized air, hydraulic oil and fire resistant fluids, in some cases special seals are required.

**Standard Seals (class 1)**

Class 1 seals are what is normally provided in a cylinder unless otherwise specified. They are intended for use with fluids such as: air, nitrogen, mineral base hydraulic oil or MIL-H-5606 within the temperature range of -10°F (-23°C) to +165°F (+74°C). Generally they are nitrile except for piston rod seals in hydraulic cylinders. However the individual seals may be nitrile (Buna-N) enhanced polyurethane, polymyte, P.T.F.E. or filled P.T.F.E.

**Water Base Fluid Seals (class 2)**

Generally class 2 seals are intended for use with water base fluids within the temperature of -10°F (-23°C) to +165°F (+74°C) except for High Water Content Fluids (H.W.C.F.) in which case Class 6 seals should be used. Typical water base fluids are: Water, Water-Glycol, Water-in Emulsion, Houghto-Safe 27, 620, 5040, Mobil Pyrogard D, Shell Irus 905, Ucon Hydrolube J-4. These seals are nitrile. Lipseal will have polymyte or P.T.F.E. back-up washer when required. O-rings will have nitrile back-up washers when required.

**Ethylene Propylene (E.P.R.) Seals (class 3)**

Class 3 seals are intended for use with some Phosphate Ester Fluids between the temperatures of -10°F (-23°C) to +130°F (+54°C). Typical fluids compatible with E.P.R. seals are Skydrol 500 and 700. E.P.R. are Ethylene Propylene. Lipseals will have a P.T.F.E. back-up washer when required. O-rings will have EPR back-up washers when required.

Note: E.P.R. seals are not compatible with mineral base hydraulic oil or greases. Even limited exposure to these fluids will cause severe swelling. P.T.F.E. back-up washer may not be suitable when used in a radiation environment.

**Low Temperature Nitrile Seals (class 4)**

Class 4 seals are intended for low temperature service with the same type of fluids as used with Class 1 seals within the temperature range of -50°F (-46°C) to +150°F (+66°C). Lipseals will have leather, polymyte or P.T.F.E. back-up washers when required. O-rings will have nitrile back-up washers when required. Note: Certain fluids may react adversely with Class 4 seals compared to Class 1 seals.

**Fluorocarbon Seals (class 5)**

Class 5 seals are intended for elevated temperature service or for some Phosphate Ester Fluids such as Houghto-Safe 1010, 1055, 1120; Fyrquel 150, 220, 300, 350; Mobile Pyrogard 42, 43, 53, and 55. Note: In addition, class 5 seals can be used with fluids listed below under standard service. However, they are not compatible with Phosphate Ester Fluids such as Skydrols. Class 5 seals can operate with a temperature range of -10°F (-23°C) to +250°F (+121°C). Class 5 seals may be operated to +400°F (+204°C) with limited service life. For temperatures above +250°F (+121°C) the cylinder must be manufactured with non-studded piston rod and thread and a pinned piston to rod connection. Class 5 Lipseals will have P.T.F.E. back-up washers when required. O-rings will have fluorocarbon back-up when required.

**H.W.C.F. Seals (class 6)**

Class 6 seals are intended for High Water Content Fluids (H.W.C.F.) such as Houghto Hydrolubric 120B and Sonsel Lubrizol within the temperature range of +40°F (+4°C) to +120°F (+49°C). Class 6 seals are special nitrile compound dynamic seals. Lipseals will have P.T.F.E. and or polymyte back-up washers when required. O-rings will have nitrile

back-up washers when required. Because of the viscosity of these fluids, cylinders specified with class 6 seals, will also be modified to have lipseal piston seals and straight cushions.

**Energized PTFE Seals (class 8)**

Class 8 seals consist of PTFE piston lipseals, rod seal and wiperseal. Piston seals have an internal stainless steel spring to energize both the static and dynamic sealing lips. They are intended for high temperature applications, to 400° F (204° C), where longer seal life and improved high temperature sealing performance is required. Minimum operating temperature is -15°F (-26°C). Body and gland o-ring seals will be fluorocarbon. Fluid resistance is comparable to Class 5.

**Warning** ⚠

The piston rod stud and the piston rod to piston threaded connections are secured with an anaerobic adhesive which is temperature sensitive. Cylinders are assembled with anaerobic adhesive having a maximum temperature rating of +250°F (+121°C). Cylinders specified with all other seal compounds (built before 1997) were assembled with anaerobic adhesive having a maximum operating temperature rating +165°F (+74°C). These temperature limitations are necessary to prevent the possible loosening of the threaded connections. Cylinders originally manufactured (before 1997) with class 1 seals (Nitrile) that will be exposed to ambient temperatures above +165°F (+74°C) must be modified for higher temperature service. Contact the factory immediately and arrange for the piston to rod and the stud to piston rod connections to be properly re-assembled to withstand the higher temperature service.

**Lipseal Pistons**

Under most conditions lipseals provide the best all around service for pneumatic applications. Lipseals with a back-up washer are often used for hydraulic applications when virtually zero static leakage is required. Lipseals will function properly in these applications when used in conjunction with moderate hydraulic pressures. A high load piston option is recommended when operating at high pressures and especially with large bore hydraulic cylinders.

**Water Service**

Series 3L cylinders can be modified to make them more suitable for use with water as the operating medium. The modifications include chrome-plated cylinder bore; electroless nickel-plated head, cap and piston; chrome-plated 17-4 stainless steel piston rod; chrome plated cushion sleeve or cushion spear.

Modified cylinders may also be used for higher operating pressures, up to 2000 psi, depending on bore size. See pressure rating for Hydraulic Cylinders on the next page. Series 3L hydraulic cylinders can also be modified for water operation and supplied with chrome-plated cylinder bore; electroless nickel-plated head, cap and piston; chrome-plated precipitation hardened stainless steel piston rod, chrome-plated cushion sleeve or cushion spear. When high water base fluids are the operating medium, hydraulic cylinders are usually supplied with high water base rod wiper and seals. Water and high water base fluid operated cylinders are best used on short stroke applications or where high pressure is applied only to clamp the load.

**Warranty**

Parker Hannifin will warrant cylinders modified for water or high water content fluid service to be free of defects in materials or workmanship, but cannot accept responsibility to premature failure due to excessive wear due to lack of lubricity or where failure is caused by corrosion, electrolysis or mineral deposits within the cylinder.

**Fluids and Temperature Range**

| Class Number   | Typical Fluids  | Temperature Range  |
|--|---|--|
| 1 (Standard)<br>(Nitrile Polyurethane)   | Air, Nitrogen<br>Hydraulic Oil, Mil-H-5606 Oil  | -10°F (-23°C) to<br>+165°F (+74°C)   |
| 2 Optional<br>Water Base Fluid Seal  | Water, Water-Glycol, H.W.C.F. — See Class 6<br>below. Water-in-Oil Emulsion Houghto-Safe, 271,<br>620, 5040. Mobil Pyrogard D, Shell Iruis 905.<br>Ucon Hydrolube J-4 | -10°F (-23°C) to<br>+165°F (+74°C)   |
| 3 Special (E.P.R.) (At extra cost)   | Some Phosphate Ester Fluids<br>Skydrol 500, 7000  | -10°F (-23°C) to<br>+130°F (+54°C)   |
| Note: (E.P.R.) seals are not compatible with Hydraulic Oil   |   |  |
| 4 Special (Nitrile) (At extra cost)  | Low Temperature Air or Hydraulic Oil  | -50°F (-46°C) to +150°F (+66°C)  |
| 5 Optional (At extra cost)<br>(Fluorocarbon Seals)   | High Temperature<br>Houghto-Safe 1010, 1055, 1120<br>Fyrquel 150, 220, 300, 550<br>Mobil Pyrogard 42,43,53,55   | See paragraph on Fluorocarbon<br>seals for recommended temperature<br>range. |
| Note: Fluorocarbon seals are not suitable for use with Skydrol fluid, but can be used with hydraulic oil if desired. |   |  |
| 6 Optional (HWCF) (At extra cost)  | Houghton, Hydrolubric 120B<br>Sonsol Lubrizol, for other HWCF — consult factory.  | +40°F (+4°C) to<br>+120°F (+49°C)  |
| 8 Optional (At extra cost) Energized PTFE  | See Class 5 Seals   | -15°F (-26°C) to<br>400°F (204°C)  |

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**Application Data**

The proper application of a fluid power cylinder requires consideration of the operating pressure, the fluid medium, the mounting style, the length of stroke, the type of piston rod connection to the load, thrust or

tension loading on the rod, mounting attitude, the speed of stroke, and how the load in motion will be stopped. Information given here provides pressure rating data for pneumatic and hydraulic cylinders.

**Pressure Ratings**

Pressure ratings for Series 3L hydraulic cylinders vary by bore size and rod size as shown in the table. For pressures

higher than those indicated, Series 2H heavy duty cylinders should be used.

**Series 3L Hydraulic Cylinders Maximum Pressure Rating**

| Bore Ø | Rod No. | Rod Ø | Pressure Rating At 4:1 Design <sup>1</sup> Factor (On Tensile) |
|--------|---------|-------|--|
| 1.00   | 1       | 0.500 | 1900   |
|        | 2       | 0.625 | 1900   |
| 1.50   | 1       | 0.625 | 2000   |
|        | 2       | 1.000 | 2300   |
| 2.00   | 1       | 0.625 | 1100   |
|        | 3       | 1.000 | 2000   |
|        | 2       | 1.375 | 2000   |
| 2.50   | 7       | 0.625 | 700  |
|        | 1       | 1.000 | 1400   |
|        | 3       | 1.375 | 1400   |
|        | 2       | 1.750 | 1400   |
| 3.25   | 1       | 1.000 | 1300   |
|        | 3       | 1.375 | 1300   |
|        | 4       | 1.750 | 1300   |
|        | 2       | 2.000 | 1300   |
| 4.00   | 7       | 1.000 | 900  |
|        | 1       | 1.375 | 900  |
|        | 3       | 1.750 | 900  |
|        | 4       | 2.000 | 900  |
|        | 2       | 2.500 | 900  |

| Bore Ø | Rod No. | Rod Ø | Pressure Rating At 4:1 Design <sup>1</sup> Factor (On Tensile) |
|--------|---------|-------|--|
| 5.00   | 7       | 1.000 | 600  |
|        | 8       | 1.375 | 950  |
|        | 1       | 1.750 | 950  |
|        | 3       | 2.000 | 950  |
|        | 4       | 2.500 | 950  |
|        | 5       | 3.000 | 950  |
|        | 2       | 3.500 | 950  |
| 6.00   | 7       | 1.375 | 700  |
|        | 1       | 1.750 | 700  |
|        | 3       | 2.000 | 700  |
|        | 4       | 2.500 | 700  |
|        | 5       | 3.000 | 700  |
|        | 6       | 3.500 | 700  |
|        | 2       | 4.000 | 700  |
| 8.00   | 7       | 1.375 | 400  |
|        | 8       | 1.750 | 650  |
|        | 1       | 2.000 | 650  |
|        | 3       | 2.500 | 650  |
|        | 4       | 3.000 | 650  |
|        | 5       | 3.500 | 650  |
|        | 6       | 4.000 | 650  |
|        | 9       | 4.500 | 650  |
|        | 0       | 5.000 | 650  |
|        | 2       | 5.500 | 650  |

<sup>1</sup> Applies to all mountings except J.



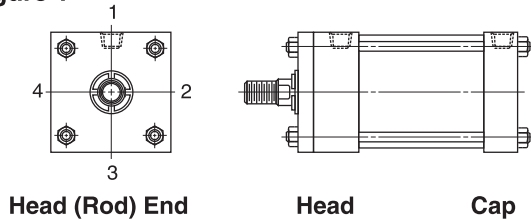
**Ports**

**Ports**

Series 3L cylinders can be supplied with S.A.E. straight O-ring ports or NPTF pipe thread ports. If specified on your order, extra ports can be provided on the sides of heads or caps that are not occupied by mountings or cushion valve.

Standard port location is position 1 as shown on line drawings in product catalog and Figure 1 below. Cushion adjustment needle and check valves are at positions 2 and 4 (or 3), depending on mounting style. Heads or caps which do not have an integral mounting can be rotated and assembled with ports at 90° or 180° from standard position. Mounting styles on which head or cap can be rotated at no extra charge are shown in Table A below. To order, specify by position number. In such assemblies the cushion adjustment needle and check valve rotate accordingly, since their relationship with port position does not change.

**Figure 1**



**Cylinder Port Options**

- Option "T" SAE Straight Thread O-Ring Port. Recommended for most hydraulic applications.
- Option "U" Conventional NPTF Ports (Dry-Seal Pipe Threads). Recommended for pneumatic applications only.
- Option "R" BSPP Port (British Parallel Thread). ISO 228 port commonly used in Europe.
- Option "B" BSPT (British Tapered Thread).
- Option "G" Metric Straight Thread Port similar to Option "R" with metric thread. Popular in some European applications.
- Option "Y" ISO-6149-1 Metric Straight Thread Port. Recommended for all hydraulic applications designed per ISO standards.

**Table A**

| Mounting Style                  | Port Position Available |              |
|---------------------------------|-------------------------|--------------|
|                                 | Head End                | Cap End      |
| T, TB, TC, TD, H, HB, J, JB, DD | 1, 2, 3 or 4            | 1, 2, 3 or 4 |
| BB, DB, SB                      | 1,2, 3 or 4             | 1 or 3       |
| D, JJ                           | 1 or 3                  | 1, 2, 3 or 4 |
| C, F                            | 1                       | 1            |

Ports can be supplied at positions other than those shown in Table A at an extra charge. To order, specify port position as shown in Figure 1.

**Available Ports for Series 3L Cylinders**

| Bore Ø | "T" SAE Straight Thread | "U" NPTF Pipe Thread | "R" BSPP Parallel Thread | "B" BSPT Taper Thread | "G" Metric Straight Thread | "Y" ISO-6149-1 Metric Straight Thread |
|--------|-------------------------|----------------------|--------------------------|-----------------------|----------------------------|---------------------------------------|
| 1.00   | #6                      | 1/4                  | 1/4                      | 1/4                   | M14 x 1.5                  | M14 x 1.5 <sup>1</sup>                |
| 1.50   | #6                      | 3/8                  | 3/8 <sup>2</sup>         | 3/8                   | M14 x 1.5                  | M14 x 1.5 <sup>1</sup>                |
| 2.00   | #6                      | 3/8                  | 3/8                      | 3/8                   | M14 x 1.5                  | M14 x 1.5                             |
| 2.50   | #6                      | 3/8                  | 3/8                      | 3/8                   | M14 x 1.5                  | M14 x 1.5                             |
| 3.25   | #10                     | 1/2                  | 1/2                      | 1/2                   | M22 x 1.5                  | M22 x 1.5                             |
| 4.00   | #10                     | 1/2                  | 1/2                      | 1/2                   | M22 x 1.5                  | M22 x 1.5                             |
| 5.00   | #10                     | 1/2                  | 1/2                      | 1/2                   | M22 x 1.5                  | M22 x 1.5                             |
| 6.00   | #12                     | 3/4                  | 3/4                      | 3/4                   | M26 x 1.5                  | M27 x 2                               |
| 8.00   | #12                     | 3/4                  | 3/4                      | 3/4                   | M26 x 1.5                  | M27 x 2                               |

<sup>1</sup> Not available on code 2 rods

<sup>2</sup> BSPP fitting thread length must not exceed 0.390" in head port for 1.50" bore with code 2 rod.

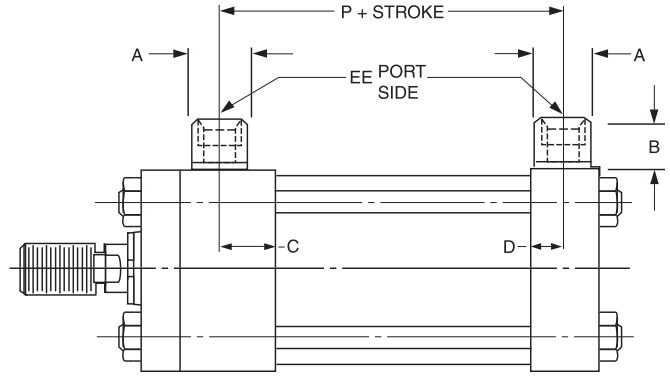


**Ports**

**Oversize Ports**

Oversize NPTF or SAE straight thread ports can be provided, at an extra charge. For ports one size larger than standard, welded port bosses which protrude from the side of the head or cap are supplied. For dimensions, see drawings and tables below. Series 3L cylinders equipped with cushions at the cylinder cap end can sustain damage to the cushion check valve (cushion bushing) if excessive oil flow enters the cylinder from the cap end port. Cylinders which are equipped with cap end cushions and ordered with one size oversize ports having hydraulic fluid flow exceeding 25 ft./sec. in the line entering the cap end of the cylinder should be ordered with a "solid cushion" at cap end. All cylinders ordered with double oversize ports should always be ordered with a "solid cushion" at cap end.

Cylinders which are connected to a meter out flow control with flow entering the cap end of a cylinder provided by an accumulator may also experience damage to the cushion bushing due to high instantaneous fluid flows. This condition can be eliminated by using a meter in flow control or "solid cushions" at cap end.



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**Oversize NPTF Port Boss Dimensions**

| Bore Ø | EE (NPTF) | A Ø  | B    | C    | D    | P    |
|--------|-----------|------|------|------|------|------|
| 1.00   | 3/8       | 0.88 | 0.75 | 0.56 | 0.50 | 2.06 |
| 1.50   | 1/2       | 1.13 | 0.94 | 0.56 | 0.50 | 2.19 |
| 2.00   | 1/2       | 1.13 | 0.94 | 0.56 | 0.50 | 2.19 |
| 2.50   | 1/2       | 1.13 | 0.94 | 0.56 | 0.50 | 2.31 |
| 3.25   | 3/4       | 1.38 | 1.00 | 0.69 | 0.63 | 2.56 |
| 4.00   | 3/4       | 1.38 | 1.00 | 0.69 | 0.63 | 2.56 |
| 5.00   | 3/4       | 1.38 | 1.00 | 0.69 | 0.63 | 2.81 |
| 6.00   | 1         | 1.75 | 1.19 | 0.94 | 0.75 | 3.19 |
| 8.00   | 1         | 1.75 | 1.19 | 0.94 | 0.75 | 3.31 |

**Oversize SAE Straight Thread Port Boss Dimensions**

| Bore Ø | EE (SAE)        | A Ø  | B    | C    | D    | P    |
|--------|-----------------|------|------|------|------|------|
| 1.00   | 8               | 1.13 | 0.94 | 0.56 | 0.50 | 2.06 |
| 1.50   | 8               | 1.13 | 0.94 | 0.56 | 0.50 | 2.19 |
| 2.00   | 8               | 1.13 | 0.94 | 0.56 | 0.50 | 2.19 |
| 2.50   | 8               | 1.13 | 0.94 | 0.56 | 0.50 | 2.31 |
| 3.25   | 12              | 1.38 | 1.00 | 0.69 | 0.63 | 2.56 |
| 4.00   | 12              | 1.38 | 1.00 | 0.69 | 0.63 | 2.56 |
| 5.00   | 12              | 1.38 | 1.00 | 0.69 | 0.63 | 2.81 |
| 6.00   | 16 <sup>1</sup> | 1.75 | 1.19 | 0.94 | 0.75 | 3.19 |
| 8.00   | 16 <sup>1</sup> | 1.75 | 1.19 | 0.94 | 0.75 | 3.31 |

<sup>1</sup> Available at head end only. For cap end, consult factory.

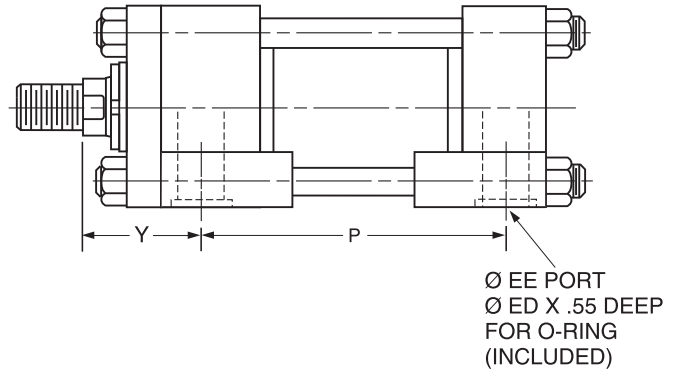


**Ports**

**Manifold Ports**

Side mounted cylinders, Style C can be furnished with the cylinder ports arranged for mounting and sealing to a manifold surface. The ports are drilled and counterbored for O-ring seals which are provided. With these specifications, the mounting is designated Style CM or KCM.

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**Dimensions —  
Manifold Ports for Single and Double Rod Cylinders**

| Bore Ø | Rod No. | Rod Ø | Y ±.031 | P ±.031 | EE   | ED   |
|--------|---------|-------|---------|---------|------|------|
| 1.00   | All     | All   | 1.94    | 2.13    | 0.38 | 0.69 |
| 1.50   | 1       | 0.625 | 2.00    | 2.13    | 0.50 | 0.81 |
|        | 2       | 1.000 | 2.38    |         |      |      |
| 2.00   | 1       | 0.625 | 2.00    | 2.13    | 0.50 | 0.81 |
|        | 2       | 1.375 | 2.63    |         |      |      |
|        | 3       | 1.000 | 2.38    |         |      |      |
| 2.50   | 1       | 1.000 | 2.38    | 2.25    | 0.50 | 0.81 |
|        | 2       | 1.750 | 2.88    |         |      |      |
|        | 3       | 1.375 | 2.63    |         |      |      |
| 3.25   | 1       | 1.000 | 2.44    | 2.63    | 0.63 | 0.94 |
|        | 2       | 2.000 | 3.06    |         |      |      |
|        | 3       | 1.375 | 2.69    |         |      |      |
|        | 4       | 1.750 | 2.94    |         |      |      |
| 4.00   | 1       | 1.375 | 2.69    | 2.63    | 0.63 | 0.94 |
|        | 2       | 2.500 | 3.31    |         |      |      |
|        | 3       | 1.750 | 2.94    |         |      |      |
|        | 4       | 2.000 | 3.06    |         |      |      |
|        | 7       | 1.000 | 2.44    |         |      |      |
| 5.00   | 1       | 1.750 | 2.94    | 2.88    | 0.63 | 0.94 |
|        | 2       | 3.500 | 3.31    |         |      |      |
|        | 3       | 2.000 | 3.06    |         |      |      |
|        | 4       | 2.500 | 3.31    |         |      |      |
|        | 5       | 3.000 | 3.31    |         |      |      |
|        | 7       | 1.000 | 2.44    |         |      |      |
|        | 8       | 1.375 | 2.69    |         |      |      |

| Bore Ø | Rod No. | Rod Ø | Y ±.031 | P ±.031 | EE   | ED   |
|--------|---------|-------|---------|---------|------|------|
| 6.00   | 1       | 1.750 | 3.06    | 3.13    | 0.88 | 1.19 |
|        | 2       | 4.000 | 3.44    |         |      |      |
|        | 3       | 2.000 | 3.19    |         |      |      |
|        | 4       | 2.500 | 3.44    |         |      |      |
|        | 5       | 3.000 | 3.44    |         |      |      |
|        | 6       | 3.500 | 3.44    |         |      |      |
|        | 7       | 1.375 | 2.81    |         |      |      |
| 8.00   | 1       | 2.000 | 3.19    | 3.25    | 0.88 | 1.19 |
|        | 2       | 5.500 | 3.44    |         |      |      |
|        | 3       | 2.500 | 3.44    |         |      |      |
|        | 4       | 3.000 | 3.44    |         |      |      |
|        | 5       | 3.500 | 3.44    |         |      |      |
|        | 6       | 4.000 | 3.44    |         |      |      |
|        | 7       | 1.375 | 2.81    |         |      |      |
|        | 8       | 1.750 | 3.06    |         |      |      |
|        | 9       | 4.500 | 3.44    |         |      |      |
|        | 0       | 5.000 | 3.44    |         |      |      |



**Stroke Data**

Parker cylinders are available in any practical stroke length. The following information should prove helpful to you in selecting the proper stroke for your cylinder application.

**Stroke Tolerances**

Stroke length tolerances are required due to buildup of tolerances of piston, head, cap and cylinder tube. Standard production of stroke tolerances run +.031" to

-.015" up to 20" stroke, +.031" to -.020" for 21" to 60" and +.031" to -.031" for greater than 60" stroke. For closer tolerances on stroke length, it is necessary to specify the required tolerance plus the pressure and temperature at which the cylinder will operate. Stroke tolerances smaller than .015" are not generally practical due to elasticity of cylinders. If machine design requires such close tolerances, use of a stroke adjuster may achieve the desire result.

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**Mounting Groups**

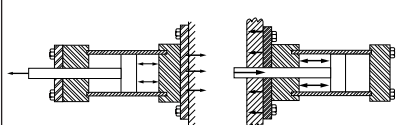
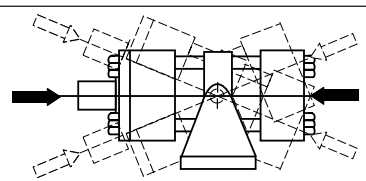
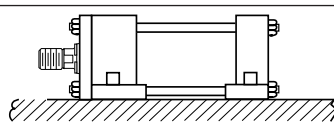
Standard mountings for fluid power cylinders fall into three basic groups. The groups can be summarized as follows:

**Group 1** Straight Line Force Transfer with fixed mounts which absorb force on cylinder centerline.

**Group 2** Pivot Force Transfer. Pivot mountings permit a cylinder to change its alignment in one plane.

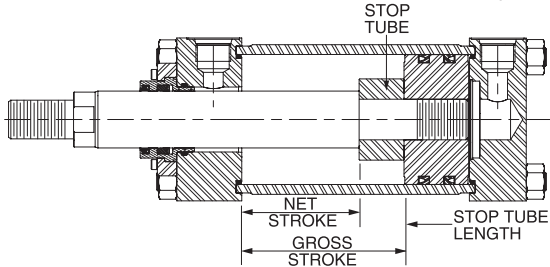
**Group 3** Straight Line Force Transfer with fixed mounts which do not absorb force on cylinder centerline.

Because a cylinder's mounting directly affects the maximum pressure at which the cylinder can be used, the chart below should be helpful in selection of the proper mounting combination for your application. Stroke length, piston rod connection to load, extra piston rod length over standard, etc., should be considered for thrust loads. Alloy steel mounting bolts are recommended for all mounting styles, and thrust keys are recommended for Styles C and F.

|  |  |
|--|--|
| <b>Group 1 FIXED MOUNTS</b> which absorb force on cylinder centerline.       |  |
| <p><b>Heavy-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p>  |  <p>Styles HB, TC<br/>Styles JB, JJ, TB</p>     |
| <p><b>Medium-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p> | <p>Styles H, HB<br/>Styles J, JB</p>   |
| <p><b>Light-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p>  | <p>Style H<br/>Style J</p>   |
| <b>Group 2 PIVOT MOUNTS</b> which absorb force on cylinder centerline.       |  |
| <p><b>Heavy-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p>  |  <p>Styles DD, D<br/>Styles BB, DD, D, DB</p> |
| <p><b>Medium-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p> | <p>Styles BB, SB<br/>Styles BB, SB</p>   |
| <b>Group 3 FIXED MOUNTS</b> which do not absorb force on the centerline.     |  |
| <p><b>Heavy-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p>  |  <p>Styles C, CP<br/>Styles C, CP</p>         |
| <p><b>Medium-Duty Service</b><br/>For Thrust Loads<br/>For Tension Loads</p> | <p>Styles F, FP<br/>Styles F, FP</p>   |

### Stop Tubing

Stop tube is recommended to lengthen the distance between the rod bearing and piston bearing to reduce bearing loads on long push stroke cylinders when the cylinder is fully extended. This is especially true of horizontally mounted cylinders. As part of the piston assembly and positioned between the piston and head, a stop tube restricts the extended position of the rod using the increased distance to achieve additional stability.



Use the following steps to determine the need for stop tube and, if required, how long it should be.

1. Examine the groups of cylinder illustrations below and determine which mounting and rod guiding group type match the required cylinder application.

2. Establish the Basic Length (L), with the piston rod fully extended, for the selected illustration by using the dimensional tables on previous pages of this catalog. For pivot mounted cylinders, the pin-to-pin dimension with the piston rod fully extended must be used. Regardless of mounting style, be sure to include any extended piston rod length beyond the catalog standard.
3. In the Stop Tube Table select the column for the appropriate mounting style and rod end guiding type. In the Basic Length (L) column, find the row with the range that includes the value calculated in Step 2. The next respective column to the right has the required length of stop tube.

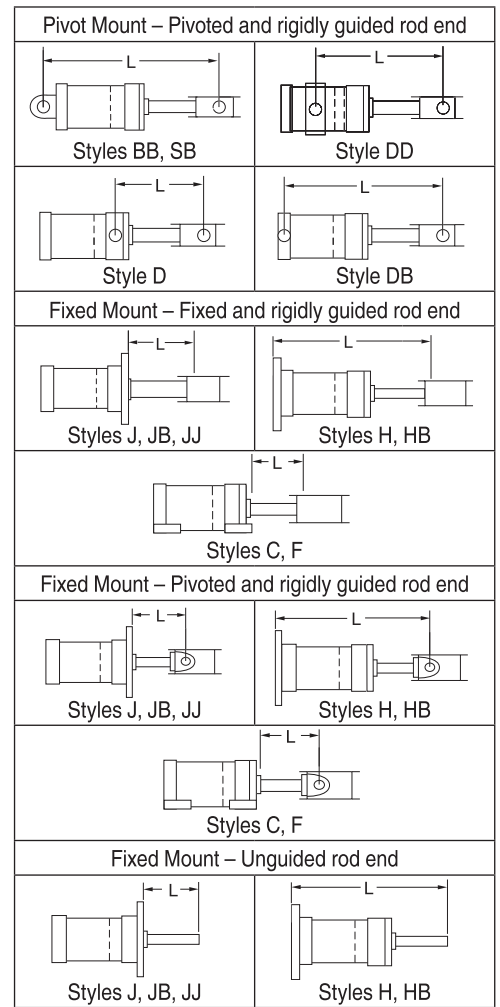
**Note:** Mounting Styles BB, DB, H, HB and SB that are mounted horizontally should also be checked for turning moments and loads between the rod bearing and piston to ensure they are not excessive. Weight of oil must be included in determining bearing loads.

When specifying cylinders with stop tube be sure to call out the net stroke and the length of the stop tube. Machine design can be continued without delay by laying in a cylinder equivalent in length to the NET STROKE PLUS STOP TUBE LENGTH, which is referred to as GROSS STROKE.

#### Stop Tube Length vs Basic Length (L)

| Pivot Mounts<br>(BB, D, DB,<br>DD and SB) |                  | Fixed Mounts<br>(C, F, H, HB, J, JB, JJ, TB, TC, TD) |                  |                                  |                  |                  |                  |
|---|------------------|--|------------------|----------------------------------|------------------|------------------|------------------|
| Pivoted and Rigidly Guided Rod End        |                  | Fixed & Rigidly Guided Rod End                       |                  | Pivoted & Rigidly Guided Rod End |                  | Unguided Rod End |                  |
| Basic Length (L)                          | Stop Tube Length | Basic Length (L)                                     | Stop Tube Length | Basic Length (L)                 | Stop Tube Length | Basic Length (L) | Stop Tube Length |
| 0 - 40                                    | 0                | 0 - 80   | 0                | 0 - 57                           | 0                | 0 - 20           | 0                |
| 41 - 50                                   | 1                | 81 - 100   | 1                | 58 - 71                          | 1                | 21 - 25          | 1                |
| 51 - 60                                   | 2                | 101 - 120  | 2                | 72 - 86                          | 2                | 26 - 30          | 2                |
| 61 - 70                                   | 3                | 121 - 140  | 3                | 87 - 100                         | 3                | 31 - 35          | 3                |
| 71 - 80                                   | 4                | 141 - 160  | 4                | 101 - 114                        | 4                | 36 - 40          | 4                |
| 81 - 90                                   | 5                | 161 - 180  | 5                | 115 - 129                        | 5                | 41 - 45          | 5                |
| 91 - 100                                  | 6                | 181 - 200  | 6                | 130 - 143                        | 6                | 46 - 50          | 6                |
| 101 - 110                                 | 7                | 201 - 220  | 7                | 144 - 157                        | 7                | 51 - 55          | 7                |
| 111 - 120                                 | 8                | 221 - 240  | 8                | 158 - 171                        | 8                | 56 - 60          | 8                |
| 121 - 130                                 | 9                | 241 - 260  | 9                | 172 - 186                        | 9                | 61 - 65          | 9                |
| 131 - 140                                 | 10               | 261 - 280  | 10               | 187 - 200                        | 10               | 66 - 70          | 10               |
| 141 - 150                                 | 11               | 281 - 300  | 11               | 201 - 214                        | 11               | 71 - 75          | 11               |
| 151 - 160                                 | 12               |  |                  | 215 - 229                        | 12               | 76 - 80          | 12               |
| 161 - 170                                 | 13               |  |                  | 230 - 243                        | 13               | 81 - 85          | 13               |
| 171 - 180                                 | 14               |  |                  | 244 - 257                        | 14               | 86 - 90          | 14               |
| 181 - 190                                 | 15               |  |                  | 258 - 271                        | 15               | 91 - 95          | 15               |
| 191 - 200                                 | 16               |  |                  | 272 - 286                        | 16               | 96 - 100         | 16               |
| 201 - 210                                 | 17               |  |                  | 287 - 300                        | 17               | 101 - 105        | 17               |
| 211 - 220                                 | 18               |  |                  |                                  |                  | 106 - 110        | 18               |
| 221 - 230                                 | 19               |  |                  |                                  |                  | 111 - 115        | 19               |
| 231 - 240                                 | 20               |  |                  |                                  |                  | 116 - 120        | 20               |
| 241 - 250                                 | 21               |  |                  |                                  |                  | 121 - 125        | 21               |
| 251 - 260                                 | 22               |  |                  |                                  |                  | 126 - 130        | 22               |
| 261 - 270                                 | 23               |  |                  |                                  |                  | 131 - 135        | 23               |
| 271 - 280                                 | 24               |  |                  |                                  |                  | 136 - 140        | 24               |
| 281 - 290                                 | 25               |  |                  |                                  |                  | 141 - 145        | 25               |
| 291 - 300                                 | 26               |  |                  |                                  |                  | 146 - 150        | 26               |
| Consult Factory                           |                  |  |                  |                                  |                  | Consult Factory  |                  |

#### Cylinder Mounting and Rod Guiding Groups



**Piston Rod Diameter Selection**

Long stroke cylinders that work on push with the piston rod loaded in compression should be checked, using the following steps, to ensure an appropriate piston rod diameter is specified.

1. First, determine whether stop tubing is required as described on the previous page.
2. Use the Basic Length (L) that was established for determining the stop tube length and then add the required stop tube length to the Basic Length to obtain an Adjusted Basic Length (L<sub>A</sub>).
3. In the table below, for the mounting style and rod end guiding condition that will be used, find the row for the Bore and Rod combination that is required.
4. Follow the Bore and Rod row to the right and find the Operating Pressure column that is closest, but exceeds the system pressure. Note that Operating Pressure column

values are different for bore size ranges 1.00 - 3.25 and 4.00 - 8.00. The intersection of the Bore and Rod row and Operating Pressure column displays the maximum allowable L<sub>A</sub>. If L<sub>A</sub> in the table is greater than or equal to the calculated L<sub>A</sub>, the rod diameter selected is satisfactory for the application.

5. If L<sub>A</sub> in the table is less than the calculated Adjusted Basic Length move down the column to a rod diameter with an L<sub>A</sub> that exceeds the requirement.
6. If the L<sub>A</sub> specifies a rod diameter in a larger bore then restart the process of sizing the stop tube and re-check the rod diameter. Contact the factory if L<sub>A</sub> exceeds 300 inches.

**Note:** Data in these tables assume standard rod extension (W dimension) and standard rod end accessories. If different, consult factory.

**Maximum Basic Lengths (L<sub>A</sub>) (all dimensions in inches)**

| Bore Ø | Rod Ø | Front and Side Fixed Mounts (J <sup>1</sup> , JB, JJ, TB, TD, C, F)                       |     |     |      |      |      |      |      |   |     |     |      |      |      |      |      |   |     |     |      |      |      |      |      |
|--------|-------|---|-----|-----|------|------|------|------|------|---|-----|-----|------|------|------|------|------|---|-----|-----|------|------|------|------|------|
|        |       | Fixed and Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      | Pivoted and Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      | Unguided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      |
|        |       | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 |
| 1.00   | 0.500 | 68  | 48  | 39  | 34   | 30   | 28   | 26   | 24   | 49  | 34  | 28  | 24   | 22   | 20   | 18   | 17   | 17  | 12  | 10  | 9    | 8    | 7    | 6    | 6    |
|        | 0.625 | 106   | 75  | 61  | 53   | 48   | 43   | 40   | 38   | 76  | 54  | 44  | 38   | 34   | 31   | 29   | 27   | 27  | 19  | 15  | 13   | 12   | 11   | 10   | 9    |
| 1.50   | 0.625 | 71  | 50  | 41  | 35   | 32   | 29   | 27   | 25   | 51  | 36  | 29  | 25   | 23   | 21   | 19   | 18   | 18  | 13  | 10  | 9    | 8    | 7    | 7    | 6    |
|        | 1.000 | 181   | 128 | 105 | 91   | 81   | 74   | 69   | 64   | 130   | 92  | 75  | 65   | 58   | 53   | 49   | 46   | 45  | 32  | 26  | 23   | 20   | 19   | 17   | 16   |
| 2.00   | 0.625 | 53  | 38  | 31  | 27   | -    | -    | -    | -    | 38  | 27  | 22  | 19   | -    | -    | -    | -    | 13  | 9   | 8   | 7    | -    | -    | -    | -    |
|        | 1.000 | 136   | 96  | 79  | 68   | 61   | 56   | 51   | 48   | 97  | 69  | 56  | 49   | 43   | 40   | 37   | 34   | 34  | 24  | 20  | 17   | 15   | 14   | 13   | 12   |
| 2.50   | 1.375 | 257   | 182 | 149 | 129  | 115  | 105  | 97   | 91   | 184   | 130 | 106 | 92   | 82   | 75   | 69   | 65   | 64  | 45  | 37  | 32   | 29   | 26   | 24   | 23   |
|        | 0.625 | 43  | 30  | 25  | -    | -    | -    | -    | -    | 30  | 21  | 18  | -    | -    | -    | -    | -    | 11  | 8   | 6   | -    | -    | -    | -    | -    |
|        | 1.000 | 109   | 77  | 63  | 54   | 49   | 44   | -    | -    | 78  | 55  | 45  | 39   | 35   | 32   | -    | -    | 27  | 19  | 16  | 14   | 12   | 11   | -    | -    |
|        | 1.375 | 206   | 146 | 119 | 103  | 92   | 84   | -    | -    | 147   | 104 | 85  | 73   | 66   | 60   | -    | -    | 51  | 36  | 30  | 26   | 23   | 21   | -    | -    |
| 3.25   | 1.750 | 300   | 236 | 192 | 167  | 149  | 136  | -    | -    | 238   | 168 | 137 | 119  | 106  | 97   | -    | -    | 83  | 59  | 48  | 42   | 37   | 34   | -    | -    |
|        | 1.000 | 84  | 59  | 48  | 42   | 37   | -    | -    | -    | 60  | 42  | 35  | 30   | 27   | -    | -    | -    | 21  | 15  | 12  | 10   | 9    | -    | -    | -    |
|        | 1.375 | 158   | 112 | 91  | 79   | 71   | -    | -    | -    | 113   | 80  | 65  | 57   | 51   | -    | -    | -    | 40  | 28  | 23  | 20   | 18   | -    | -    | -    |
|        | 1.750 | 256   | 181 | 148 | 128  | 115  | -    | -    | -    | 183   | 130 | 106 | 92   | 82   | -    | -    | -    | 64  | 45  | 37  | 32   | 29   | -    | -    | -    |
|        | 2.000 | 300   | 237 | 193 | 167  | 150  | -    | -    | -    | 239   | 169 | 138 | 120  | 107  | -    | -    | -    | 84  | 59  | 48  | 42   | 37   | -    | -    | -    |
| Bore Ø | Rod Ø | Max. Allowable Basic Length (L <sub>A</sub> ) at psi:                                     |     |     |      |      |      |      |      | Max. Allowable Basic Length (L <sub>A</sub> ) at psi:                                       |     |     |      |      |      |      |      | Max. Allowable Basic Length (L <sub>A</sub> ) at psi:                     |     |     |      |      |      |      |      |
|        |       | 125   | 250 | 375 | 500  | 625  | 750  | 875  | 1000 | 125   | 250 | 375 | 500  | 625  | 750  | 875  | 1000 | 125   | 250 | 375 | 500  | 625  | 750  | 875  | 1000 |
| 4.00   | 1.000 | 96  | 68  | 56  | 48   | 43   | 39   | 36   | 34   | 69  | 49  | 40  | 34   | 31   | 28   | 26   | 24   | 24  | 17  | 14  | 12   | 11   | 10   | 9    | 9    |
|        | 1.375 | 182   | 129 | 105 | 91   | 81   | 74   | 69   | 64   | 130   | 92  | 75  | 65   | 58   | 53   | 49   | 46   | 45  | 32  | 26  | 23   | 20   | 19   | 17   | 16   |
|        | 1.750 | 295   | 208 | 170 | 147  | 132  | 120  | 111  | 104  | 210   | 149 | 122 | 105  | 94   | 86   | 80   | 74   | 74  | 52  | 43  | 37   | 33   | 30   | 28   | 26   |
|        | 2.000 | 300   | 272 | 222 | 192  | 172  | 157  | 145  | 136  | 275   | 194 | 159 | 137  | 123  | 112  | 104  | 97   | 96  | 68  | 56  | 48   | 43   | 39   | 36   | 34   |
|        | 2.500 | 300   | 300 | 300 | 300  | 269  | 245  | 227  | 213  | 300   | 300 | 248 | 215  | 192  | 175  | 162  | 152  | 150   | 106 | 87  | 75   | 67   | 61   | 57   | 53   |
| 5.00   | 1.000 | 77  | 54  | 44  | 38   | 34   | -    | -    | -    | 55  | 39  | 32  | 27   | 25   | -    | -    | -    | 19  | 14  | 11  | 10   | 9    | -    | -    | -    |
|        | 1.375 | 146   | 103 | 84  | 73   | 65   | 59   | 55   | 51   | 104   | 73  | 60  | 52   | 46   | 42   | 39   | 37   | 36  | 26  | 21  | 18   | 16   | 15   | 14   | 13   |
|        | 1.750 | 236   | 167 | 136 | 118  | 105  | 96   | 89   | 83   | 168   | 119 | 97  | 84   | 75   | 69   | 64   | 60   | 59  | 42  | 34  | 29   | 26   | 24   | 22   | 21   |
|        | 2.000 | 300   | 218 | 178 | 154  | 138  | 126  | 116  | 109  | 220   | 155 | 127 | 110  | 98   | 90   | 83   | 78   | 77  | 54  | 44  | 38   | 34   | 31   | 29   | 27   |
|        | 2.500 | 300   | 300 | 278 | 241  | 215  | 196  | 182  | 170  | 300   | 243 | 198 | 172  | 154  | 140  | 130  | 121  | 120   | 85  | 69  | 60   | 54   | 49   | 45   | 43   |
|        | 3.000 | 300   | 300 | 300 | 300  | 300  | 283  | 262  | 245  | 300   | 300 | 286 | 247  | 221  | 202  | 187  | 175  | 173   | 122 | 100 | 87   | 77   | 71   | 65   | 61   |
| 6.00   | 3.500 | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 300 | 300 | 300  | 300  | 275  | 255  | 238  | 236   | 167 | 136 | 118  | 105  | 96   | 89   | 83   |
|        | 1.375 | 121   | 86  | 70  | 61   | 54   | 50   | -    | -    | 87  | 61  | 50  | 43   | 39   | 35   | -    | -    | 30  | 21  | 18  | 15   | 14   | 12   | -    | -    |
|        | 1.750 | 196   | 139 | 113 | 98   | 88   | 80   | -    | -    | 140   | 99  | 81  | 70   | 63   | 57   | -    | -    | 49  | 35  | 28  | 25   | 22   | 20   | -    | -    |
|        | 2.000 | 257   | 181 | 148 | 128  | 115  | 105  | -    | -    | 183   | 130 | 106 | 92   | 82   | 75   | -    | -    | 64  | 45  | 37  | 32   | 29   | 26   | -    | -    |
|        | 2.500 | 300   | 283 | 231 | 200  | 179  | 164  | -    | -    | 286   | 202 | 165 | 143  | 128  | 117  | -    | -    | 100   | 71  | 58  | 50   | 45   | 41   | -    | -    |
|        | 3.000 | 300   | 300 | 300 | 289  | 258  | 236  | -    | -    | 300   | 292 | 238 | 206  | 184  | 168  | -    | -    | 144   | 102 | 83  | 72   | 65   | 59   | -    | -    |
| 8.00   | 3.500 | 300   | 300 | 300 | 300  | 300  | 300  | -    | -    | 300   | 300 | 300 | 281  | 251  | 229  | -    | -    | 196   | 139 | 113 | 98   | 88   | 80   | -    | -    |
|        | 4.000 | 300   | 300 | 300 | 300  | 300  | 300  | -    | -    | 300   | 300 | 300 | 300  | 300  | 299  | -    | -    | 257   | 181 | 148 | 128  | 115  | 105  | -    | -    |
|        | 1.375 | 91  | 64  | 53  | -    | -    | -    | -    | -    | 65  | 46  | 38  | -    | -    | -    | -    | -    | 23  | 16  | 13  | -    | -    | -    | -    | -    |
|        | 1.750 | 147   | 104 | 85  | 74   | 66   | -    | -    | -    | 105   | 74  | 61  | 53   | 47   | -    | -    | -    | 37  | 26  | 21  | 18   | 16   | -    | -    | -    |
|        | 2.000 | 192   | 136 | 111 | 96   | 86   | -    | -    | -    | 137   | 97  | 79  | 69   | 61   | -    | -    | -    | 48  | 34  | 28  | 24   | 22   | -    | -    | -    |
|        | 2.500 | 300   | 213 | 174 | 150  | 134  | -    | -    | -    | 215   | 152 | 124 | 107  | 96   | -    | -    | -    | 75  | 53  | 43  | 38   | 34   | -    | -    | -    |
|        | 3.000 | 300   | 300 | 300 | 250  | 216  | 194  | -    | -    | 300   | 219 | 179 | 155  | 138  | -    | -    | -    | 108   | 77  | 62  | 54   | 48   | -    | -    | -    |
|        | 3.500 | 300   | 300 | 300 | 295  | 264  | -    | -    | -    | 300   | 298 | 243 | 210  | 188  | -    | -    | -    | 147   | 104 | 85  | 74   | 66   | -    | -    | -    |
|        | 4.000 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 275  | 246  | -    | -    | -    | 192   | 136 | 111 | 96   | 86   | -    | -    | -    |
|        | 4.500 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 244   | 172 | 141 | 122  | 109  | -    | -    | -    |
| 5.000  | 300   | 300   | 300 | 300 | 300  | -    | -    | -    | 300  | 300   | 300 | 300 | 300  | -    | -    | -    | 300  | 213   | 174 | 150 | 134  | -    | -    | -    |      |
| 5.500  | 300   | 300   | 300 | 300 | 300  | -    | -    | -    | 300  | 300   | 300 | 300 | 300  | -    | -    | -    | 300  | 257   | 210 | 182 | 163  | -    | -    | -    |      |

<sup>1</sup> Maximum operating pressure is limited for Mounting Style J. Please refer to maximum operating pressure per bore in Pressure Ratings table located on the dimension page for Mounting Style J.



Piston Rod Selection Data

Maximum Basic Lengths (L<sub>A</sub>) (all dimensions in inches)

| Bore Ø | Rod Ø | Rear Fixed Mounts (H, HB, TC)   |     |     |      |      |      |      |      |   |     |     |      |      |      |      |      |   |     |     |      |      |      |      |      |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|--------|-------|---|-----|-----|------|------|------|------|------|---|-----|-----|------|------|------|------|------|---|-----|-----|------|------|------|------|------|-----|-----|----|----|----|----|---|---|---|---|---|---|---|---|---|
|        |       | Fixed and Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      | Pivoted and Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      | Unguided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        |       | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 1.00   | 0.500 | 94  | 66  | 54  | 47   | 42   | 38   | 36   | 33   | 67  | 47  | 39  | 34   | 30   | 27   | 25   | 24   | 23  | 17  | 14  | 12   | 11   | 10   | 9    | 8    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 0.625 | 142   | 101 | 82  | 71   | 64   | 58   | 54   | 50   | 102   | 72  | 59  | 51   | 45   | 42   | 38   | 36   | 36  | 25  | 21  | 18   | 16   | 15   | 13   | 13   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.000 | 230   | 162 | 133 | 115  | 103  | 94   | 87   | 81   | 164   | 116 | 95  | 82   | 73   | 67   | 62   | 58   | 57  | 41  | 33  | 29   | 26   | 23   | 22   | 20   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 1.50   | 0.625 | 74  | 53  | 43  | 37   | -    | -    | -    | -    | 53  | 38  | 31  | 27   | -    | -    | -    | -    | 19  | 13  | 11  | 9    | -    | -    | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.000 | 182   | 129 | 105 | 91   | 82   | 74   | 69   | 65   | 130   | 92  | 75  | 65   | 58   | 53   | 49   | 46   | 46  | 32  | 26  | 23   | 20   | 19   | 17   | 16   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.375 | 300   | 218 | 178 | 154  | 138  | 126  | 116  | 109  | 220   | 155 | 127 | 110  | 98   | 90   | 83   | 78   | 77  | 54  | 44  | 38   | 34   | 31   | 29   | 27   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 2.00   | 0.625 | 60  | 42  | 35  | -    | -    | -    | -    | -    | 43  | 30  | 25  | -    | -    | -    | -    | -    | 15  | 11  | 9   | -    | -    | -    | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.000 | 149   | 106 | 86  | 75   | 67   | 61   | -    | -    | 107   | 75  | 62  | 53   | 48   | 44   | -    | -    | 37  | 26  | 22  | 19   | 17   | 15   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.375 | 264   | 187 | 153 | 132  | 118  | 108  | -    | -    | 189   | 134 | 109 | 94   | 84   | 77   | -    | -    | 66  | 47  | 38  | 33   | 30   | 27   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 2.50   | 1.000 | 300   | 268 | 219 | 189  | 169  | 155  | -    | -    | 270   | 191 | 156 | 135  | 121  | 110  | -    | -    | 95  | 67  | 55  | 47   | 42   | 39   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.375 | 417   | 311 | 251 | 211  | 185  | 168  | -    | -    | 300   | 221 | 176 | 149  | 131  | 120  | -    | -    | 100   | 71  | 58  | 50   | 45   | 41   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 2.000 | 300   | 279 | 228 | 197  | 176  | 161  | -    | -    | 282   | 199 | 163 | 141  | 126  | 115  | -    | -    | 99  | 70  | 57  | 49   | 44   | 40   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 3.25   | 1.000 | 117   | 83  | 67  | 58   | 52   | 48   | -    | -    | 83  | 59  | 48  | 42   | 37   | 34   | -    | -    | 29  | 21  | 17  | 15   | 13   | 12   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.375 | 213   | 151 | 123 | 107  | 95   | 87   | -    | -    | 152   | 108 | 88  | 76   | 68   | 62   | -    | -    | 53  | 38  | 31  | 27   | 24   | 22   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.750 | 300   | 228 | 186 | 161  | 144  | 132  | -    | -    | 231   | 163 | 133 | 115  | 103  | 94   | -    | -    | 81  | 57  | 47  | 40   | 36   | 33   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 4.00   | 2.000 | 300   | 279 | 228 | 197  | 176  | 161  | -    | -    | 282   | 199 | 163 | 141  | 126  | 115  | -    | -    | 99  | 70  | 57  | 49   | 44   | 40   | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 2.500 | 300   | 300 | 300 | 300  | 300  | 285  | 264  | 247  | 300   | 300 | 288 | 249  | 223  | 204  | 188  | 176  | 174   | 123 | 101 | 87   | 78   | 71   | 66   | 62   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 3.000 | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 277 | 256 | 240  | 237  | 168  | 137  | 119  | 106 | 97  | 90 | 84 |    |    |   |   |   |   |   |   |   |   |   |
| 5.00   | 1.000 | 108   | 77  | 63  | 54   | 48   | -    | -    | -    | 77  | 55  | 45  | 39   | 35   | -    | -    | -    | 27  | 19  | 16  | 14   | 12   | -    | -    | -    |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.375 | 203   | 144 | 117 | 102  | 91   | 83   | 77   | 72   | 145   | 103 | 84  | 73   | 65   | 59   | 55   | 51   | 51  | 36  | 29  | 25   | 23   | 21   | 19   | 18   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 1.750 | 300   | 229 | 187 | 162  | 145  | 132  | 122  | 114  | 231   | 163 | 133 | 115  | 103  | 94   | 87   | 82   | 81  | 57  | 47  | 40   | 36   | 33   | 31   | 29   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
| 6.00   | 2.000 | 300   | 293 | 239 | 207  | 185  | 169  | 157  | 146  | 296   | 209 | 171 | 148  | 132  | 121  | 112  | 105  | 104   | 73  | 60  | 52   | 46   | 42   | 39   | 37   |     |     |    |    |    |    |   |   |   |   |   |   |   |   |   |
|        | 2.500 | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 283 | 253 | 231  | 214  | 200  | 198  | 140  | 114 | 99  | 89 | 81 | 75 | 70 |   |   |   |   |   |   |   |   |   |
|        | 3.500 | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 277 | 256 | 240  | 237  | 168  | 137  | 119  | 106 | 97  | 90 | 84 | -  | -  |   |   |   |   |   |   |   |   |   |
| 8.00   | 1.375 | 170   | 120 | 98  | 85   | 76   | 70   | -    | -    | 122   | 86  | 70  | 61   | 54   | 50   | -    | -    | 43  | 30  | 25  | 21   | 19   | 17   | -    | -    | -   | -   | -  | -  | -  |    |   |   |   |   |   |   |   |   |   |
|        | 1.750 | 274   | 193 | 158 | 137  | 122  | 112  | -    | -    | 195   | 138 | 113 | 98   | 87   | 80   | -    | -    | 68  | 48  | 39  | 34   | 31   | 28   | -    | -    | -   | -   | -  | -  | -  | -  |   |   |   |   |   |   |   |   |   |
|        | 2.000 | 300   | 250 | 204 | 177  | 158  | 144  | -    | -    | 253   | 179 | 146 | 126  | 113  | 103  | -    | -    | 88  | 63  | 51  | 44   | 40   | 36   | -    | -    | -   | -   | -  | -  | -  | -  | - |   |   |   |   |   |   |   |   |
| 8.00   | 2.500 | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 294 | 268 | -    | -    | 230  | 163  | 133  | 115 | 103 | 94 | -  | -  | -  | - | - |   |   |   |   |   |   |   |
|        | 3.000 | 300   | 300 | 300 | 300  | 300  | 298  | -    | -    | 300   | 300 | 300 | 261  | 233  | 213  | -    | -    | 183   | 129 | 105 | 91   | 82   | 75   | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - |   |   |   |   |   |   |
|        | 3.500 | 300   | 300 | 300 | 300  | 300  | 300  | -    | -    | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 294 | 268 | -    | -    | 230  | 163  | 133  | 115 | 103 | 94 | -  | -  | -  | - | - | - | - |   |   |   |   |   |
| 8.00   | 4.000 | 300   | 300 | 300 | 300  | 300  | 300  | -    | -    | 300   | 300 | 300 | 300  | 300  | 300  | 300  | 300  | 300   | 294 | 268 | -    | -    | 230  | 163  | 133  | 115 | 103 | 94 | -  | -  | -  | - | - | - | - |   |   |   |   |   |
|        | 1.375 | 128   | 91  | 74  | -    | -    | -    | -    | -    | 92  | 65  | 53  | -    | -    | -    | -    | -    | 32  | 23  | 19  | -    | -    | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - |   |   |   |   |   |
|        | 1.750 | 207   | 146 | 120 | 104  | 93   | -    | -    | -    | 148   | 105 | 85  | 74   | 66   | -    | -    | -    | 52  | 37  | 30  | 26   | 23   | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - |   |   |   |   |
| 8.00   | 2.000 | 270   | 191 | 156 | 135  | 121  | -    | -    | -    | 193   | 136 | 111 | 96   | 86   | -    | -    | -    | 67  | 48  | 39  | 34   | 30   | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - |   |   |   |   |
|        | 2.500 | 300   | 294 | 240 | 208  | 186  | -    | -    | -    | 297   | 210 | 172 | 149  | 133  | -    | -    | -    | 104   | 74  | 60  | 52   | 47   | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - |   |   |   |
|        | 3.000 | 300   | 300 | 300 | 300  | 294  | 263  | -    | -    | 300   | 296 | 242 | 210  | 188  | -    | -    | -    | 147   | 104 | 85  | 73   | 66   | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - |   |   |
| 8.00   | 3.500 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 276  | 247  | -    | -    | -    | 193   | 137 | 112 | 97   | 86   | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - |   |   |
|        | 4.000 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 241   | 171 | 139 | 121  | 108  | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - | - |   |
|        | 4.500 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 287   | 203 | 166 | 144  | 129  | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - | - |   |
| 8.00   | 5.000 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 233 | 190 | 165  | 147  | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - | - |   |
|        | 5.500 | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 300 | 300 | 300  | 300  | -    | -    | -    | 300   | 259 | 212 | 183  | 164  | -    | -    | -    | -   | -   | -  | -  | -  | -  | - | - | - | - | - | - | - | - | - |

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D



**Piston Rod Selection Data**

**Maximum Basic Lengths (L<sub>A</sub>) (all dimensions in inches)**

| Bore Ø | Rod Ø | Rear Pivot Mounts (BB, SB <sup>1</sup> , DB)  |     |     |      |      |      |      |      | Front and Intermediate Pivot Mounts (D, DD)   |     |     |      |      |      |      |      |
|--------|-------|---|-----|-----|------|------|------|------|------|---|-----|-----|------|------|------|------|------|
|        |       | Pivoted & Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      | Pivoted & Rigidly Guided Rod End<br>Max. Allowable Basic Length (L <sub>A</sub> ) at psi: |     |     |      |      |      |      |      |
|        |       | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 | 250   | 500 | 750 | 1000 | 1250 | 1500 | 1750 | 2000 |
| 1.00   | 0.500 | 47  | 33  | 27  | 23   | 21   | 19   | 18   | 17   | 34  | 24  | 20  | 17   | 15   | 14   | 13   | 12   |
|        | 0.625 | 71  | 50  | 41  | 36   | 32   | 29   | 27   | 25   | 53  | 38  | 31  | 27   | 24   | 22   | 20   | 19   |
| 1.50   | 0.625 | 49  | 35  | 28  | 25   | 22   | 20   | 19   | 17   | 35  | 25  | 20  | 18   | 16   | 14   | 13   | 13   |
|        | 1.000 | 115   | 81  | 66  | 57   | 51   | 47   | 43   | 41   | 91  | 64  | 52  | 45   | 41   | 37   | 34   | 32   |
| 2.00   | 0.625 | 37  | 26  | 21  | 19   | -    | -    | -    | -    | 27  | 19  | 15  | 13   | -    | -    | -    | -    |
|        | 1.000 | 91  | 65  | 53  | 46   | 41   | 37   | 34   | 32   | 68  | 48  | 39  | 34   | 30   | 28   | 26   | 24   |
|        | 1.375 | 154   | 109 | 89  | 77   | 69   | 63   | 58   | 54   | 129   | 91  | 74  | 64   | 58   | 53   | 49   | 45   |
| 2.50   | 0.625 | 30  | 21  | 17  | -    | -    | -    | -    | -    | 21  | 15  | 12  | -    | -    | -    | -    | -    |
|        | 1.000 | 75  | 53  | 43  | 37   | 33   | 31   | -    | -    | 54  | 38  | 31  | 27   | 24   | 22   | -    | -    |
|        | 1.375 | 132   | 93  | 76  | 66   | 59   | 54   | -    | -    | 103   | 73  | 59  | 51   | 46   | 42   | -    | -    |
|        | 1.750 | 189   | 134 | 109 | 95   | 85   | 77   | -    | -    | 167   | 118 | 96  | 83   | 75   | 68   | -    | -    |
| 3.25   | 1.000 | 58  | 41  | 34  | 29   | 26   | 24   | -    | -    | 42  | 30  | 24  | 21   | 19   | 17   | -    | -    |
|        | 1.375 | 107   | 75  | 62  | 53   | 48   | 44   | -    | -    | 79  | 56  | 46  | 40   | 35   | 32   | -    | -    |
|        | 1.750 | 161   | 114 | 93  | 81   | 72   | 66   | -    | -    | 128   | 91  | 74  | 64   | 57   | 52   | -    | -    |
|        | 2.000 | 197   | 139 | 114 | 99   | 88   | 80   | -    | -    | 167   | 118 | 97  | 84   | 75   | 68   | -    | -    |
| Bore Ø | Rod Ø | Max. Allowable Basic Length (L <sub>A</sub> ) at psi:                                     |     |     |      |      |      |      |      | Max. Allowable Basic Length (L <sub>A</sub> ) at psi:                                     |     |     |      |      |      |      |      |
|        |       | 125   | 250 | 375 | 500  | 625  | 750  | 875  | 1000 | 125   | 250 | 375 | 500  | 625  | 750  | 875  | 1000 |
| 4.00   | 1.000 | 68  | 48  | 39  | 34   | 30   | 28   | 26   | 24   | 48  | 34  | 28  | 24   | 22   | 20   | 18   | 17   |
|        | 1.375 | 126   | 89  | 73  | 63   | 56   | 51   | 48   | 44   | 91  | 64  | 53  | 45   | 41   | 37   | 34   | 32   |
|        | 1.750 | 197   | 139 | 114 | 99   | 88   | 80   | 74   | 70   | 147   | 104 | 85  | 74   | 66   | 60   | 56   | 52   |
|        | 2.000 | 248   | 176 | 143 | 124  | 111  | 101  | 94   | 88   | 192   | 136 | 111 | 96   | 86   | 79   | 73   | 68   |
|        | 2.500 | 300   | 247 | 201 | 174  | 156  | 142  | 132  | 123  | 300   | 213 | 174 | 150  | 134  | 123  | 114  | 106  |
| 5.00   | 1.000 | 54  | 38  | 31  | 27   | 24   | -    | -    | -    | 38  | 27  | 22  | 19   | 17   | -    | -    | -    |
|        | 1.375 | 102   | 72  | 59  | 51   | 45   | 41   | 38   | 36   | 73  | 51  | 42  | 36   | 33   | 30   | 27   | 26   |
|        | 1.750 | 162   | 114 | 93  | 81   | 72   | 66   | 61   | 57   | 118   | 83  | 68  | 59   | 53   | 48   | 45   | 42   |
|        | 2.000 | 207   | 146 | 120 | 104  | 93   | 85   | 78   | 73   | 154   | 109 | 89  | 77   | 69   | 63   | 58   | 54   |
|        | 2.500 | 300   | 215 | 175 | 152  | 136  | 124  | 115  | 107  | 241   | 170 | 139 | 120  | 108  | 98   | 91   | 85   |
|        | 3.000 | 300   | 280 | 229 | 198  | 177  | 162  | 150  | 140  | 300   | 245 | 200 | 173  | 155  | 141  | 131  | 122  |
| 6.00   | 3.500 | 300   | 300 | 274 | 237  | 212  | 194  | 179  | 168  | 300   | 300 | 272 | 236  | 211  | 192  | 178  | 167  |
|        | 1.375 | 85  | 60  | 49  | 43   | 38   | 35   | -    | -    | 61  | 43  | 35  | 30   | 27   | 25   | -    | -    |
|        | 1.750 | 137   | 97  | 79  | 68   | 61   | 56   | -    | -    | 98  | 69  | 57  | 49   | 44   | 40   | -    | -    |
|        | 2.000 | 177   | 125 | 102 | 88   | 79   | 72   | -    | -    | 128   | 91  | 74  | 64   | 57   | 52   | -    | -    |
|        | 2.500 | 268   | 189 | 155 | 134  | 120  | 109  | -    | -    | 200   | 142 | 116 | 100  | 90   | 82   | -    | -    |
|        | 3.000 | 300   | 258 | 211 | 183  | 163  | 149  | -    | -    | 289   | 204 | 167 | 144  | 129  | 118  | -    | -    |
|        | 3.500 | 300   | 300 | 266 | 230  | 206  | 188  | -    | -    | 300   | 278 | 227 | 196  | 176  | 160  | -    | -    |
| 8.00   | 4.000 | 300   | 300 | 300 | 272  | 243  | 222  | -    | -    | 300   | 300 | 296 | 257  | 229  | 209  | -    | -    |
|        | 1.375 | 64  | 45  | 37  | -    | -    | -    | -    | -    | 45  | 32  | 26  | -    | -    | -    | -    | -    |
|        | 1.750 | 104   | 73  | 60  | 52   | 46   | -    | -    | -    | 74  | 52  | 43  | 37   | 33   | -    | -    | -    |
|        | 2.000 | 135   | 95  | 78  | 67   | 60   | -    | -    | -    | 96  | 68  | 56  | 48   | 43   | -    | -    | -    |
|        | 2.500 | 208   | 147 | 120 | 104  | 93   | -    | -    | -    | 150   | 106 | 87  | 75   | 67   | -    | -    | -    |
|        | 3.000 | 294   | 208 | 169 | 147  | 131  | -    | -    | -    | 216   | 153 | 125 | 108  | 97   | -    | -    | -    |
|        | 3.500 | 300   | 273 | 223 | 193  | 173  | -    | -    | -    | 295   | 208 | 170 | 147  | 132  | -    | -    | -    |
|        | 4.000 | 300   | 300 | 278 | 241  | 216  | -    | -    | -    | 300   | 272 | 222 | 192  | 172  | -    | -    | -    |
|        | 4.500 | 300   | 300 | 300 | 287  | 257  | -    | -    | -    | 300   | 300 | 281 | 244  | 218  | -    | -    | -    |
|        | 5.000 | 300   | 300 | 300 | 300  | 295  | -    | -    | -    | 300   | 300 | 300 | 300  | 269  | -    | -    | -    |
| 5.500  | 300   | 300   | 300 | 300 | 300  | -    | -    | -    | 300  | 300   | 300 | 300 | 300  | -    | -    | -    |      |

<sup>1</sup> Maximum operating pressure is limited for Mounting Style SB. Please refer to maximum operating pressure per bore in Pressure Ratings table located on the dimension page for Mounting Styles SB.

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**Application and Design Data**

The spherical bearing life is influenced by many factors, i.e., bearing pressure, load direction oscillating angle and lubrication. The maximum operating pressure ratings of the spherical bearing mountings are based on standard commercial bearing ratings. The 4:1 design factor rating is based on the tensile strength of the material.

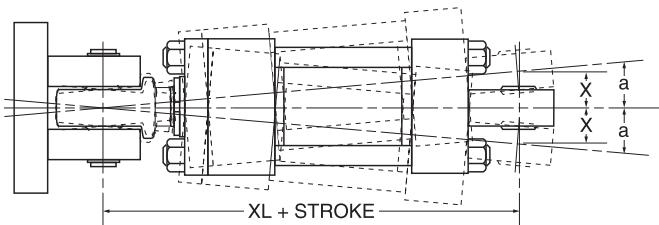
The spherical bearings are dimensioned to ensure a satisfactory bearing life under normal operating conditions. The bearing races are made of through-hardened steel and are precision ground. They are phosphate treated and coated with dry film lubricant to minimize friction of contacting surfaces. In the case of a permanent unidirectional load to the bearing, or other unusual operating conditions, the use of a larger bearing may be required.

For longer bearing life, regular lubrication will protect the spherical plain bearing from premature wear and corrosion. Rust-inhibiting EP greases of lithium base, preferably with molybdenum disulphide additives are particularly suited. The radial bearings have lubricating holes and grooves in the races permitting lubrication. The bearing housings at the cap and rod end are provided with grease fittings for lubrication.

Maximum angle of swivel in relation to the center line of the pivot pin is shown as angle *a* in the table below. It is recommended that this angle is not exceeded when mounting the cylinder.

**Mounting Information**

**Head End Mounting**

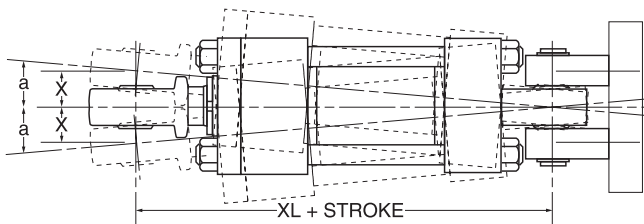


Recommended maximum swivel angle on each side of the cylinder centerline.

**Table 1**

| Bore Ø | Head End Mounted |           | Cap End Mounted |           |
|--------|------------------|-----------|-----------------|-----------|
|        | Angle a          | Tan. of a | Angle a         | Tan. of a |
| 1.50   | 2.50°            | 0.035     | 2.50°           | 0.035     |
| 2.00   | 2.50°            | 0.044     | 4.50°           | 0.079     |
| 2.50   | 2.50°            | 0.044     | 4.50°           | 0.079     |
| 3.25   | 3.50°            | 0.052     | 3.50°           | 0.052     |
| 4.00   | 2.50°            | 0.044     | 3.50°           | 0.052     |
| 5.00   | 3.50°            | 0.052     | 3.50°           | 0.052     |
| 6.00   | 3.50°            | 0.052     | 3.50°           | 0.052     |
| 8.00   | 3.50°            | 0.052     | 3.50°           | 0.052     |

**Cap End Mounting**



Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply distance between pivot pin holes by tangent of angle *a*. For extended position use  $X = XL + 2X$  stroke.

**Cushioning**

**An Introduction to Cushioning**

Cushioning is recommended as a means of controlling the deceleration of masses, or for applications where piston speed is in excess of 4 in/sec and the piston will make full stroke. Cushioning extends cylinder life and reduces undesirable noise and hydraulic shock. Built-in “cushions” are optional and can be supplied at the head and cap ends of a cylinder without affecting its envelope or mounting dimensions.

**Standard Cushioning**

**Ideal cushion performance shows an almost uniform absorption of energy along the cushioning length, as shown. Many forms of cushioning exist, and each has its own specific merits and advantages.**

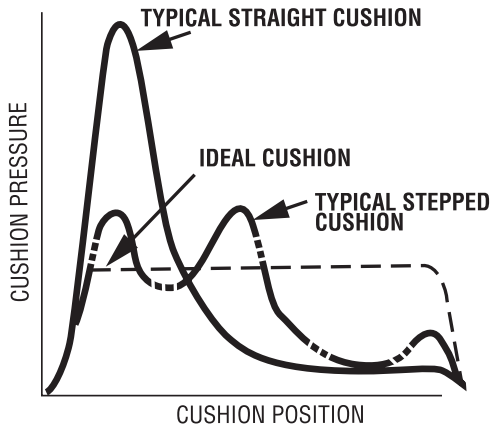
In order to cover the majority of applications, 3L cylinders are supplied with profiled cushioning as standard. Final speed may be adjusted using the cushion screw. The performance of profiled cushioning is indicated on the diagram below.

Note: Cushion performance will be affected by the use of water or high water based fluids. Please consult factory for details.

**Cushion Length**

Where specified, 3L cylinders incorporate the longest cushion sleeve and spear that can be accommodated within the standard envelope without reducing the rod bearing and piston bearing length. See cushion lengths at right. Cushions are adjustable via recessed needle valves.

**Cushion Performance**



**Cushion Length**

| Cylinder Bore (Inches) | Rod Ø <sup>1</sup> (Inches) | Rod Number | Cushion Length (Inches) |      |
|------------------------|-----------------------------|------------|-------------------------|------|
|                        |                             |            | Head <sup>1</sup>       | Cap  |
| 1.00                   | 0.500                       | 1          | 0.88                    | 0.75 |
|                        | 0.625                       | 2          | 0.88                    | 0.75 |
| 1.50                   | 0.625                       | 1          | 0.88                    | 0.81 |
|                        | 1.000                       | 2          | 0.88                    | 0.81 |
| 2.00                   | 0.625                       | 1          | 0.88                    | 0.81 |
|                        | 1.375                       | 2          | 0.88                    | 0.81 |
| 2.50                   | 1.000                       | 1          | 0.88                    | 0.81 |
|                        | 1.750                       | 2          | 0.88                    | 0.81 |
| 3.25                   | 1.000                       | 1          | 1.13                    | 1.00 |
|                        | 2.000                       | 2          | 0.81                    | 1.00 |
| 4.00                   | 1.375                       | 1          | 1.13                    | 1.00 |
|                        | 2.500                       | 2          | 0.81                    | 1.00 |
| 5.00                   | 1.750                       | 1          | 1.13                    | 1.00 |
|                        | 3.500                       | 2          | 0.81                    | 1.00 |
| 6.00                   | 1.750                       | 1          | 1.38                    | 1.25 |
|                        | 4.000                       | 2          | 1.06                    | 1.25 |
| 8.00                   | 2.000                       | 1          | 1.06                    | 1.25 |
|                        | 5.500                       | 2          | 0.94                    | 1.25 |

<sup>1</sup> Head end cushions for rod diameters not listed have cushion lengths within the limits shown.

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## Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

**WARNING:** ⚠ FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:

- Unanticipated or uncontrolled movement of the cylinder or objects connected to it.
- Falling of the cylinder or objects held up by it.
- Fluid escaping from the cylinder, potentially at high velocity.

**THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.**

Before selecting or using Parker Hannifin Corporation (the Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using the Company's products.

### 1.0 General Instructions

**1.1 Scope** – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

**1.2 Fail Safe** – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

**1.3 Distribution** – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use the Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

**1.4 User Responsibility** – Due to very wide variety of cylinder applications and cylinder operating conditions, the Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to the Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

**1.5 Additional Questions** – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-847-298-2400, or go to [www.parker.com](http://www.parker.com), for telephone numbers of the appropriate technical service department.

### 2.0 Cylinder and Accessories Selection

**2.1 Seals** – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

**2.2 Piston Rods** – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.

- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

**2.3 Cushions** – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be reviewed by our engineering department.

**2.4 Cylinder Mountings** – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

**2.5 Port Fittings** – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure} \times \text{effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

### 3.0 Cylinder and Accessories Installation and Mounting

#### 3.1 Installation

**3.1.1** – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

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**3.1.2** – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

**3.1.3** – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

**3.1.4** – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston rod to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded piston rod gland and loosen it from the cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

### **3.2 Mounting Recommendations**

**3.2.1** – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

**3.2.2** – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

**3.2.3** – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

**3.2.4** – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

**3.2.5** – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

**3.2.6** – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

### **4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement**

**4.1 Storage** – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

**4.1.1** – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

**4.1.2** – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

**4.1.3** – Port protector plugs should be left in the cylinder until the time of installation.

**4.1.4** – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

**4.1.5** – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

### **4.2 Cylinder Trouble Shooting**

#### **4.2.1 – External Leakage**

**4.2.1.1** – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to gland wear. If clearance is excessive, replace rod bushing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

**4.2.1.2** – Cylinder body seal leak can generally be traced to loose tie rods. Torque the tie rods to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque tie rods as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the tie rods replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

#### **4.2.2 – Internal Leakage**

**4.2.2.1** – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

**4.2.2.2** – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

**4.2.2.3** – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

#### **4.2.3 – Cylinder Fails to Move the Load**

**4.2.3.1** – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

**4.2.3.2** – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

**4.2.3.3** – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

### **4.3 Erratic or Chatter Operation**

**4.3.1** – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

**4.3.2** – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

**4.3.3** – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

**4.4 Cylinder Modifications, Repairs, or Failed Component** – Cylinders as shipped from the factory are not to be disassembled and or modified. If cylinders require modifications, these modifications must be done at company locations or by the Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, tie rod, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

## Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products".

**1. Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at [www.parker.com/saleterms/](http://www.parker.com/saleterms/). Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.

**2. Price Adjustments; Payments.** Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

**3. Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferral of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

**4. Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of eighteen months from the date of delivery to Buyer. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

**5. Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.

**6. LIMITATION OF LIABILITY.** UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

**7. User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

**8. Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

**9. Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

**10. Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

**11. Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright

infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

**12. Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

**13. Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

**14. Force Majeure.** Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

**15. Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

**16. Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.

**17. Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

**18. Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

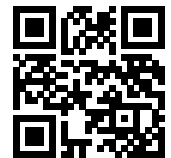
**19. Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

**20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act.** Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.



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