



aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



Heavy Duty Hydraulic Cylinders

Series 2H / 2HD & 3H / 3HD



ENGINEERING YOUR SUCCESS.



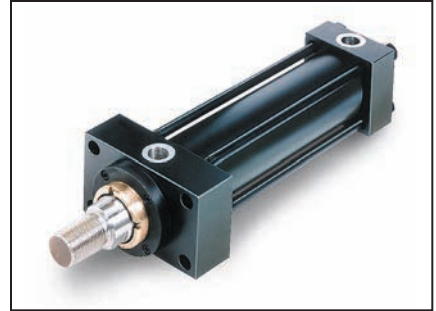
Series CHE

- 20 through 100mm Bore Sizes
- Stroke Lengths to 150mm
- Operating Pressure to 140 bar
- 4 Different Rod Ends Available



Series CHD

- 20 through 80mm Bore Sizes
- Stroke Lengths to 100mm
- Operating Pressure to 207 bar
- 4 Different Rod Ends Available



Series HMI

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



Series MH

- 1.50" through 14.00" Bore
- Heavy-Duty Service – Mill Type Construction
- 13 Mounting Styles Available
- 2,000 psi Hydraulic Service



Series 3L

- Bore Sizes 1.00" through 8.00"
- Removable Rod Gland
- 15 Standard Mounting Styles
- 1,000 psi Nominal Hydraulic Service



WaveScale

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

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Offer of Sale

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Series 2A

- 1.00" through 20.00" Bore
- 3 Standard Rod Ends/Specials to Order
- 15 NFPA Mounting Styles
- 250 psi Air Service



Series VE

- 2.00" through 24.00" Bore
- 3 Standard Rod Ends/Specials to Order
- Aluminum/Steel/Composite Tube
- 150 psi Air/Water Service



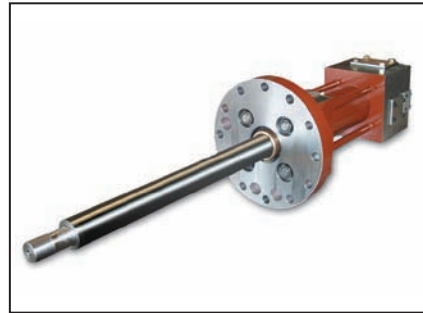
Series MA

- 1.50" through 6.00" Bore
- 11 Mounting Styles
- NFPA Interchangeable
- 200 psi Air Service



Series VH

- 2.50" through 8.00" Bore
- 13 Standard Mounting Styles
- Larger Ports Than Standard
- 3,000 psi Hydraulic Service



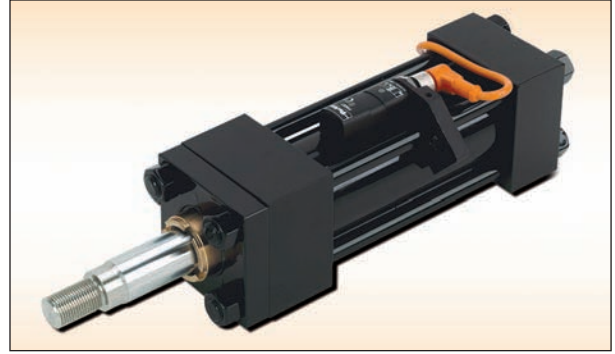
Custom Cylinder

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

Parker Hannifin's Industrial 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 Industrial Cylinder's wide breadth of product encompasses NFPA, ISO, and Custom designed products in a multitude of configurations and sizes.

Series 2H/3L Magnetic Piston

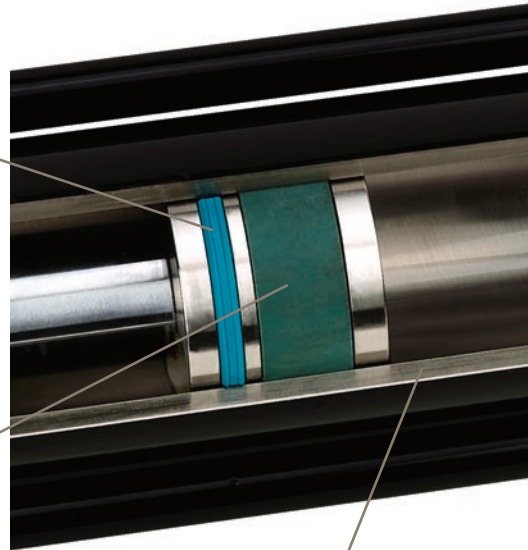
Position Sensing Technology
for Hydraulic Cylinders



Series 2H 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.

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:

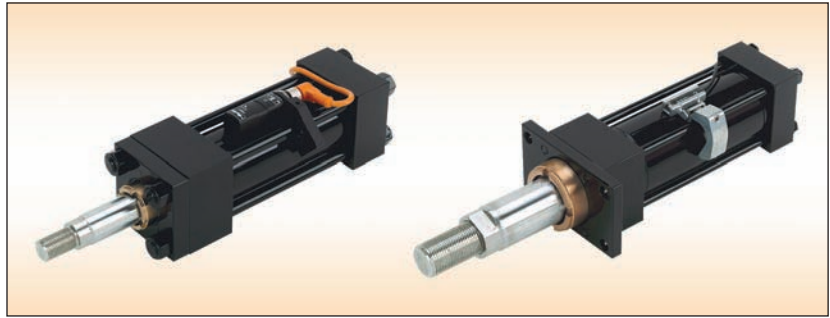
- Available for Series 2H, 3L, and 2A cylinders
- 1.50" through 6.00" bore Series 2H pistons
- Available on 15 different mounting styles
- Adjustability over the entire working stroke length
- Multiple switches can be used per cylinder
- Non intrusive design eliminates potential leakage

Magnetic Switch Choices

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 in 1.50" - 6.00" bores.

Technology Comparison

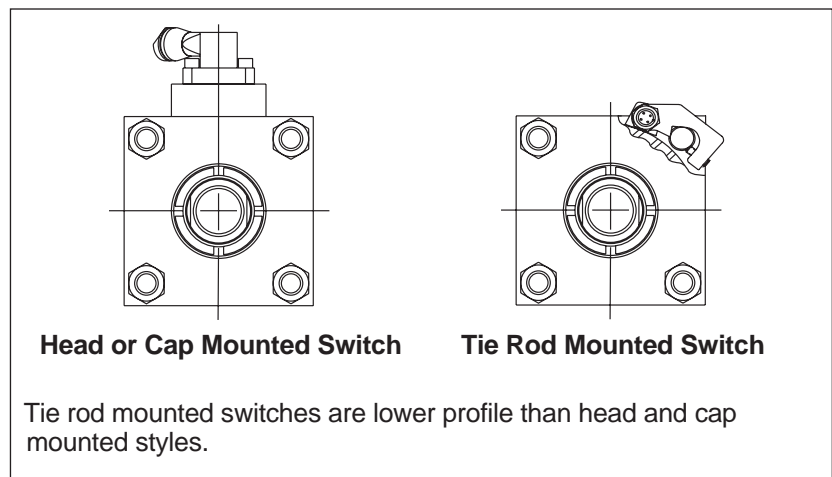


ALS Switch

- 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
- +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



Extreme High Temperature Seal Option – Up to 400°F

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



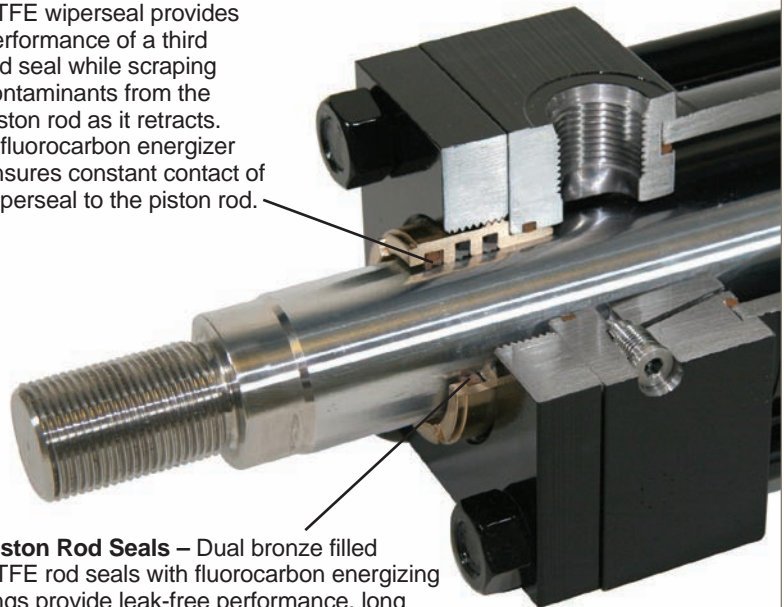
Customer Value Proposition:

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.

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

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.



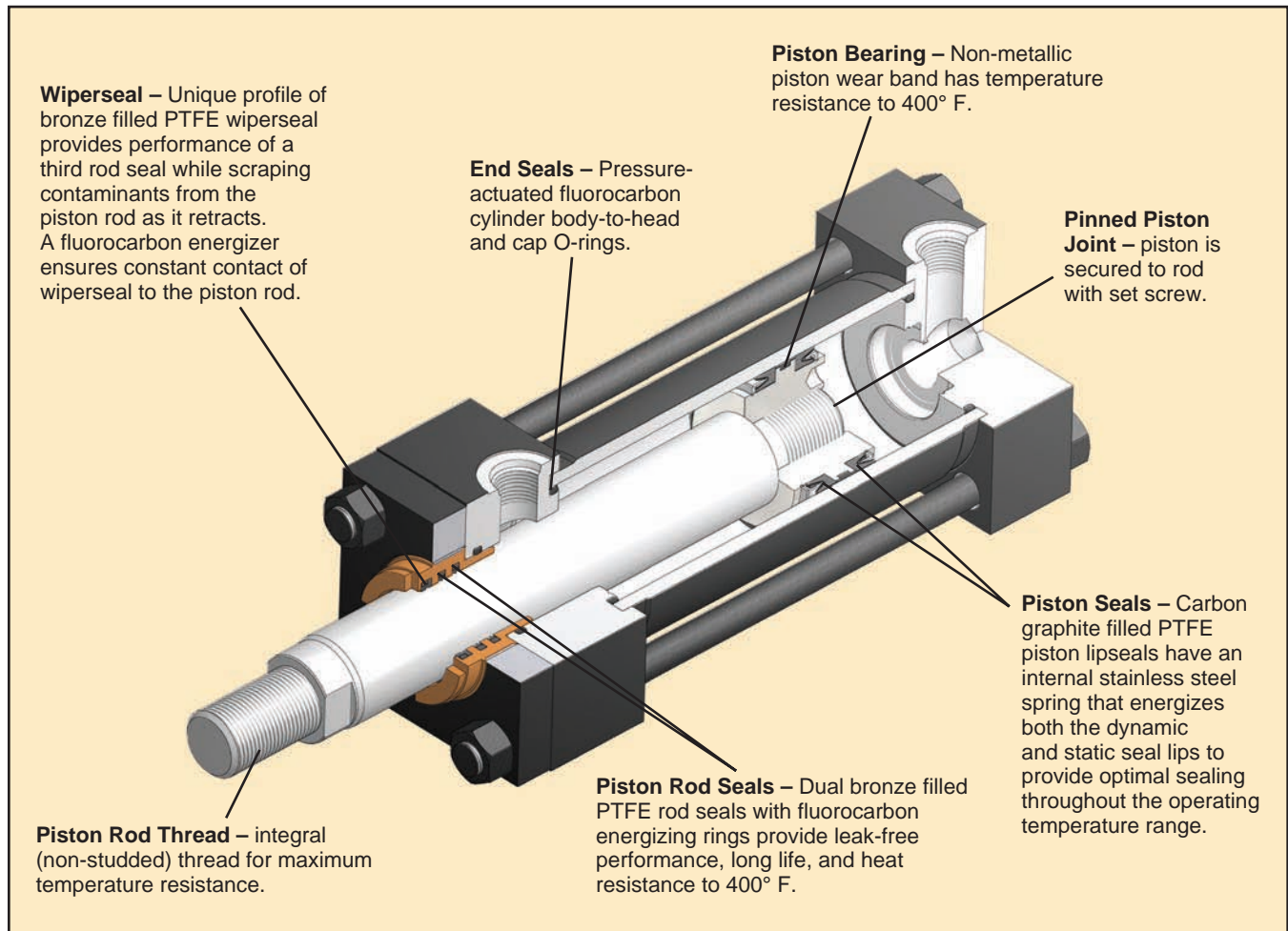
Piston Rod Seals – Dual bronze filled PTFE rod seals with fluorocarbon energizing rings provide leak-free performance, long life, and heat resistance to 400° F.

Cylinders for High Temperature Applications

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.





With annual sales exceeding \$10 billion, 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 52,000 people in 48 countries around the world. Parker has increased its annual dividends paid to shareholders for 53 consecutive years, among the top five longest-running dividend-increase records in the S&P 500 index. For more information, visit the company's web site at <http://www.parker.com>, or its investor information site at <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.

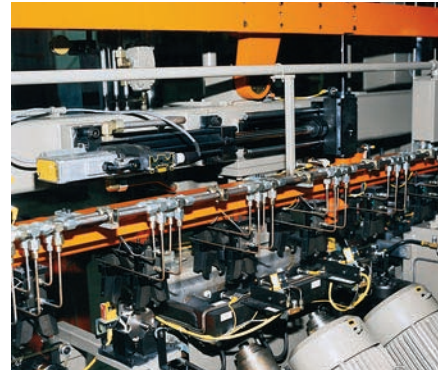
Our design engineers utilize the highest quality materials and cutting edge manufacturing processes available to push the envelope for performance, value and reliability.

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.



Table of Contents

| <i>Description</i> | <i>Page</i> | <i>Section</i> |
|---|-------------|----------------|
| Series 2H Heavy Duty Hydraulic Cylinders | 1 | A |
| Series 3H Heavy Duty Hydraulic Cylinders | 31 | B |
| Cylinder Accessories and Replacement Parts | 65 | C |
| Custom Modifications | 81 | D |
| Engineering Data | 95 | E |

Manufacturing Locations



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 2H Heavy Duty Hydraulic Cylinders 1.50" Through 6.00" Bore

| | |
|---------------------------------------|-------|
| Performance | 2 |
| Specifications and Mounting Styles | 3 |
| Cylinder Features | 4-5 |
| Application Check List | 6 |
| Mounting Styles & Tips for Applying | 7 |
| 2H Cylinder Model Code & How To Order | 8-9 |
| Rod End Styles and Dimensions | 10-11 |
| TD, T, TB, TC Mount Dimensions | 12 |
| J Mount Dimensions | 13 |
| JB Mount Dimensions | 14 |
| JJ Mount Dimensions | 15 |
| H Mount Dimensions | 16 |
| HB Mount Dimensions | 17 |
| HH Mount Dimensions | 18 |
| C Mount Dimensions | 19 |
| F Mount Dimensions | 20 |
| BB Mount Dimensions | 21 |
| D Mount Dimensions | 22 |
| DB Mount Dimensions | 23 |
| DD Mount Dimensions | 24 |
| DE Mount Dimensions | 25 |
| SB Mount Dimensions | 26 |
| Double Rod End Cylinders | 27 |
| 2HD & 3HD Bolt-On Gland Option | 28 |



Parker Series 2H Heavy Duty Hydraulic Cylinder

Series 2H cylinders set the standard for performance, durability, and trouble free operation. Parker superior design, the use of high quality materials and stringent manufacturing practices provide all customers with long cylinder service life and reduced operating costs. Design features such as the “Jewel” rod gland, hard chrome plated piston rods, and stepped cushions provide increased machine productivity through reduced downtime, faster cycle times, and improved system efficiency. Every Parker cylinder is individually tested before leaving our plant to assure proper performance and leak free operation. All Parker Cylinder products carry an eighteen month warranty.

Select Parker Series 2H cylinder for your hydraulic cylinder requirements. Parker Series 2H will provide the value and performance you need for all of your industrial hydraulic application demands.



Standard Specifications

- Heavy Duty Service – ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 3000 psi¹
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10°F to +165°F²
- Bore Diameters – 1.50" through 6.00" (Larger sizes available)

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

Note: Series 2H Hydraulic Cylinders fully meet ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards for Square Head Industrial Fluid Power Cylinders.

- Piston Rod Diameter – .625" through 4.000"
- Mounting Styles – 18 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

¹ If hydraulic operating pressure exceeds 3000 psi, send application data for engineering evaluation and recommendation. See Section E for actual design factors.

² See Section E for higher temperature service.



Available Mounting Styles

| | | | |
|---|---|---|--|
| <p>Basic Style T 1.50" - 6.00"</p> <p>(NFPA MX0)</p> | <p>Tie Rods Extended Head End Style TB 1.50" - 6.00"</p> <p>(NFPA MX3)</p> | <p>Tie Rods Extended Cap End Style TC 1.50" - 6.00"</p> <p>(NFPA MX2)</p> | <p>Tie Rods Extended Both Ends Style TD 1.50" - 6.00"</p> <p>(NFPA MX1)</p> |
| <p>Head Rectangular Flange Style J 1.50" - 6.00"</p> <p>(NFPA MF1)</p> | <p>Head Square Flange Style JB 1.50" - 6.00"</p> <p>(NFPA MF5)</p> | <p>Head Rectangular Style JJ 1.50" - 6.00"</p> <p>(NFPA ME5)</p> | <p>Cap Rectangular Flange Style H 1.50" - 6.00"</p> <p>(NFPA MF2)</p> |
| <p>Cap Square Flange Style HB 1.50" - 6.00"</p> <p>(NFPA MF6)</p> | <p>Cap Rectangular Style HH 1.50" - 6.00"</p> <p>(NFPA ME6)</p> | <p>Side Lug Style C 1.50" - 6.00"</p> <p>(NFPA MS2)</p> | <p>Side Tapped Style F 1.50" - 6.00"</p> <p>(NFPA MS4)</p> |
| <p>Cap Fixed Clevis Style BB 1.50" - 6.00"</p> <p>(NFPA MP1)</p> | <p>Head Trunnion Style D 1.50" - 6.00"</p> <p>(NFPA MT1)</p> | <p>Cap Trunnion Style DB 1.50" - 6.00"</p> <p>(NFPA MT2)</p> | <p>Intermediate Fixed Trunnion Style DD 1.50" - 6.00"</p> <p>(NFPA MT4)</p> |
| <p>HD Intermediate Fixed Trunnion Style DE 4.00" - 6.00"</p> <p>(NFPA MT4)</p> | <p>Spherical Bearing Style SB 1.50" - 6.00"</p> | <p>Double Rod Cylinders Style KT Shown 1.50" - 6.00"</p> <p>Most of the above illustrated mounting styles are available in double rod cylinders.</p> | |

The inside story on why Series 2H is your best choice in heavy duty hydraulic cylinders

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

Ports – SAE "O" ring ports are standard.

Optional Ports

Ports – NPTF ports are optional at no extra charge. Oversize NPTF and SAE ports are available at extra charge.

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.

"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.

Secondary Seal – Double-Service Wiperseal™ wiper 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 .625" through 4.000" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter.

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

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

Parker's Exclusive Stepped floating cushions combine the best features of known cushion technology.

Deceleration devices or built-in "cushions" are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. Parker cylinder cushions are a stepped design and combine the best features of known cushion technology.

Standard straight or tapered cushions have been used in industrial cylinders over a very broad range of applications. Parker research has found that both designs have their limitations.

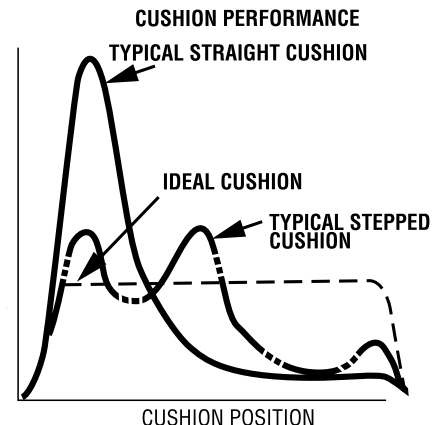
As a result, Parker has taken a new approach in cushioning of industrial hydraulic cylinders and for specific load and velocity conditions have been able to obtain deceleration curves that come very close to the ideal. The success lies in a stepped sleeve or spear concept where the steps are calculated to approximate theoretical orifice area curves.

In the cushion performance chart, pressure traces show the results of typical orifice flow conditions. Tests of a three-step sleeve or spear show three pressure pulses coinciding with the

steps. The deceleration cushion plunger curves shape comes very close to being theoretical, with the exception of the last $\frac{1}{2}$ inch of travel. This is a constant shape in order to have some flexibility in application. The stepped cushion design shows reduced pressure peaks for most load and speed conditions, with comparable reduction of objectionable stopping forces being transmitted to the load and the support structure.

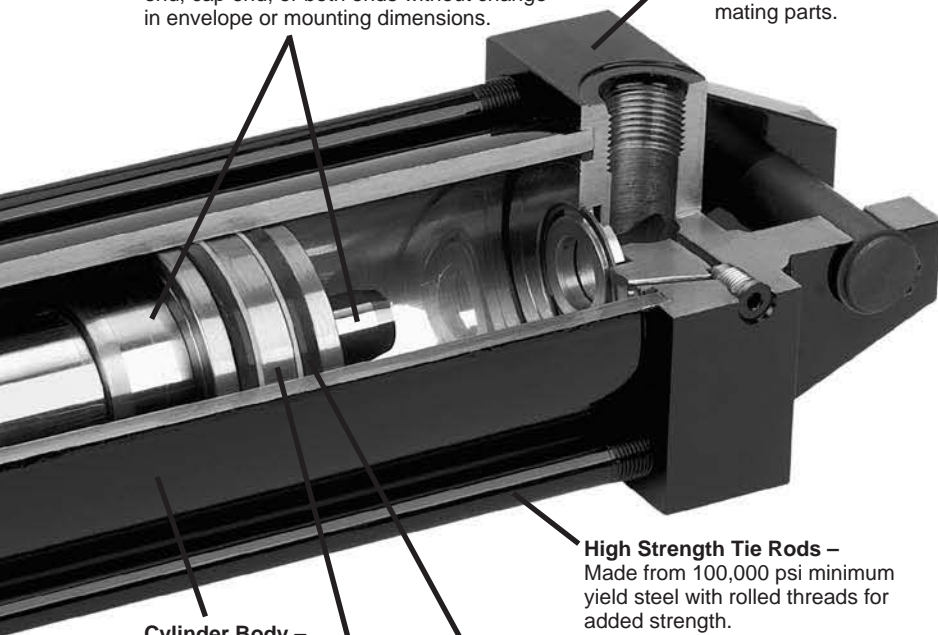
All Parker Hannifin cushions are adjustable.

The Series 2H 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 strengths.



Adjustable Floating Stepped Cushions – For maximum performance – economical and flexible for even the most demanding applications – provides superior performance in reducing shock. Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions.

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

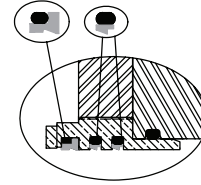


Cylinder Body – Heavy-wall steel tubing, honed to a micro finish bore.

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

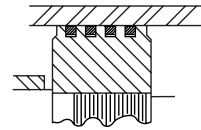
Lipseal™ Piston – Zero leakage under static conditions for hydraulic pressures up to 3000 PSI. Seals are self-compensating to conform to variations in pressure, mechanical deflection, and wear. Back-up washer prevents extrusion.

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.

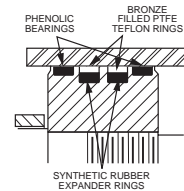


Optional High Temperature Gland – Dual filled PTFE rod seals and filled PTFE wiper seal are energized with fluorocarbon o-rings to maintain consistent contact with the piston rod. Excellent sealing performance produce dry rod on extend stroke with rod scraping to clean rod on retract. Combine with Spring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

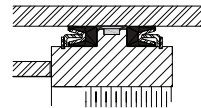
Optional Pistons



Step cut iron piston rings are optional at no extra charge.



Hi Load Piston – Optional at extra charge. Includes wear rings and bronze-filled PTFE seals. Two wear rings serve as bearings which deform radially under side-loading, enabling the load to be spread over a larger area and reduce unit loading. Bronze-filled PTFE seals are designed for extrusion-free, leak-proof service and longer cylinder life than the lipseal type piston.



Spring Loaded PTFE Piston Seals

Optional 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 in 1.50"-6.00" bores (bronze in 7.00" & 8.00" bore 3H) 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 in Section E.

- (1) When a cushion is specified at the head end:
 - a. A self-centering stepped sleeve is furnished on the piston rod assembly.
 - b. A needle valve is provided that is flush with the side of the head even 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, DD, DE, JJ, and HH. In these styles it is located on side number 3.
 - c. On 6.00" bore and larger cylinders 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 mounting style C, where it is mounted opposite the needle valve. It may be identified by the fact that it is slotted.
 - d. On 1.50" - 5.00" bore cylinders a slotted sleeve design is used in place of the check valve.

- e. 1.50" - 2.50" bore cylinders use a cartridge style needle valve (see Figure A).
- (2) When a cushion is specified at the cap end:
 - a. A stepped cushion spear is provided on the piston rod.
 - 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, DD, DE, JJ, and HH. In these styles it is located on side number 3.

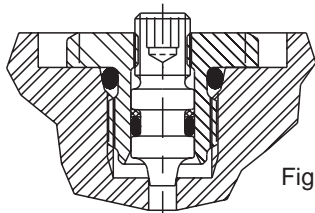
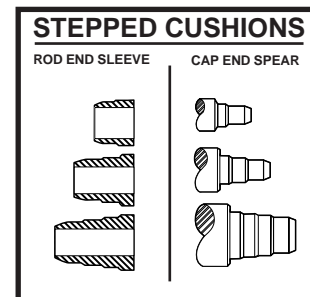


Figure A



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.

- 1. Establish the system requirements** Series 2H
 - 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 96](#)
 - Review the theoretical push and pull force for a given bore size to determine.

- 4. Piston Rod** [Page 104](#)
 - 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 99](#)
 - Determine the best seal type for your application.
Piston Lipseals can hold a load in position, but are not as durable as cast iron rings or Hi-Load seals. For applications with a working pressure in excess of 2000 psi, where the duty cycle requires sustained piston speeds in excess of 15 ips or high cycling performance, other seal options should also be considered. Where these performance criteria will be exceeded, please contact the factory with details of the application.
 - Select the proper seal type and configuration for the application.
 - Select the proper seal to assure fluid and temperature compatibility.

- 6. Cushioning** [Page 106](#)
 - Determine if cushions are required to safely stop the load.

- 7. Ports** [Page 101](#)
 - Select the best possible port size for a given speed requirement.
 - Select port position.

- 8. Piston rod and mounting accessories** [Page 66](#)
 - Determine how you will attach the cylinder to the load.

- 9. Accessories and custom modifications** [Page 65, 81](#)

Mounting Styles & Tips for Applying Them

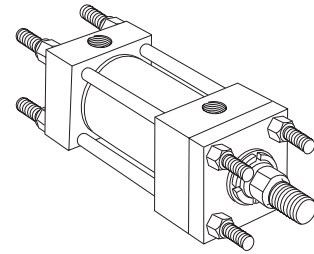
Extended Tie Rod Mountings – TB, TC, and TD

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



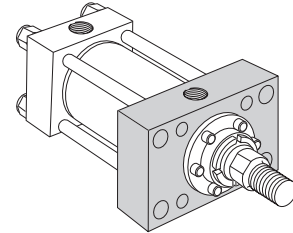
Flange Mountings – J, JB, JJ, H, HB, and HH

Application:

- Straight line force transfer
- Compression loads (push)
– use H, HB or HH
- 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



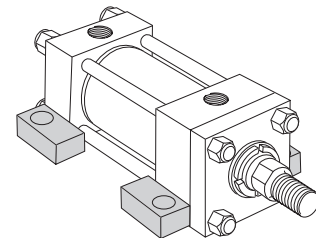
Side Tap Mounting – F / Side Lug Mounting – C

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



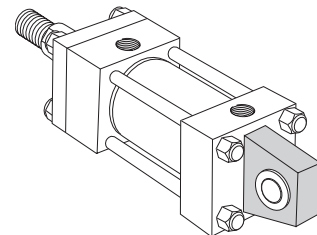
Pivot Mountings – BB and SB

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)



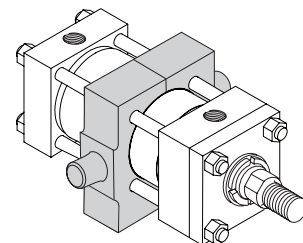
Trunnion Mountings – D, DB, DD and DE

Application:

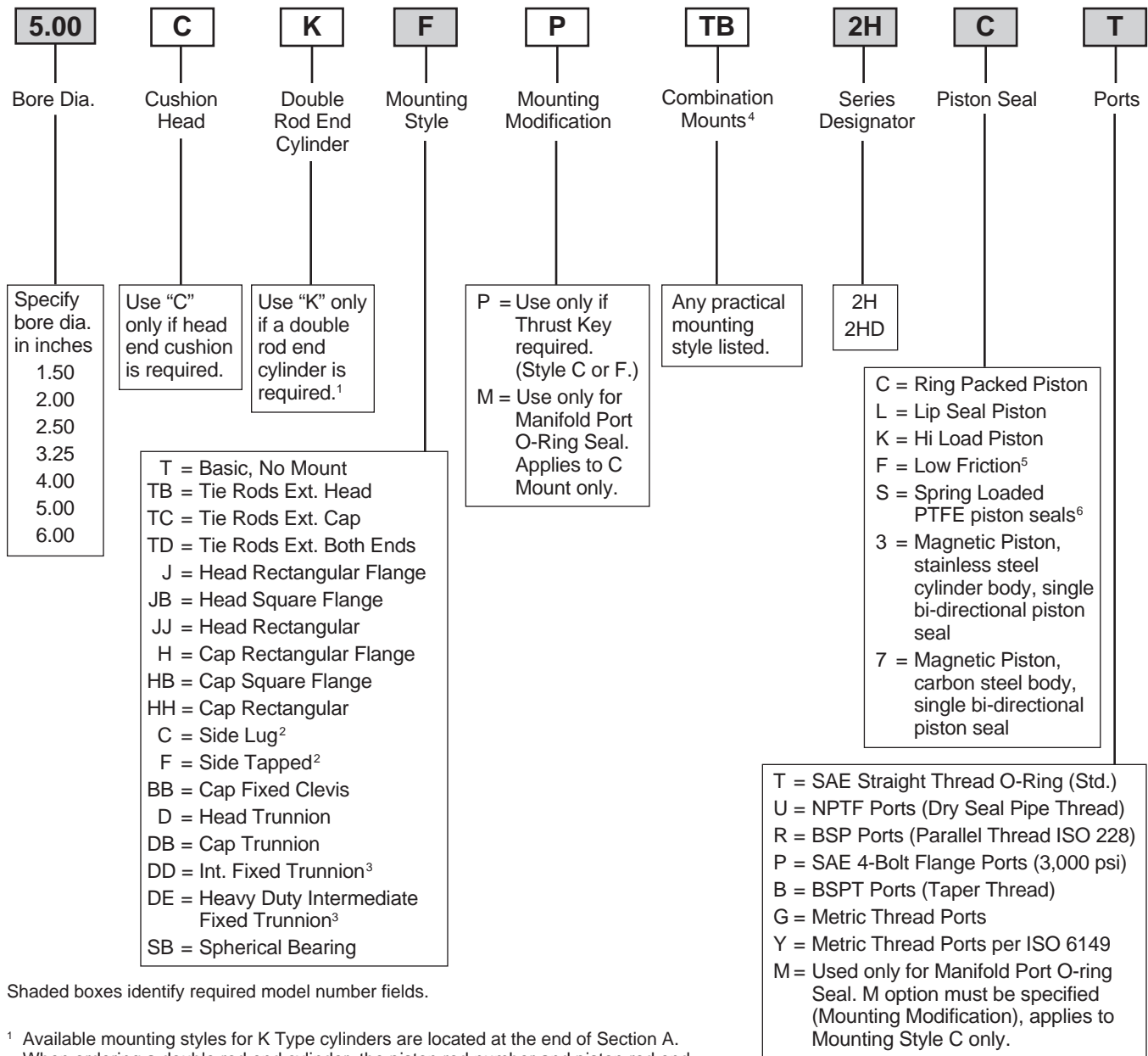
- Curved or arc line force transfer
- Can be used in compression or tension loads
- Compression loads – use DB or DD, DE mountings
- Tension loads – use D, DD or DE mountings

Advantages:

- Ease of mounting
- Design flexibility
- Self aligning



2H Model Code



Shaded boxes identify required model number fields.

¹ 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:
4.00CKTD2HLT14A28AC10.000

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

³ Specify XI dimension.

⁴ 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.

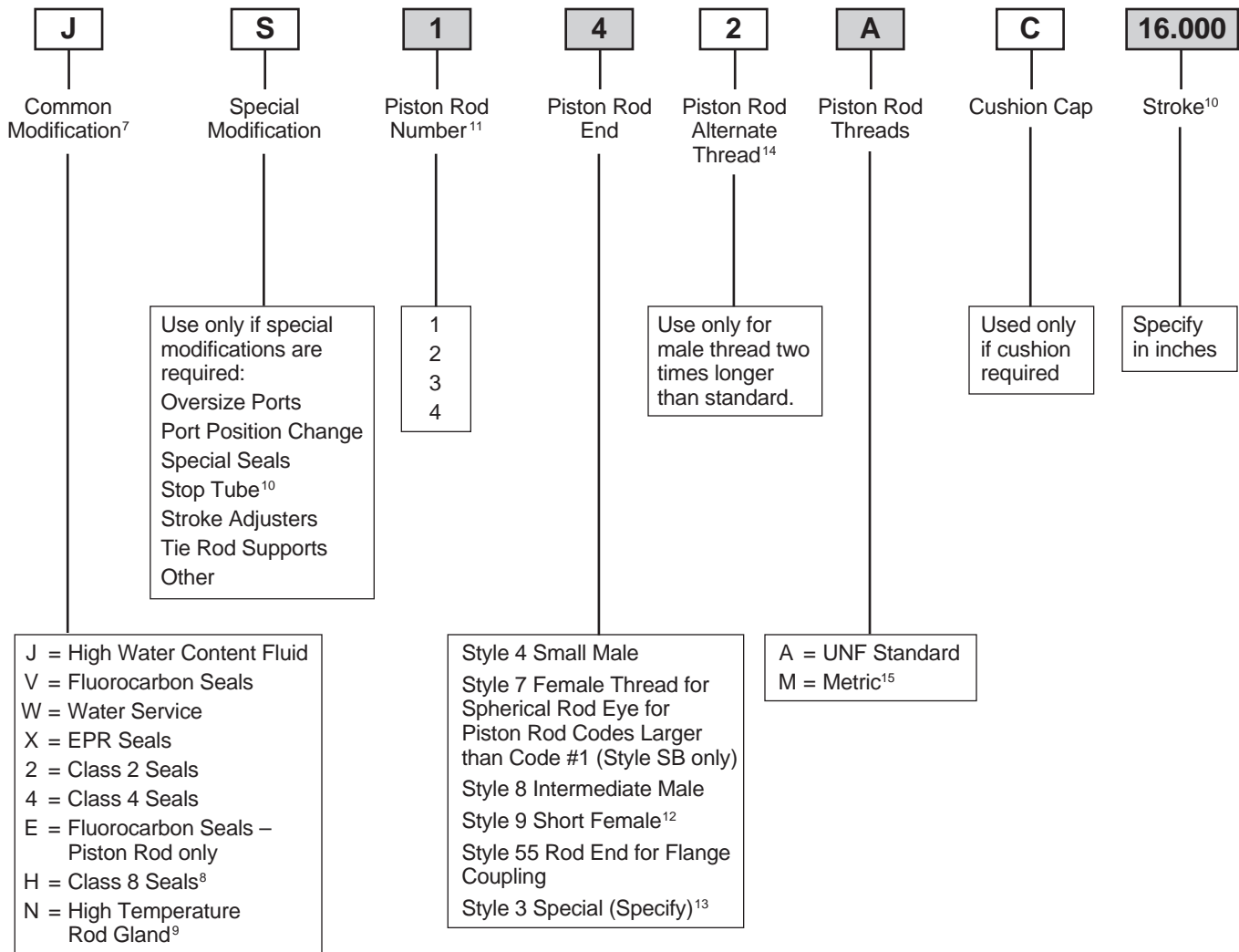
⁵ Low friction rod seals are also supplied when this option is selected.

⁶ Spring loaded PTFE piston seals are not available in 1.50, 2.00 and 2.50 bores with code 2 rod.



How To Order

2H Model Code



Shaded boxes identify required model number fields.

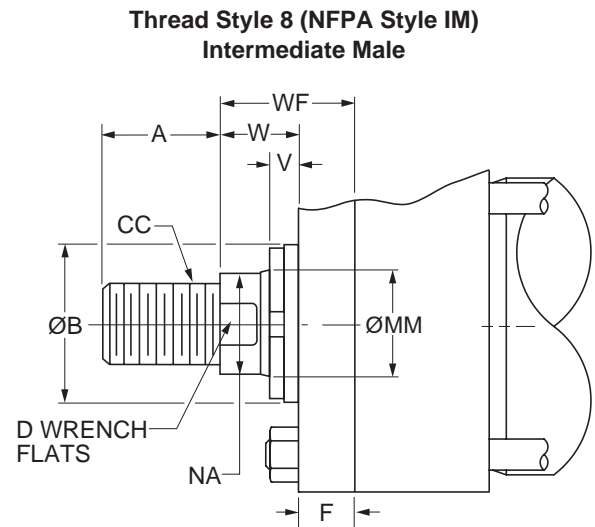
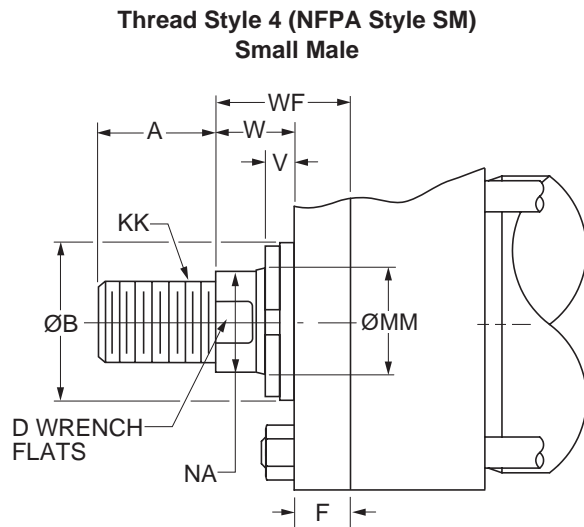
⁷ See common modifications Section D for additional options.
⁸ Class 8 piston seals will be cast iron rings in 1.50, 2.00 & 2.50 inch bores with code 2 rod. Spring loaded PTFE piston seals are not available in these bore and rod combinations.
⁹ Energized PTFE rod seals & wiperseal. All other cylinder seals are fluorocarbon.
¹⁰ 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

¹¹ Refer to Rod buckling chart in Section E to assure rod number selected will not buckle under load.
¹² Style 9 stroke restrictions may apply. See Style 9 Minimum Stroke Table for details.
¹³ Provide dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.
¹⁴ Available only in combination with Style 4 or Style 8.
¹⁵ See Section D for detailed information regarding standard metric rod end thread sizes.

Style 9 Minimum Stroke Table

| Bore Ø | Rod Ø | Minimum Stroke |
|-------------|-------|----------------|
| 1.50 - 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 |

Rod End Dimensions



Rod End Dimensions

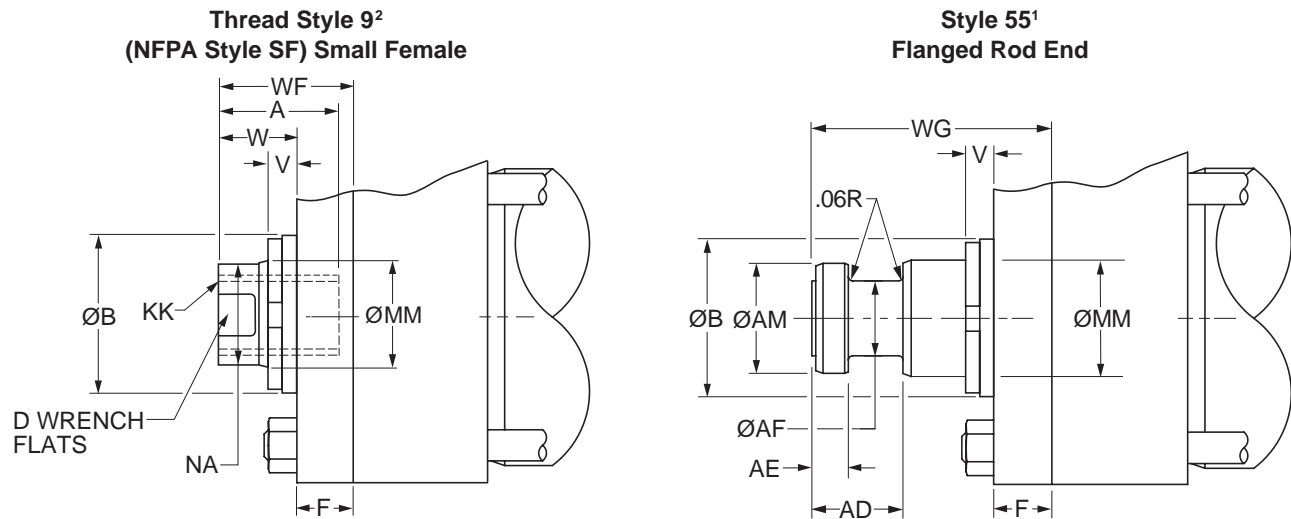
| Bore Ø | Rod No. | MM Rod Ø | Thread | | A | B Ø +0.000 -0.002 | D | F | NA | V | W | WF |
|--------|----------|----------|---------------|---------------|------|-------------------------|------|------|------|------|------|------|
| | | | Style 8 CC | Style 4 KK | | | | | | | | |
| 1.50 | 1 (Std.) | 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.) | 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 | 1.375 | 1 1/4-12 | 1-14 | 1.63 | 1.999 | 1.13 | 0.63 | 1.31 | 0.38 | 1.00 | 1.63 |
| 2.50 | 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 | 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 |
| | 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 |
| 3.25 | 1 (Std.) | 1.375 | 1 1/4-12 | 1-14 | 1.63 | 1.999 | 1.13 | 0.75 | 1.31 | 0.25 | 0.88 | 1.63 |
| | 2 | 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 |
| | 3 | 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 |
| 4.00 | 1 (Std.) | 1.750 | 1 1/2-12 | 1 1/4-12 | 2.00 | 2.374 | 1.50 | 0.88 | 1.69 | 0.25 | 1.00 | 1.88 |
| | 2 | 2.500 | 2 1/4-12 | 1 7/8-12 | 3.00 | 3.124 | 2.06 | 0.88 | 2.38 | 0.38 | 1.38 | 2.25 |
| | 3 | 2.000 | 1 3/4-12 | 1 1/2-12 | 2.25 | 2.624 | 1.69 | 0.88 | 1.94 | 0.25 | 1.13 | 2.00 |
| 5.00 | 1 (Std.) | 2.000 | 1 3/4-12 | 1 1/2-12 | 2.25 | 2.624 | 1.69 | 0.88 | 1.94 | 0.25 | 1.13 | 2.00 |
| | 2 | 3.500 | 3 1/4-12 | 2 1/2-12 | 3.50 | 4.249 | 3.00 | 0.88 | 3.38 | 0.38 | 1.38 | 2.25 |
| | 3 | 2.500 | 2 1/4-12 | 1 7/8-12 | 3.00 | 3.124 | 2.06 | 0.88 | 2.38 | 0.38 | 1.38 | 2.25 |
| | 4 | 3.000 | 2 3/4-12 | 2 1/4-12 | 3.50 | 3.749 | 2.63 | 0.88 | 2.88 | 0.38 | 1.38 | 2.25 |
| 6.00 | 1 (Std.) | 2.500 | 2 1/4-12 | 1 7/8-12 | 3.00 | 3.124 | 2.06 | 1.00 | 2.38 | 0.25 | 1.25 | 2.25 |
| | 2 | 4.000 | 3 3/4-12 | 3-12 | 4.00 | 4.749 | 3.38 | 1.00 | 3.88 | 0.25 | 1.25 | 2.25 |
| | 3 | 3.000 | 2 3/4-12 | 2 1/4-12 | 3.50 | 3.749 | 2.63 | 1.00 | 2.88 | 0.25 | 1.25 | 2.25 |
| | 4 | 3.500 | 3 1/4-12 | 2 1/2-12 | 3.50 | 4.249 | 3.00 | 1.00 | 3.38 | 0.25 | 1.25 | 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.

Rod End Dimensions



Rod End Dimensions

| Bore Ø | Rod No. | MM Rod Ø | Thread | A | AD | AE +.001 -.001 | AF Ø | AM Ø | B Ø +.000 -.002 | D | F | NA | V | W | WF | WG |
|--------|----------|----------|---------------|------|------|----------------------|---------|---------|-----------------------|------|------|------|------|------|------|------|
| | | | Style 9 KK | | | | | | | | | | | | | |
| 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.) | 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 | 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 |
| 2.50 | 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 | 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 |
| | 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 |
| 3.25 | 1 (Std.) | 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 |
| | 2 | 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 |
| | 3 | 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 |
| 4.00 | 1 (Std.) | 1.750 | 1 1/4-12 | 2.00 | 1.31 | 0.499 | 1.13 | 1.70 | 2.374 | 1.50 | 0.88 | 1.69 | 0.25 | 1.00 | 1.88 | 3.13 |
| | 2 | 2.500 | 1 7/8-12 | 3.00 | 1.94 | 0.749 | 1.75 | 2.45 | 3.124 | 2.06 | 0.88 | 2.38 | 0.38 | 1.38 | 2.25 | 4.50 |
| | 3 | 2.000 | 1 1/2-12 | 2.25 | 1.69 | 0.624 | 1.38 | 1.95 | 2.624 | 1.69 | 0.88 | 1.94 | 0.25 | 1.13 | 2.00 | 3.75 |
| 5.00 | 1 (Std.) | 2.000 | 1 1/2-12 | 2.25 | 1.69 | 0.624 | 1.38 | 1.95 | 2.624 | 1.69 | 0.88 | 1.94 | 0.25 | 1.13 | 2.00 | 3.75 |
| | 2 | 3.500 | 2 1/2-12 | 3.50 | 2.69 | 0.999 | 2.50 | 3.45 | 4.249 | 3.00 | 0.88 | 3.38 | 0.38 | 1.38 | 2.25 | 5.63 |
| | 3 | 2.500 | 1 7/8-12 | 3.00 | 1.94 | 0.749 | 1.75 | 2.45 | 3.124 | 2.06 | 0.88 | 2.38 | 0.38 | 1.38 | 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 | 0.88 | 2.88 | 0.38 | 1.38 | 2.25 | 4.88 |
| 6.00 | 1 (Std.) | 2.500 | 1 7/8-12 | 3.00 | 1.94 | 0.749 | 1.75 | 2.45 | 3.124 | 2.06 | 1.00 | 2.38 | 0.25 | 1.25 | 2.25 | 4.50 |
| | 2 | 4.000 | 3-12 | 4.00 | 2.69 | 0.999 | 3.00 | 3.95 | 4.749 | 3.38 | 1.00 | 3.88 | 0.25 | 1.25 | 2.25 | 5.75 |
| | 3 | 3.000 | 2 1/4-12 | 3.50 | 2.44 | 0.874 | 2.25 | 2.95 | 3.749 | 2.63 | 1.00 | 2.88 | 0.25 | 1.25 | 2.25 | 4.88 |
| | 4 | 3.500 | 2 1/2-12 | 3.50 | 2.69 | 0.999 | 2.50 | 3.45 | 4.249 | 3.00 | 1.00 | 3.38 | 0.25 | 1.25 | 2.25 | 5.63 |

“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.

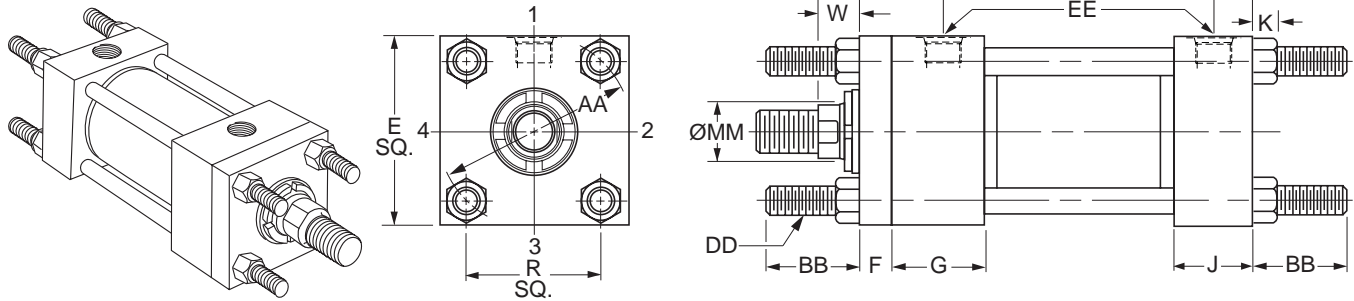
¹ For special WG dimension, specify “Style 3” and give desired dimension for WG. For other changes, place “S” in the model code, and describe rod end with dimensioned sketch.

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



Mounting Information – 1.50" to 6.00" Bore

Tie Rods Extended Both Ends Mounting
Style TD
(NFA Style MX1)



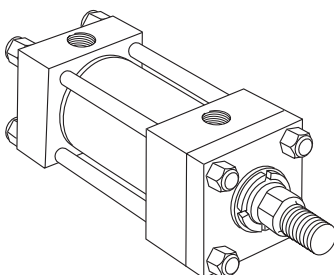
Style TD – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | AA | BB | DD | E | EE | | F | G | J | K | R | W | Y | Add Stroke | | |
|-----------|------------|-------------|------|------|--------|------|-------------------|------------------|------|------|------|------|------|------|------|------------|------|------|
| | | | | | | | NPTF ¹ | SAE ² | | | | | | | | LB | P | ZJ |
| 1.50 | 1 (std.) | 0.625 | 2.31 | 1.38 | 3/8-24 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 1.63 | 0.63 | 2.00 | 5.00 | 2.88 | 5.63 |
| | 2 | 1.000 | 2.31 | 1.38 | 3/8-24 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 1.63 | 1.00 | 2.38 | 5.00 | 2.88 | 6.00 |
| 2.00 | 1 (std.) | 1.000 | 2.90 | 1.81 | 1/2-20 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 2.05 | 0.75 | 2.38 | 5.25 | 2.88 | 6.00 |
| | 2 | 1.375 | 2.90 | 1.81 | 1/2-20 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 2.05 | 1.00 | 2.63 | 5.25 | 2.88 | 6.25 |
| 2.50 | 1 (std.) | 1.000 | 3.61 | 1.81 | 1/2-20 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 2.55 | 0.75 | 2.38 | 5.38 | 3.00 | 6.13 |
| | 2 | 1.750 | 3.61 | 1.81 | 1/2-20 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 2.55 | 1.25 | 2.88 | 5.38 | 3.00 | 6.63 |
| | 3 | 1.375 | 3.61 | 1.81 | 1/2-20 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 2.55 | 1.00 | 2.63 | 5.38 | 3.00 | 6.38 |
| 3.25 | 1 (std.) | 1.375 | 4.60 | 2.31 | 5/8-18 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 3.25 | 0.88 | 2.75 | 6.25 | 3.50 | 7.13 |
| | 2 | 2.000 | 4.60 | 2.31 | 5/8-18 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 3.25 | 1.25 | 3.13 | 6.25 | 3.50 | 7.50 |
| | 3 | 1.750 | 4.60 | 2.31 | 5/8-18 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 3.25 | 1.13 | 3.00 | 6.25 | 3.50 | 7.38 |
| 4.00 | 1 (std.) | 1.750 | 5.40 | 2.31 | 5/8-18 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 3.82 | 1.00 | 3.00 | 6.63 | 3.75 | 7.63 |
| | 2 | 2.500 | 5.40 | 2.31 | 5/8-18 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 3.82 | 1.38 | 3.38 | 6.63 | 3.75 | 8.00 |
| | 3 | 2.000 | 5.40 | 2.31 | 5/8-18 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 3.82 | 1.13 | 3.13 | 6.63 | 3.75 | 7.75 |
| 5.00 | 1 (std.) | 2.000 | 7.00 | 3.19 | 7/8-14 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 4.95 | 1.13 | 3.13 | 7.13 | 4.25 | 8.25 |
| | 2 | 3.500 | 7.00 | 3.19 | 7/8-14 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 4.95 | 1.38 | 3.38 | 7.13 | 4.25 | 8.50 |
| | 3 | 2.500 | 7.00 | 3.19 | 7/8-14 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 4.95 | 1.38 | 3.38 | 7.13 | 4.25 | 8.50 |
| | 4 | 3.000 | 7.00 | 3.19 | 7/8-14 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 4.95 | 1.38 | 3.38 | 7.13 | 4.25 | 8.50 |
| 6.00 | 1 (std.) | 2.500 | 8.10 | 3.63 | 1-14 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 5.73 | 1.25 | 3.50 | 8.38 | 4.88 | 9.63 |
| | 2 | 4.000 | 8.10 | 3.63 | 1-14 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 5.73 | 1.25 | 3.50 | 8.38 | 4.88 | 9.63 |
| | 3 | 3.000 | 8.10 | 3.63 | 1-14 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 5.73 | 1.25 | 3.50 | 8.38 | 4.88 | 9.63 |
| | 4 | 3.500 | 8.10 | 3.63 | 1-14 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 5.73 | 1.25 | 3.50 | 8.38 | 4.88 | 9.63 |

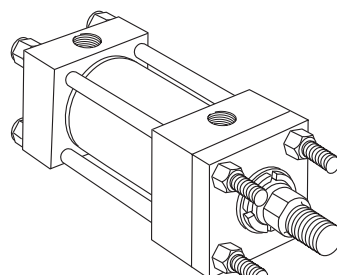
¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

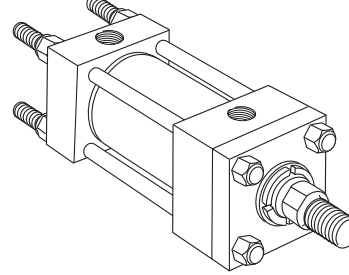
Style T



Style TB



Style TC

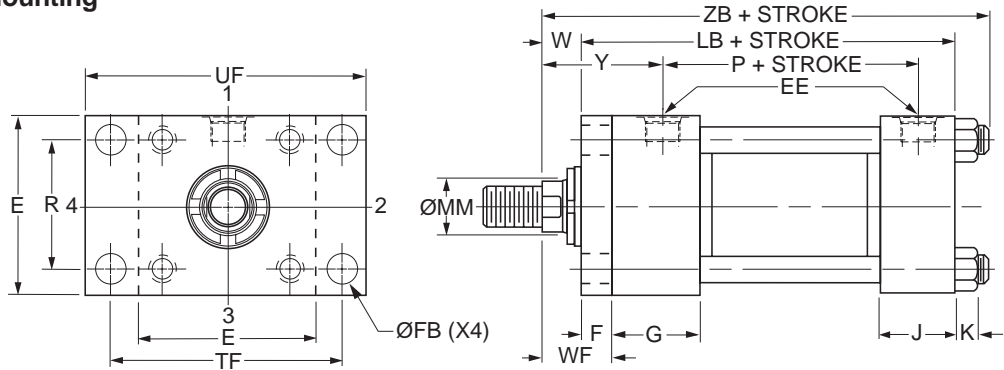
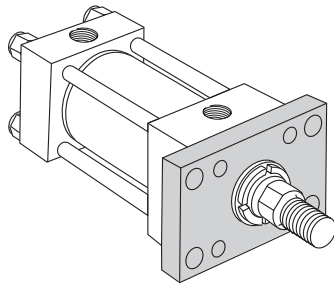


Dimensions for T, TB and TC Mount may be obtained from the above dimensional table.

Mounting Information – 1.50" to 6.00" Bore Series 2H

Head Rectangular Flange Mounting

Style J
(NFPA Style MF1)



Style J – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style J – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | WF | Y | Add Stroke |
|--------|----------|----------|------|------|------|------------|
| | | | | | | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 1.00 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.00 | 1.38 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 1.38 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.00 | 1.63 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 1.38 | 2.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 1.88 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 1.63 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 1.63 | 2.75 | 7.94 |
| | 2 | 2.000 | 1.25 | 2.00 | 3.13 | 8.31 |
| | 3 | 1.750 | 1.13 | 1.88 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 1.88 | 3.00 | 8.50 |
| | 2 | 2.500 | 1.38 | 2.25 | 3.38 | 8.88 |
| | 3 | 2.000 | 1.13 | 2.00 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 2.00 | 3.13 | 9.38 |
| | 2 | 3.500 | 1.38 | 2.25 | 3.38 | 9.63 |
| | 3 | 2.500 | 1.38 | 2.25 | 3.38 | 9.63 |
| | 4 | 3.000 | 1.38 | 2.25 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 2 | 4.000 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 3 | 3.000 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 4 | 3.500 | 1.25 | 2.25 | 3.50 | 10.81 |

Style J – Maximum Operating Pressure / 2H

| Bore Ø | Maximum psi Push ³ | | | |
|--------|-------------------------------|------|------|------|
| | Rod Code | | | |
| | 1 | 2 | 3 | 4 |
| 1.50 | 1500 | 1000 | - | - |
| 2.00 | 2000 | 1200 | - | - |
| 2.50 | 2000 | 1100 | 1500 | - |
| 3.25 | 1800 | 1300 | 1400 | - |
| 4.00 | 1800 | 1300 | 1700 | - |
| 5.00 | 1300 | 800 | 1200 | 1000 |
| 6.00 | 1200 | 800 | 1000 | 900 |

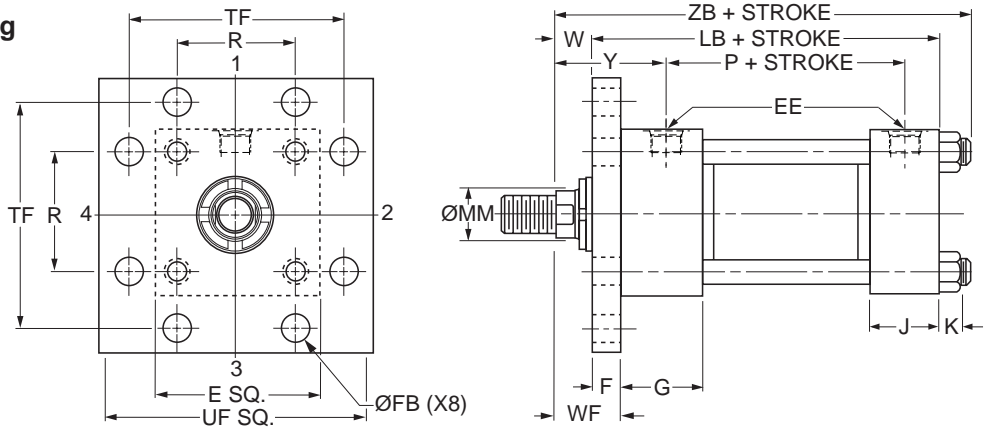
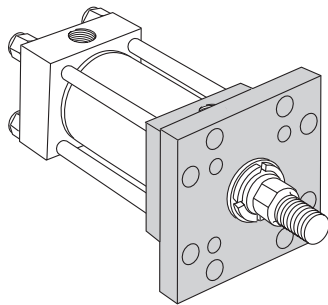
Style J – Maximum Operating Pressure / 2HD

| Bore Ø | Maximum psi Push ³ | | | |
|--------|-------------------------------|------|------|-----|
| | Rod Code | | | |
| | 1 | 2 | 3 | 4 |
| 1.50 | 1400 | 1000 | - | - |
| 2.00 | 2000 | 1200 | - | - |
| 2.50 | 700 | 1000 | 700 | - |
| 3.25 | 800 | 600 | 800 | - |
| 4.00 | 1000 | 700 | 1000 | - |
| 5.00 | 850 | 800 | 850 | 450 |
| 6.00 | 650 | 400 | 650 | 400 |

³Maximum Pressure Rating – Push Application.

Mounting Information – 1.50" to 6.00" Bore Series 2H

**Head Square Flange Mounting
Style JB
(NFPA Style MF5)**



Style JB – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style JB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | WF | Y | Add Stroke |
|--------|----------|----------|------|------|------|------------|
| | | | | | | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 1.00 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.00 | 1.38 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 1.38 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.00 | 1.63 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 1.38 | 2.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 1.88 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 1.63 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 1.63 | 2.75 | 7.94 |
| | 2 | 2.000 | 1.25 | 2.00 | 3.13 | 8.31 |
| | 3 | 1.750 | 1.13 | 1.88 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 1.88 | 3.00 | 8.50 |
| | 2 | 2.500 | 1.38 | 2.25 | 3.38 | 8.88 |
| | 3 | 2.000 | 1.13 | 2.00 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 2.00 | 3.13 | 9.38 |
| | 2 | 3.500 | 1.38 | 2.25 | 3.38 | 9.63 |
| | 3 | 2.500 | 1.38 | 2.25 | 3.38 | 9.63 |
| | 4 | 3.000 | 1.38 | 2.25 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 2 | 4.000 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 3 | 3.000 | 1.25 | 2.25 | 3.50 | 10.81 |
| | 4 | 3.500 | 1.25 | 2.25 | 3.50 | 10.81 |

Style JB – Maximum Operating Pressure / 2H

| Bore Ø | Maximum psi Push ³ | | | |
|--------|-------------------------------|------|------|------|
| | Rod Code | | | |
| | 1 | 2 | 3 | 4 |
| 1.50 | 3000 | 3000 | - | - |
| 2.00 | 3000 | 3000 | - | - |
| 2.50 | 3000 | 3000 | 3000 | - |
| 3.25 | 3000 | 3000 | 3000 | - |
| 4.00 | 3000 | 3000 | 3000 | - |
| 5.00 | 3000 | 3000 | 3000 | 3000 |
| 6.00 | 3000 | 2700 | 3000 | 2700 |

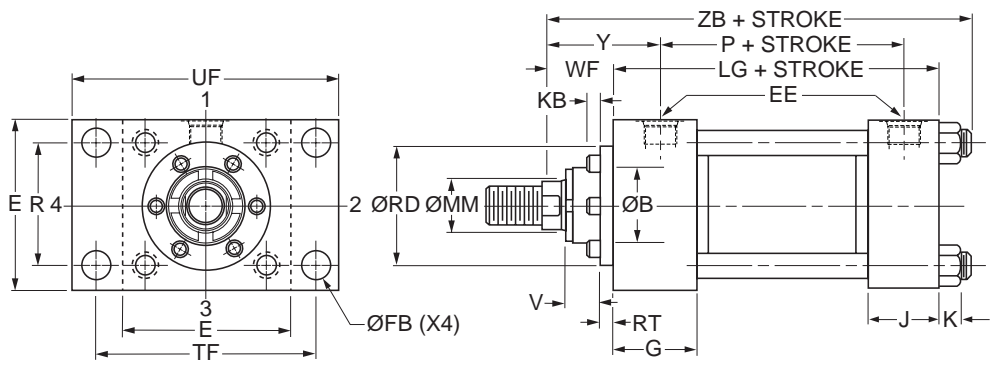
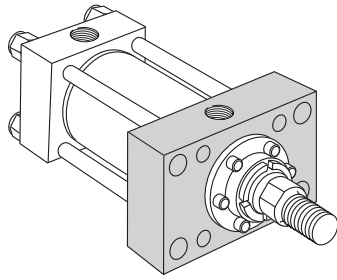
Style JB – Maximum Operating Pressure / 2HD

| Bore Ø | Maximum psi Push ³ | | | |
|--------|-------------------------------|------|------|------|
| | Rod Code | | | |
| | 1 | 2 | 3 | 4 |
| 1.50 | 3000 | 3000 | - | - |
| 2.00 | 3000 | 3000 | - | - |
| 2.50 | 3000 | 3000 | 3000 | - |
| 3.25 | 3000 | 3000 | 3000 | - |
| 4.00 | 3000 | 3000 | 3000 | - |
| 5.00 | 2500 | 2300 | 2500 | 1800 |
| 6.00 | 2000 | 1600 | 2000 | 1600 |

³Maximum Pressure Rating – Push Application.

Mounting Information – 1.50" to 6.00" Bore Series 2H

Head Rectangular Mounting
Style JJ
(NFA Style ME5)



Style JJ – Dimensional and Mounting Data

| Bore Ø | E | EE | | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | LG | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 4.63 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 4.63 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 4.75 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 5.50 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 5.75 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 6.25 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 7.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style JJ – Dimensional and Mounting Data

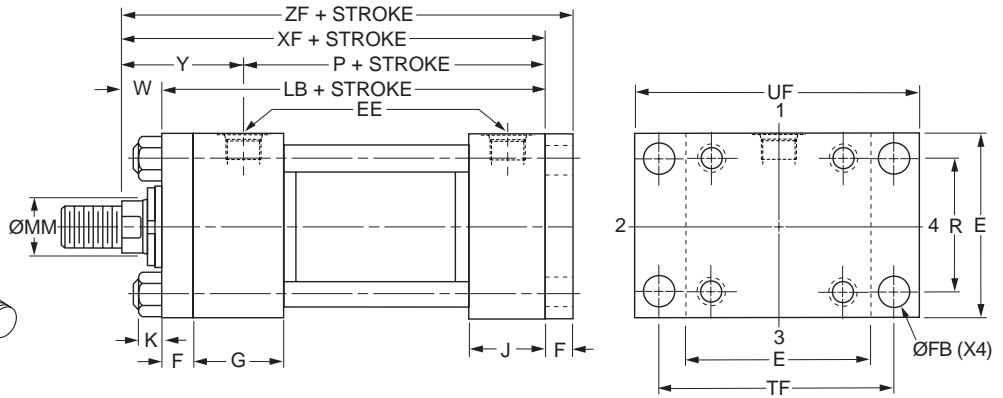
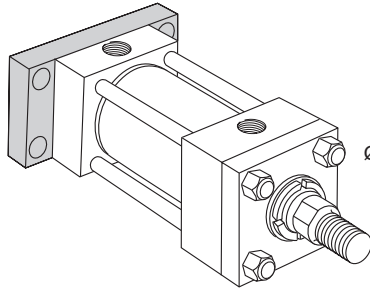
| Bore Ø | Rod No. | MM Rod Ø | B Ø +.000 -0.002 | KB | RD Ø | RT | V | WF | Y | Add Stroke |
|--------|----------|----------|------------------|-----|------|------|------|------|------|------------|
| | | | | | | | | | | ZB Max |
| 1.50 | 1 (std.) | 0.625 | 1.124 | - | 2.13 | 0.38 | 0.25 | 1.00 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.499 | - | 2.50 | 0.38 | 0.50 | 1.38 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 1.499 | - | 2.50 | 0.38 | 0.50 | 1.38 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.999 | .25 | 3.00 | 0.38 | 0.63 | 1.63 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 1.499 | - | 2.50 | 0.38 | 0.50 | 1.38 | 2.38 | 6.81 |
| | 2 | 1.750 | 2.374 | .25 | 3.50 | 0.38 | 0.75 | 1.88 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.999 | .25 | 3.00 | 0.38 | 0.63 | 1.63 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 1.999 | .25 | 3.00 | 0.38 | 0.63 | 1.63 | 2.75 | 7.94 |
| | 2 | 2.000 | 2.624 | .13 | 4.00 | 0.63 | 0.50 | 2.00 | 3.13 | 8.31 |
| | 3 | 1.750 | 2.374 | .25 | 3.50 | 0.38 | 0.75 | 1.88 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 2.374 | .25 | 3.50 | 0.38 | 0.75 | 1.88 | 3.00 | 8.50 |
| | 2 | 2.500 | 3.124 | .25 | 4.50 | 0.63 | 0.63 | 2.25 | 3.38 | 8.88 |
| | 3 | 2.000 | 2.624 | .13 | 4.00 | 0.63 | 0.50 | 2.00 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 2.624 | .13 | 4.00 | 0.63 | 0.50 | 2.00 | 3.13 | 9.38 |
| | 2 | 3.500 | 4.249 | .25 | 5.75 | 0.63 | 0.63 | 2.25 | 3.38 | 9.63 |
| | 3 | 2.500 | 3.124 | .25 | 4.50 | 0.63 | 0.63 | 2.25 | 3.38 | 9.63 |
| | 4 | 3.000 | 3.749 | .25 | 5.25 | 0.63 | 0.63 | 2.25 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 3.124 | .25 | 4.50 | 0.63 | 0.63 | 2.25 | 3.50 | 10.81 |
| | 2 | 4.000 | 4.749 | .25 | 6.50 | 0.75 | 0.50 | 2.25 | 3.50 | 10.81 |
| | 3 | 3.000 | 3.749 | .25 | 5.25 | 0.63 | 0.63 | 2.25 | 3.50 | 10.81 |
| | 4 | 3.500 | 4.249 | .25 | 5.75 | 0.63 | 0.63 | 2.25 | 3.50 | 10.81 |



Mounting Information – 1.50" to 6.00" Bore Series 2H

Cap Rectangular Flange Mounting

Style H
(NFPA Style MF2)



Style H – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style H – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | Y | Add Stroke | |
|--------|----------|----------|------|------|------------|-------|
| | | | | | XF | ZF |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 5.63 | 6.00 |
| | 2 | 1.000 | 1.00 | 2.38 | 6.00 | 6.38 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.00 | 6.63 |
| | 2 | 1.375 | 1.00 | 2.63 | 6.25 | 6.88 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.13 | 6.75 |
| | 2 | 1.750 | 1.25 | 2.88 | 6.63 | 7.25 |
| | 3 | 1.375 | 1.00 | 2.63 | 6.38 | 7.00 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 7.13 | 7.88 |
| | 2 | 2.000 | 1.25 | 3.13 | 7.50 | 8.25 |
| | 3 | 1.750 | 1.13 | 3.00 | 7.38 | 8.13 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 7.63 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.38 | 8.00 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.13 | 7.75 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 8.25 | 9.13 |
| | 2 | 3.500 | 1.38 | 3.38 | 8.50 | 9.38 |
| | 3 | 2.500 | 1.38 | 3.38 | 8.50 | 9.38 |
| | 4 | 3.000 | 1.38 | 3.38 | 8.50 | 9.38 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 2 | 4.000 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 3 | 3.000 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 4 | 3.500 | 1.25 | 3.50 | 9.63 | 10.63 |

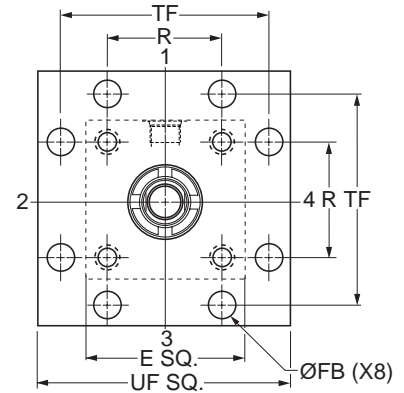
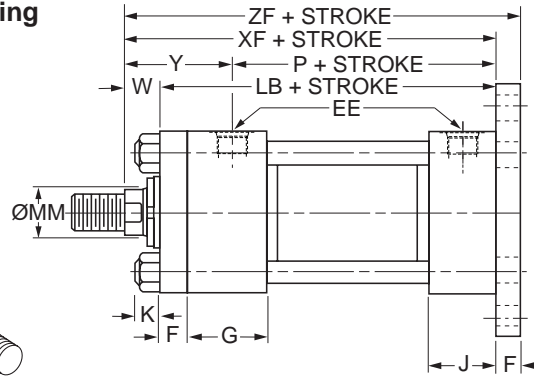
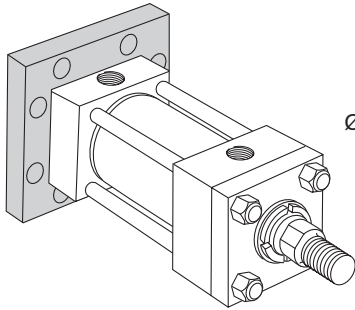
Style H – Maximum Operating Pressure / 2H & 2HD

| Bore Ø | Maximum psi Pull ³ | | | |
|--------|-------------------------------|------|------|------|
| | Rod Code | | | |
| | 1 | 2 | 3 | 4 |
| 1.50 | 2500 | 3000 | - | - |
| 2.00 | 3000 | 3000 | - | - |
| 2.50 | 3000 | 3000 | 3000 | - |
| 3.25 | 3000 | 3000 | 3000 | - |
| 4.00 | 3000 | 3000 | 3000 | - |
| 5.00 | 2000 | 3000 | 2000 | 2500 |
| 6.00 | 1800 | 2500 | 2000 | 2000 |

³Maximum pressure rating — pull application.

Mounting Information – 1.50" to 6.00" Bore Series 2H

Cap Square Flange Mounting
Style HB
(NFPA Style MF6)



Style HB – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

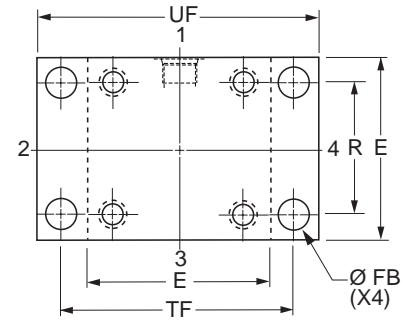
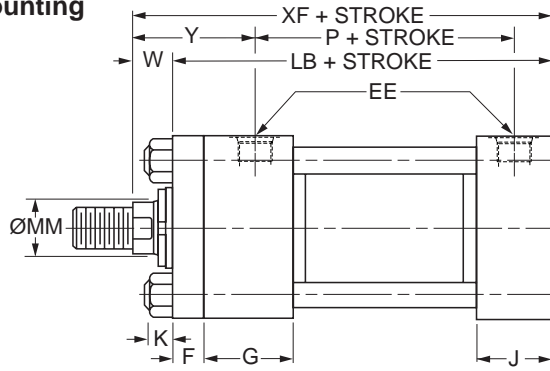
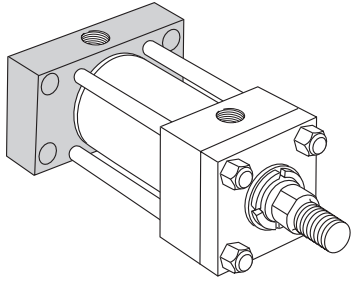
Style HB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | Y | Add Stroke | |
|--------|----------|----------|------|------|------------|-------|
| | | | | | XF | ZF |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 5.63 | 6.00 |
| | 2 | 1.000 | 1.00 | 2.38 | 6.00 | 6.38 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.00 | 6.63 |
| | 2 | 1.375 | 1.00 | 2.63 | 6.25 | 6.88 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.13 | 6.75 |
| | 2 | 1.750 | 1.25 | 2.88 | 6.63 | 7.25 |
| | 3 | 1.375 | 1.00 | 2.63 | 6.38 | 7.00 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 7.13 | 7.88 |
| | 2 | 2.000 | 1.25 | 3.13 | 7.50 | 8.25 |
| | 3 | 1.750 | 1.13 | 3.00 | 7.38 | 8.13 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 7.63 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.38 | 8.00 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.13 | 7.75 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 8.25 | 9.13 |
| | 2 | 3.500 | 1.38 | 3.38 | 8.50 | 9.38 |
| | 3 | 2.500 | 1.38 | 3.38 | 8.50 | 9.38 |
| | 4 | 3.000 | 1.38 | 3.38 | 8.50 | 9.38 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 2 | 4.000 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 3 | 3.000 | 1.25 | 3.50 | 9.63 | 10.63 |
| | 4 | 3.500 | 1.25 | 3.50 | 9.63 | 10.63 |



Mounting Information – 1.50" to 6.00" Bore Series 2H

Cap Rectangular Flange Mounting
 Style HH
 (NFPA Style ME6)



Style HH – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 0.44 | 1.75 | 1.50 | 0.38 | 1.63 | 3.44 | 4.25 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.05 | 4.13 | 5.13 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 0.56 | 1.75 | 1.50 | 0.44 | 2.55 | 4.63 | 5.63 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 0.69 | 2.00 | 1.75 | 0.56 | 3.25 | 5.88 | 7.13 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 0.69 | 2.00 | 1.75 | 0.56 | 3.82 | 6.38 | 7.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 0.94 | 2.00 | 1.75 | 0.81 | 4.95 | 8.19 | 9.75 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 1.06 | 2.25 | 2.25 | 0.88 | 5.73 | 9.44 | 11.25 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

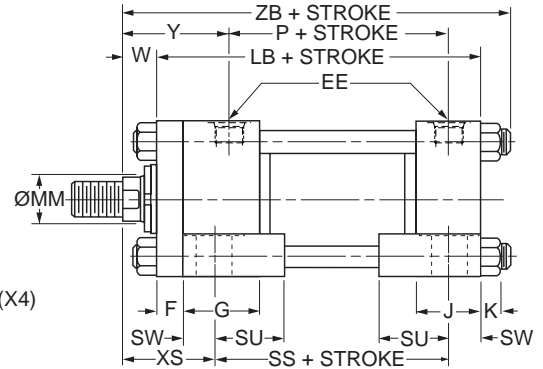
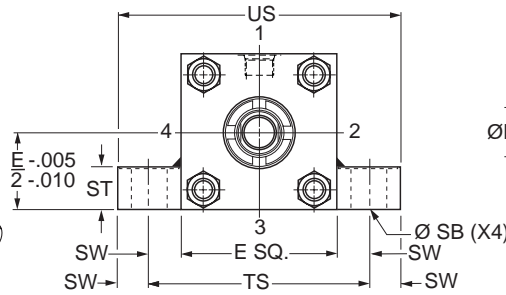
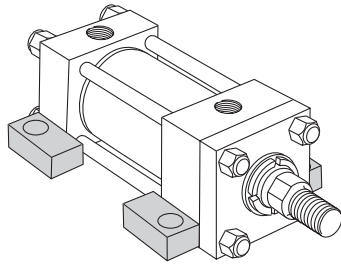
²SAE straight thread ports are standard and are indicated by port number.

Style HH – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | Y | Add Stroke |
|--------|----------|----------|------|------|------------|
| | | | | | XF |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 5.63 |
| | 2 | 1.000 | 1.00 | 2.38 | 6.00 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.00 |
| | 2 | 1.375 | 1.00 | 2.63 | 6.25 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 6.13 |
| | 2 | 1.750 | 1.25 | 2.88 | 6.63 |
| | 3 | 1.375 | 1.00 | 2.63 | 6.38 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 7.13 |
| | 2 | 2.000 | 1.25 | 3.13 | 7.50 |
| | 3 | 1.750 | 1.13 | 3.00 | 7.38 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 7.63 |
| | 2 | 2.500 | 1.38 | 3.38 | 8.00 |
| | 3 | 2.000 | 1.13 | 3.13 | 7.75 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 8.25 |
| | 2 | 3.500 | 1.38 | 3.38 | 8.50 |
| | 3 | 2.500 | 1.38 | 3.38 | 8.50 |
| | 4 | 3.000 | 1.38 | 3.38 | 8.50 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 9.63 |
| | 2 | 4.000 | 1.25 | 3.50 | 9.63 |
| | 3 | 3.000 | 1.25 | 3.50 | 9.63 |
| | 4 | 3.500 | 1.25 | 3.50 | 9.63 |

Mounting Information – 1.50" to 6.00" Bore Series 2H

Side Lug Mounting
Style C
(NFPA Style MS2)



Style C – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | G | J | K | SB ³ Ø | ST | SU | SW | TS | US | Add Stroke | | |
|--------|------|-------------------|------------------|------|------|------|------|-------------------|------|------|------|------|-------|------------|------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | | | LB | P | SS |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 0.44 | 0.50 | 0.94 | 0.38 | 3.25 | 4.00 | 5.00 | 2.88 | 3.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 0.56 | 0.75 | 1.25 | 0.50 | 4.00 | 5.00 | 5.25 | 2.88 | 3.63 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 0.81 | 1.00 | 1.56 | 0.69 | 4.88 | 6.25 | 5.38 | 3.00 | 3.38 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 0.81 | 1.00 | 1.56 | 0.69 | 5.88 | 7.25 | 6.25 | 3.50 | 4.13 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 1.06 | 1.25 | 2.00 | 0.88 | 6.75 | 8.50 | 6.63 | 3.75 | 4.00 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 1.06 | 1.25 | 2.00 | 0.88 | 8.25 | 10.00 | 7.13 | 4.25 | 4.50 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 1.31 | 1.50 | 2.50 | 1.13 | 9.75 | 12.00 | 8.38 | 4.88 | 5.13 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

³Upper surface spot faced for socket head screws.

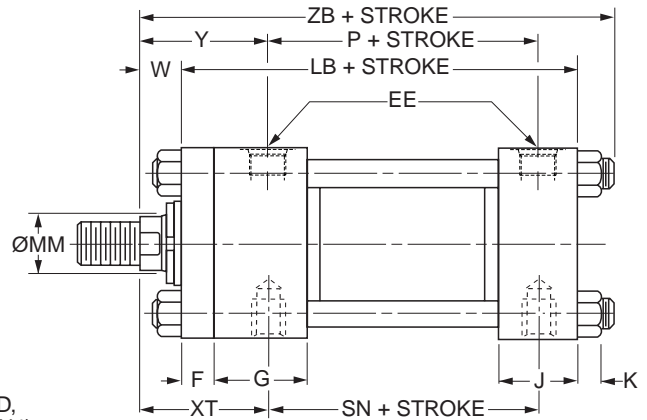
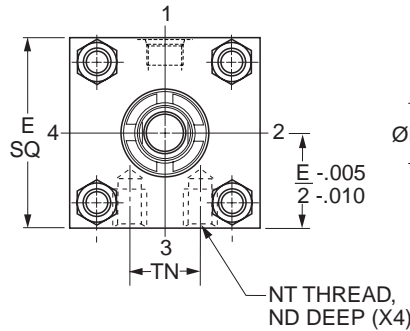
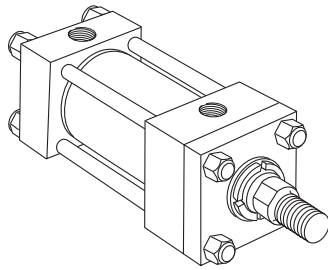
Style C – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | XS | Y | Add Stroke |
|--------|----------|----------|------|------|------|------------|
| | | | | | | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 1.38 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.00 | 1.75 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 1.88 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.00 | 2.13 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.06 | 2.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 2.56 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 2.31 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.31 | 2.75 | 7.94 |
| | 2 | 2.000 | 1.25 | 2.69 | 3.13 | 8.31 |
| | 3 | 1.750 | 1.13 | 2.56 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 2.75 | 3.00 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.13 | 3.38 | 8.88 |
| | 3 | 2.000 | 1.13 | 2.88 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 2.88 | 3.13 | 9.38 |
| | 2 | 3.500 | 1.38 | 3.13 | 3.38 | 9.63 |
| | 3 | 2.500 | 1.38 | 3.13 | 3.38 | 9.63 |
| | 4 | 3.000 | 1.38 | 3.13 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 2 | 4.000 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 3 | 3.000 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 4 | 3.500 | 1.25 | 3.38 | 3.50 | 10.81 |



Mounting Information – 1.50" to 6.00" Bore Series 2H

**Side Tapped Mounting
Style F
(NFPA Style MS4)**



Style F – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | G | J | K | ND | NT | TN | Add Stroke | | |
|-----------|------|-------------------|------------------|------|------|------|------|------|----------|------|------------|------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | LB | P | SN |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 0.38 | 3/8-16 | 0.75 | 5.00 | 2.88 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 0.44 | 1/2-13 | 0.94 | 5.25 | 2.88 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 0.50 | 5/8-11 | 1.31 | 5.38 | 3.00 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 0.69 | 3/4-10 | 1.50 | 6.25 | 3.50 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 0.69 | 1-8 | 2.06 | 6.63 | 3.75 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 1.00 | 1-8 | 2.94 | 7.13 | 4.25 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 1.25 | 1 1/4 -7 | 3.31 | 8.38 | 4.88 | 5.13 |

¹NPTF ports are available at no extra charge.

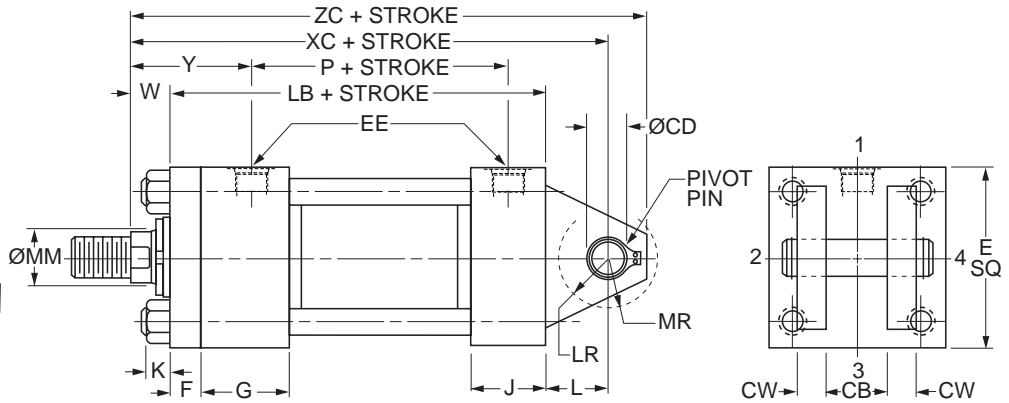
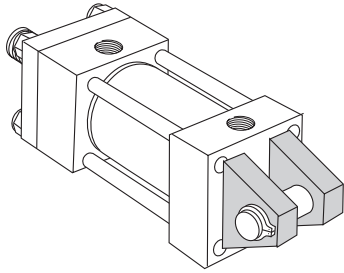
²SAE straight thread ports are standard and are indicated by port number.

Style F – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | XT | Y | Add Stroke |
|-----------|------------|-------------|------|------|------|------------|
| | | | | | | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.00 | 2.38 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.00 | 2.63 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 2.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 2.88 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 2.63 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 2.75 | 7.94 |
| | 2 | 2.000 | 1.25 | 3.13 | 3.13 | 8.31 |
| | 3 | 1.750 | 1.13 | 3.00 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 3.00 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.38 | 3.38 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.13 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 3.13 | 9.38 |
| | 2 | 3.500 | 1.38 | 3.38 | 3.38 | 9.63 |
| | 3 | 2.500 | 1.38 | 3.38 | 3.38 | 9.63 |
| | 4 | 3.000 | 1.38 | 3.38 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 3.50 | 10.81 |
| | 2 | 4.000 | 1.25 | 3.50 | 3.50 | 10.81 |
| | 3 | 3.000 | 1.25 | 3.50 | 3.50 | 10.81 |
| | 4 | 3.500 | 1.25 | 3.50 | 3.50 | 10.81 |

Mounting Information – 1.50" to 6.00" Bore Series 2H

Cap Fixed Clevis Mounting
Style BB
(NFFPA Style MP1)



Style BB – Dimensional and Mounting Data

| Bore Ø | E | EE | | CB | CD ³ Ø | CW | F | G | J | K | L | LR | MR | Add Stroke | |
|--------|------|-------------------|------------------|------|-------------------|------|------|------|------|------|------|------|------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.75 | .501 | 0.50 | 0.38 | 1.75 | 1.50 | 0.38 | 0.75 | 0.56 | 0.63 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 1.25 | .751 | 0.63 | 0.63 | 1.75 | 1.50 | 0.44 | 1.25 | 1.00 | 0.94 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 1.25 | .751 | 0.63 | 0.63 | 1.75 | 1.50 | 0.44 | 1.25 | 0.94 | 0.94 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 1.50 | 1.001 | 0.75 | 0.75 | 2.00 | 1.75 | 0.56 | 1.50 | 1.25 | 1.19 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 2.00 | 1.376 | 1.00 | 0.88 | 2.00 | 1.75 | 0.56 | 2.13 | 1.75 | 1.63 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 2.50 | 1.751 | 1.25 | 0.88 | 2.00 | 1.75 | 0.81 | 2.25 | 2.06 | 2.13 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 2.50 | 2.001 | 1.25 | 1.00 | 2.25 | 2.25 | 0.88 | 2.50 | 2.31 | 2.38 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

³Diameter CD is Pin Diameter.

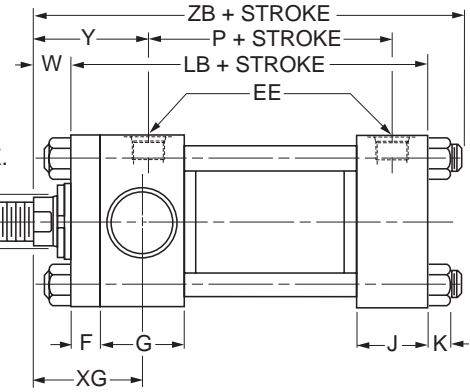
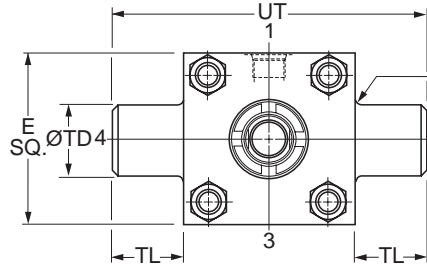
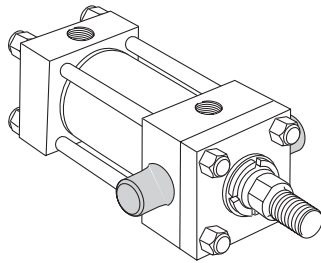
Style BB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | Y | Add Stroke | |
|--------|----------|----------|------|------|------------|-------|
| | | | | | XC | ZC |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 6.38 | 6.88 |
| | 2 | 1.000 | 1.00 | 2.38 | 6.75 | 7.25 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 7.25 | 8.00 |
| | 2 | 1.375 | 1.00 | 2.63 | 7.50 | 8.25 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 7.38 | 8.13 |
| | 2 | 1.750 | 1.25 | 2.88 | 7.88 | 8.63 |
| | 3 | 1.375 | 1.00 | 2.63 | 7.63 | 8.38 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 8.63 | 9.63 |
| | 2 | 2.000 | 1.25 | 3.13 | 9.00 | 10.00 |
| | 3 | 1.750 | 1.13 | 3.00 | 8.88 | 9.88 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 9.75 | 11.13 |
| | 2 | 2.500 | 1.38 | 3.38 | 10.13 | 11.50 |
| | 3 | 2.000 | 1.13 | 3.13 | 9.88 | 11.25 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 10.50 | 12.25 |
| | 2 | 3.500 | 1.38 | 3.38 | 10.75 | 12.50 |
| | 3 | 2.500 | 1.38 | 3.38 | 10.75 | 12.50 |
| | 4 | 3.000 | 1.38 | 3.38 | 10.75 | 12.50 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 12.13 | 14.13 |
| | 2 | 4.000 | 1.25 | 3.50 | 12.13 | 14.13 |
| | 3 | 3.000 | 1.25 | 3.50 | 12.13 | 14.13 |
| | 4 | 3.500 | 1.25 | 3.50 | 12.13 | 14.13 |



Mounting Information – 1.50" to 6.00" Bore Series 2H

**Head Trunnion Mounting
Style D
(NFPA Style MT1)**



Style D – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | G | J | K | TD Ø +0.000 -0.001 | TL | UT | Add Stroke | |
|-----------|------|-------------------|------------------|------|------|------|------|--------------------------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 1.000 | 1.00 | 4.50 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 5.75 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 6.25 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 8.00 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 8.50 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 1.750 | 1.75 | 10.00 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 2.000 | 2.00 | 11.50 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

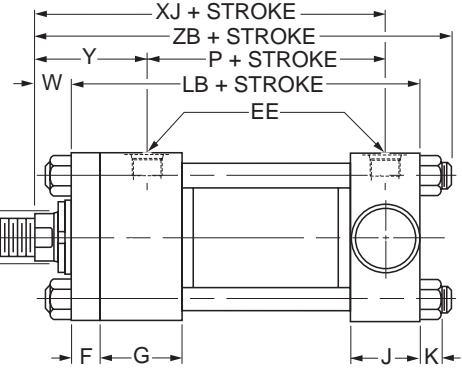
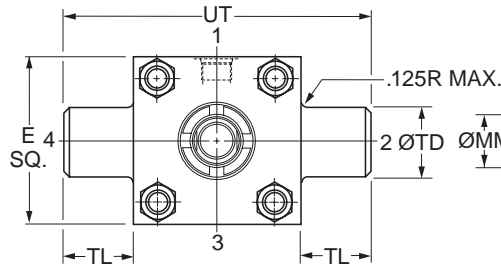
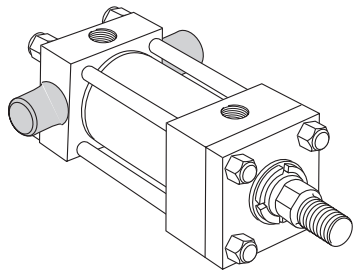
Style D – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | XG | Y | Add Stroke |
|-----------|------------|-------------|------|------|------|------------|
| | | | | | | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 1.88 | 2.00 | 6.25 |
| | 2 | 1.000 | 1.00 | 2.25 | 2.38 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.25 | 2.38 | 6.69 |
| | 2 | 1.375 | 1.00 | 2.50 | 2.63 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.25 | 2.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 2.75 | 2.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 2.50 | 2.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.63 | 2.75 | 7.94 |
| | 2 | 2.000 | 1.25 | 3.00 | 3.13 | 8.31 |
| | 3 | 1.750 | 1.13 | 2.88 | 3.00 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 2.88 | 3.00 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.25 | 3.38 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.00 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.00 | 3.13 | 9.38 |
| | 2 | 3.500 | 1.38 | 3.25 | 3.38 | 9.63 |
| | 3 | 2.500 | 1.38 | 3.25 | 3.38 | 9.63 |
| | 4 | 3.000 | 1.38 | 3.25 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 2 | 4.000 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 3 | 3.000 | 1.25 | 3.38 | 3.50 | 10.81 |
| | 4 | 3.500 | 1.25 | 3.38 | 3.50 | 10.81 |

Mounting Information – 1.50" to 6.00" Bore Series 2H

Cap Trunnion Mounting

Style DB
(NFPA Style MT2)



Style DB – Dimensional and Mounting Data

| Bore Ø | E | EE | | F | G | J | K | TD Ø +0.000 -0.001 | TL | UT | Add Stroke | |
|--------|------|-------------------|------------------|------|------|------|------|--------------------------|------|-------|------------|------|
| | | NPTF ¹ | SAE ² | | | | | | | | LB | P |
| 1.50 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 1.000 | 1.00 | 4.50 | 5.00 | 2.88 |
| 2.00 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 5.75 | 5.25 | 2.88 |
| 2.50 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 6.25 | 5.38 | 3.00 |
| 3.25 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 8.00 | 6.25 | 3.50 |
| 4.00 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 8.50 | 6.63 | 3.75 |
| 5.00 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 1.750 | 1.75 | 10.00 | 7.13 | 4.25 |
| 6.00 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 2.000 | 2.00 | 11.50 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

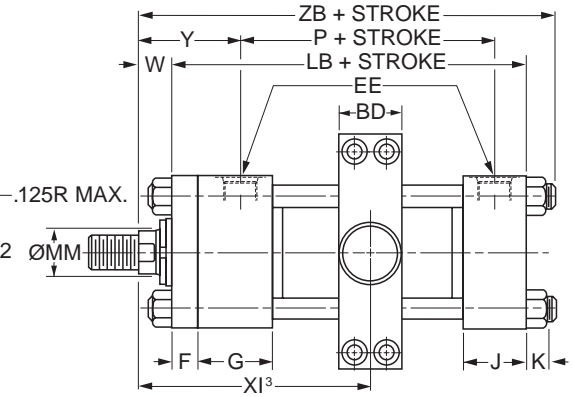
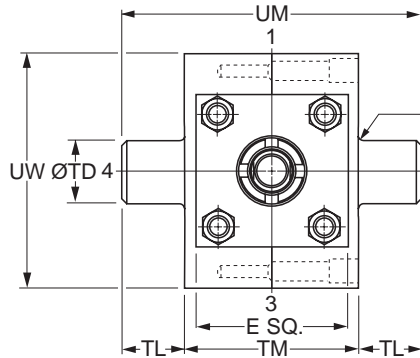
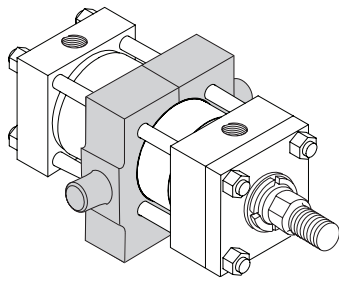
²SAE straight thread ports are standard and are indicated by port number.

Style DB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | W | Y | Add Stroke | |
|--------|----------|----------|------|------|------------|---------|
| | | | | | XJ | ZB Max. |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 4.88 | 6.25 |
| | 2 | 1.000 | 1.00 | 2.38 | 5.25 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 5.25 | 6.69 |
| | 2 | 1.375 | 1.00 | 2.63 | 5.50 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 5.38 | 6.81 |
| | 2 | 1.750 | 1.25 | 2.88 | 5.88 | 7.31 |
| | 3 | 1.375 | 1.00 | 2.63 | 5.63 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 6.25 | 7.94 |
| | 2 | 2.000 | 1.25 | 3.13 | 6.63 | 8.31 |
| | 3 | 1.750 | 1.13 | 3.00 | 6.50 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 6.75 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.38 | 7.13 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.13 | 6.88 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 7.38 | 9.38 |
| | 2 | 3.500 | 1.38 | 3.38 | 7.63 | 9.63 |
| | 3 | 2.500 | 1.38 | 3.38 | 7.63 | 9.63 |
| | 4 | 3.000 | 1.38 | 3.38 | 7.63 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 8.38 | 10.81 |
| | 2 | 4.000 | 1.25 | 3.50 | 8.38 | 10.81 |
| | 3 | 3.000 | 1.25 | 3.50 | 8.38 | 10.81 |
| | 4 | 3.500 | 1.25 | 3.50 | 8.38 | 10.81 |

Mounting Information – 1.50" to 6.00" Bore Series 2H

Intermediate Fixed Trunnion Mounting
Style DD
 (NFPA Style MT4)



Style DD – Dimensional and Mounting Data

| Bore Ø | BD | E | EE | | F | G | J | K | TD Ø +.000 -.001 | TL | TM | UM | UW | Add Stroke | |
|-----------|------|------|-------------------|------------------|------|------|------|------|------------------------|------|------|-------|-------|------------|------|
| | | | NPTF ¹ | SAE ² | | | | | | | | | | LB | P |
| 1.50 | 1.25 | 2.50 | 1/2 | 10 | 0.38 | 1.75 | 1.50 | 0.38 | 1.000 | 1.00 | 3.00 | 5.00 | 3.38 | 5.00 | 2.88 |
| 2.00 | 1.50 | 3.00 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 3.50 | 6.25 | 4.13 | 5.25 | 2.88 |
| 2.50 | 1.50 | 3.50 | 1/2 | 10 | 0.63 | 1.75 | 1.50 | 0.44 | 1.375 | 1.38 | 4.00 | 6.75 | 4.63 | 5.38 | 3.00 |
| 3.25 | 2.00 | 4.50 | 3/4 | 12 | 0.75 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 5.00 | 8.50 | 5.81 | 6.25 | 3.50 |
| 4.00 | 2.00 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 1.750 | 1.75 | 5.50 | 9.00 | 6.38 | 6.63 | 3.75 |
| 5.00 | 2.00 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 1.750 | 1.75 | 7.00 | 10.50 | 7.75 | 7.13 | 4.25 |
| 6.00 | 3.00 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 2.000 | 2.00 | 8.50 | 12.50 | 10.38 | 8.38 | 4.88 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style DD – Dimensional and Mounting Data

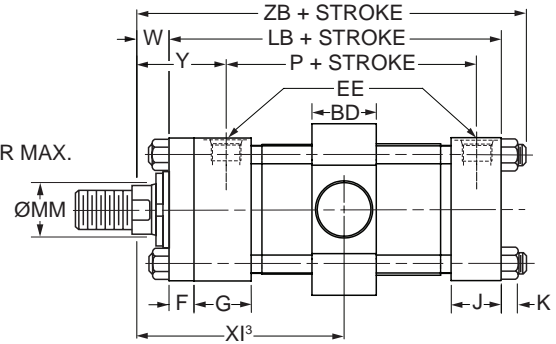
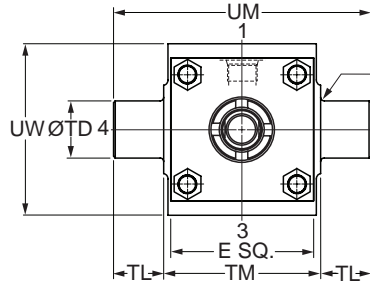
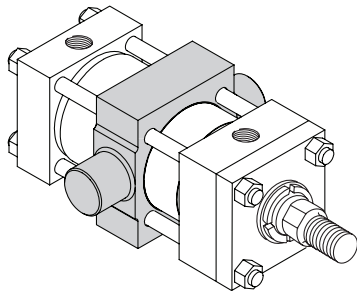
| Bore Ø | Rod No. | MM Rod Ø | W | Y | Min. XI ³ | Min. Stroke | Add Stroke |
|-----------|------------|----------------|------|------|-------------------------|----------------|------------|
| | | | | | | | ZB Max |
| 1.50 | 1 (std.) | 0.625 | 0.63 | 2.00 | 3.44 | 0 | 6.25 |
| | 2 | 1.000 | 1.00 | 2.38 | 3.81 | 0 | 6.63 |
| 2.00 | 1 (std.) | 1.000 | 0.75 | 2.38 | 3.94 | 0.25 | 6.69 |
| | 2 | 1.375 | 1.00 | 2.63 | 4.19 | 0.25 | 6.94 |
| 2.50 | 1 (std.) | 1.000 | 0.75 | 2.38 | 3.94 | 0.13 | 6.81 |
| | 2 | 1.750 | 1.25 | 2.88 | 4.44 | 0.13 | 7.31 |
| | 3 | 1.375 | 1.00 | 2.63 | 4.19 | 0.13 | 7.06 |
| 3.25 | 1 (std.) | 1.375 | 0.88 | 2.75 | 4.69 | 0.38 | 7.94 |
| | 2 | 2.000 | 1.25 | 3.13 | 5.06 | 0.38 | 8.31 |
| | 3 | 1.750 | 1.13 | 3.00 | 4.94 | 0.38 | 8.19 |
| 4.00 | 1 (std.) | 1.750 | 1.00 | 3.00 | 4.94 | 0.13 | 8.50 |
| | 2 | 2.500 | 1.38 | 3.38 | 5.31 | 0.13 | 8.88 |
| | 3 | 2.000 | 1.13 | 3.13 | 5.06 | 0.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 1.13 | 3.13 | 5.06 | 0 | 9.38 |
| | 2 | 3.500 | 1.38 | 3.38 | 5.31 | 0 | 9.63 |
| | 3 | 2.500 | 1.38 | 3.38 | 5.31 | 0 | 9.63 |
| | 4 | 3.000 | 1.38 | 3.38 | 5.31 | 0 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 1.25 | 3.50 | 6.06 | 0.25 | 10.81 |
| | 2 | 4.000 | 1.25 | 3.50 | 6.06 | 0.25 | 10.81 |
| | 3 | 3.000 | 1.25 | 3.50 | 6.06 | 0.25 | 10.81 |
| | 4 | 3.500 | 1.25 | 3.50 | 6.06 | 0.25 | 10.81 |

³Dimension XI to be specified by customer.

Mounting Information – 1.50" to 6.00" Bore Series 2H

Heavy Duty Intermediate Fixed Trunnion Mounting

Style DE
(NFPA Style MT4)



Style DE – Dimensional and Mounting Data

| Bore Ø | BD | E | EE | | F | G | J | K | TD Ø +0.000 -0.001 | TL | TM | UM | UW | Add Stroke | | Style DE Minimum Stroke |
|--------|------|------|-------------------|------------------|------|------|------|------|--------------------------|------|------|-------|------|------------|------|-------------------------------|
| | | | NPTF ¹ | SAE ² | | | | | | | | | | LB | P | |
| 4.00 | 2.25 | 5.00 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.56 | 2.000 | 1.75 | 5.50 | 9.00 | 6.00 | 6.63 | 3.75 | 0.13 |
| 5.00 | 2.75 | 6.50 | 3/4 | 12 | 0.88 | 2.00 | 1.75 | 0.81 | 2.500 | 1.75 | 7.00 | 10.50 | 7.50 | 7.13 | 4.25 | 0.00 |
| 6.00 | 3.25 | 7.50 | 1 | 16 | 1.00 | 2.25 | 2.25 | 0.88 | 3.000 | 2.00 | 8.50 | 12.50 | 9.50 | 8.38 | 4.88 | 0.25 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style DE – Dimensional and Mounting Data

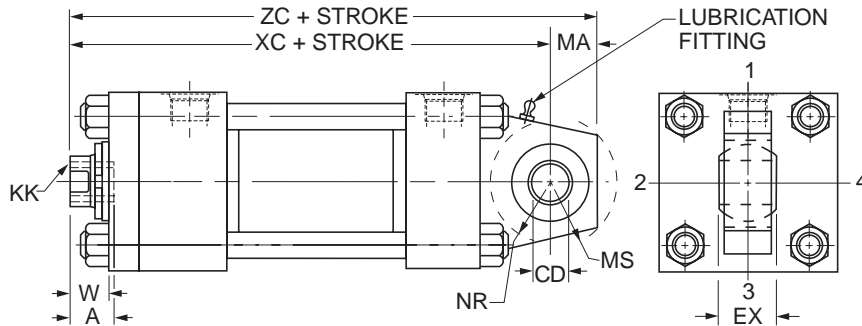
| Bore Ø | Rod No. | MM Rod Ø | Min. XI ³ | W | Y | Add Stroke |
|--------|----------|----------|----------------------|------|------|------------|
| | | | | | | ZB Max. |
| 4.00 | 1 (std.) | 1.750 | 4.94 | 1.00 | 3.00 | 8.50 |
| | 2 | 2.500 | 5.31 | 1.38 | 3.38 | 8.88 |
| | 3 | 2.000 | 5.06 | 1.13 | 3.13 | 8.63 |
| 5.00 | 1 (std.) | 2.000 | 5.06 | 1.13 | 3.13 | 9.38 |
| | 2 | 3.500 | 5.31 | 1.38 | 3.38 | 9.63 |
| | 3 | 2.500 | 5.31 | 1.38 | 3.38 | 9.63 |
| | 4 | 3.000 | 5.31 | 1.38 | 3.38 | 9.63 |
| 6.00 | 1 (std.) | 2.500 | 6.06 | 1.25 | 3.50 | 10.81 |
| | 2 | 4.000 | 6.06 | 1.25 | 3.50 | 10.81 |
| | 3 | 3.000 | 6.06 | 1.25 | 3.50 | 10.81 |
| | 4 | 3.500 | 6.06 | 1.25 | 3.50 | 10.81 |

³Dimension XI to be specified by customer.

Mounting Information – 1.50" to 6.00" Bore Series 2H

Spherical Bearing Mounting
Style SB

| Bore Ø | Maximum Operating psi ¹ |
|--------|------------------------------------|
| 1.50 | 1500 |
| 2.00 | 2200 |
| 2.50 | 1450 |
| 3.25 | 1500 |
| 4.00 | 1850 |
| 5.00 | 2000 |
| 6.00 | 1800 |



Style SB — Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | Thread | | A | CD ² Ø | EX | MA | MS | NR | W | Add Stroke | | |
|--------|----------|----------|-------------------------|-------------------------|------|-------------------|------|------|------|------|------|------------|-------|-------|
| | | | Style 9 KK ³ | Style 7 KK ³ | | | | | | | | XC | ZC | |
| 1.50 | 1 (Std.) | 0.625 | 7/16-20 | — | 0.75 | -.0005 .5000 | 0.44 | 0.75 | 0.94 | 0.63 | 0.63 | 6.38 | 7.13 | |
| | 2 | 1.000 | — | 7/16-20 | 0.75 | | | | | | | 1.00 | 6.75 | 7.50 |
| 2.00 | 1 (Std.) | 1.000 | 3/4-16 | — | 1.13 | -.0005 .7500 | 0.66 | 1.00 | 1.38 | 1.00 | 0.75 | 7.25 | 8.25 | |
| | 2 | 1.375 | — | 3/4-16 | 1.13 | | | | | | | 1.00 | 7.50 | 8.50 |
| 2.50 | 1 (Std.) | 1.000 | 3/4-16 | — | 1.13 | -.0005 .7500 | 0.66 | 1.00 | 1.38 | 1.00 | 0.75 | 7.38 | 8.38 | |
| | 2 | 1.750 | — | 3/4-16 | 1.13 | | | | | | | 1.25 | 7.88 | 8.88 |
| | 3 | 1.375 | — | 3/4-16 | 1.13 | | | | | | | 1.00 | 7.63 | 8.63 |
| 3.25 | 1 (Std.) | 1.375 | 1-14 | — | 1.63 | -.0005 1.0000 | 0.88 | 1.25 | 1.69 | 1.25 | 0.88 | 8.63 | 9.88 | |
| | 2 | 2.000 | — | 1-14 | 1.63 | | | | | | | 1.25 | 9.00 | 10.25 |
| | 3 | 1.750 | — | 1-14 | 1.63 | | | | | | | 1.13 | 8.88 | 10.13 |
| 4.00 | 1 (Std.) | 1.750 | 1 1/4-12 | — | 2.00 | -.0005 1.3750 | 1.19 | 1.88 | 2.44 | 1.63 | 1.00 | 9.75 | 11.63 | |
| | 2 | 2.500 | — | 1 1/4-12 | 2.00 | | | | | | | 1.38 | 10.13 | 12.00 |
| | 3 | 2.000 | — | 1 1/4-12 | 2.00 | | | | | | | 1.13 | 9.88 | 11.75 |
| 5.00 | 1 (Std.) | 2.000 | 1 1/2-12 | — | 2.25 | -.0005 1.7500 | 1.53 | 2.50 | 2.88 | 2.06 | 1.13 | 10.50 | 13.00 | |
| | 2 | 3.500 | — | 1 1/2-12 | 2.25 | | | | | | | 1.38 | 10.75 | 13.25 |
| | 3 | 2.500 | — | 1 1/2-12 | 2.25 | | | | | | | 1.38 | 10.75 | 13.25 |
| | 4 | 3.000 | — | 1 1/2-12 | 2.25 | | | | | | | 1.38 | 10.75 | 13.25 |
| 6.00 | 1 (Std.) | 2.500 | 1 7/8-12 | — | 3.00 | -.0005 2.0000 | 1.75 | 2.50 | 3.31 | 2.38 | 1.25 | 12.13 | 14.63 | |
| | 2 | 4.000 | — | 1 7/8-12 | 3.00 | | | | | | | 1.25 | 12.13 | 14.63 |
| | 3 | 3.000 | — | 1 7/8-12 | 3.00 | | | | | | | 1.25 | 12.13 | 14.63 |
| | 4 | 3.500 | — | 1 7/8-12 | 3.00 | | | | | | | 1.25 | 12.13 | 14.63 |

Note: for additional dimensions see Series 2H Style BB mount.

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

² Dimension "CD" is hole diameter.

³ 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 2H/3H mounting accessories for detailed information.

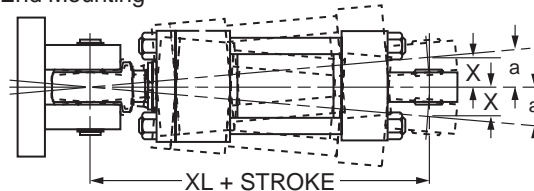
Style SB – Recommended maximum swivel angle on each side of the cylinder centerline.

| Bore Ø | Head End Mounted | | Cap End Mounted | |
|--------|------------------|-----------|-----------------|-----------|
| | Angle a | Tan. of a | Angle a | Tan. of a |
| 1.50 | 2.00° | .035 | 2.00° | .035 |
| 2.00 | 2.50° | .044 | 4.50° | .079 |
| 2.50 | 2.50° | .044 | 4.50° | .079 |
| 3.25 | 3.00° | .052 | 3.00° | .052 |
| 4.00 | 2.50° | .044 | 3.00° | .052 |
| 5.00 | 3.00° | .052 | 3.00° | .052 |
| 6.00 | 3.00° | .052 | 3.00° | .052 |

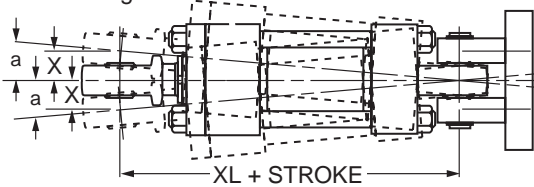
Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply the distance between pivot pin holes by tangent of angle a. For extended position use X = XL + 2X stroke.

Mounting Information

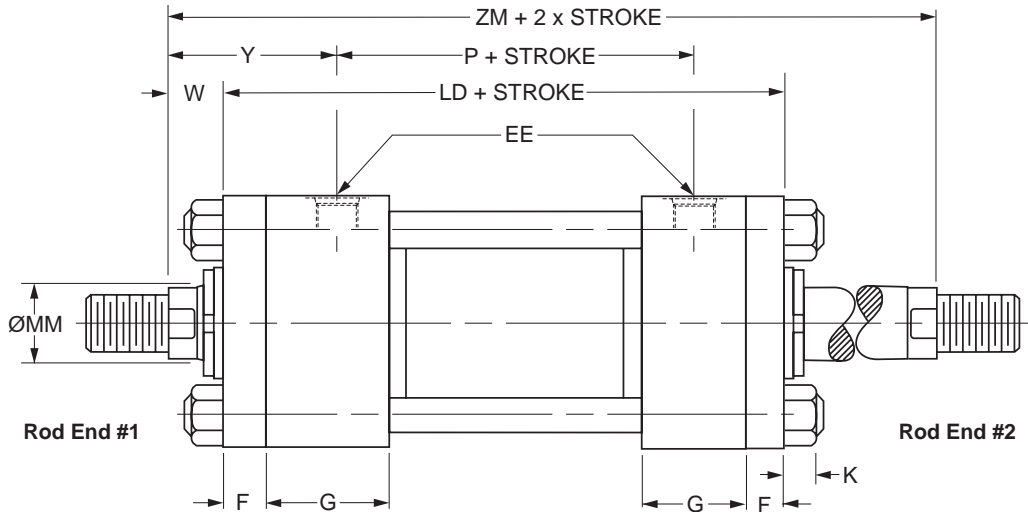
Head End Mounting



Cap End Mounting



**Double Rod Cylinder
Style K**



| Mounting Styles for Single Rod Models | Mounting Styles for Corresponding Double Rod Models ¹ | Dimensions Shown on This Page Supplement Dimensions on Pages Listed Below |
|---------------------------------------|--|---|
| | | 1.50" - 6.00" Bores Page No. |
| T | KT | 12 |
| TB | KTB | 12 |
| TD | KTD | 12 |
| J | KJ | 13 |
| JB | KJB | 14 |
| JJ | KJJ | 15 |
| C | KC | 19 |
| F | KF | 20 |
| D | KD | 22 |
| DD | KDD ² | 24 |
| DE | KDE ² | 25 |

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

² Specify XI dimension from rod end #1.

| Bore Ø | Rod No. | MM Rod Ø | Add Stroke | | | Add 2X Stroke |
|---|----------|----------|-----------------|------|------|-----------------|
| | | | LD | SNK | SSK | ZM |
| 1.50 | 1 (std.) | 0.625 | 5.63 | 2.88 | 4.13 | 6.88 |
| | 2 | 1.000 | 5.63 | 2.88 | 4.13 | 7.63 |
| 2.00 | 1 (std.) | 1.000 | 6.13 | 2.88 | 3.88 | 7.63 |
| | 2 | 1.375 | 6.13 | 2.88 | 3.88 | 8.13 |
| 2.50 | 1 (std.) | 1.000 | 6.25 | 3.00 | 3.63 | 7.75 |
| | 2 | 1.750 | 6.25 | 3.00 | 3.63 | 8.75 |
| | 3 | 1.375 | 6.25 | 3.00 | 3.63 | 8.25 |
| 3.25 | 1 (std.) | 1.375 | 7.25 | 3.50 | 4.38 | 9.00 |
| | 2 | 2.000 | 7.25 | 3.50 | 4.38 | 9.75 |
| | 3 | 1.750 | 7.25 | 3.50 | 4.38 | 9.50 |
| 4.00 | 1 (std.) | 1.750 | 7.75 | 3.75 | 4.25 | 9.75 |
| | 2 | 2.500 | 7.75 | 3.75 | 4.25 | 10.50 |
| | 3 | 2.000 | 7.75 | 3.75 | 4.25 | 10.00 |
| 5.00 | 1 (std.) | 2.000 | 8.25 | 4.25 | 4.75 | 10.50 |
| | 2 | 3.500 | 8.25 | 4.25 | 4.75 | 11.00 |
| | 3 | 2.500 | 8.25 | 4.25 | 4.75 | 11.00 |
| | 4 | 3.000 | 8.25 | 4.25 | 4.75 | 11.00 |
| 6.00 | 1 (std.) | 2.500 | 9.38 | 4.88 | 5.13 | 11.88 |
| | 2 | 4.000 | 9.38 | 4.88 | 5.13 | 11.88 |
| | 3 | 3.000 | 9.38 | 4.88 | 5.13 | 11.88 |
| | 4 | 3.500 | 9.38 | 4.88 | 5.13 | 11.88 |
| Replaces On single rod mounting styles: | | | LB | SN | SS | - |
| | | | All Mtg. Styles | F | C | All Mtg. Styles |

**How to Use Double Rod Cylinder
Dimension Drawings**

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 supplement the single rod dimensions with those shown on drawing at right 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 E.

Bolt-On Gland Option Series 2HD & 3HD Heavy Duty Hydraulic Cylinders



Now Featuring Optional Bolt-On Gland

**For 1.50"-6.00" Bore Series 2H and
7.00" & 8.00" Bore Series 3H Cylinders**

- **Non-threaded gland is clamped between bolt-on circular retainer and head for simplified service**
- **Polyurethane Rod Seal with multiple sealing edges for leak proof service**
- **Long inboard rod bearing surface that is lubricated from within**

Parker Series 2HD & 3HD – your best choice in heavy duty hydraulic cylinders

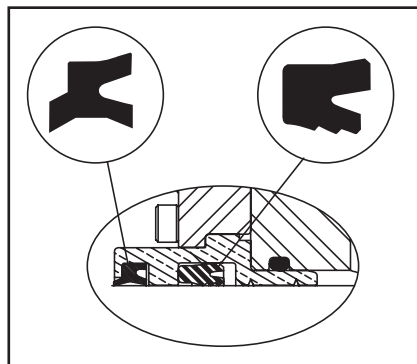
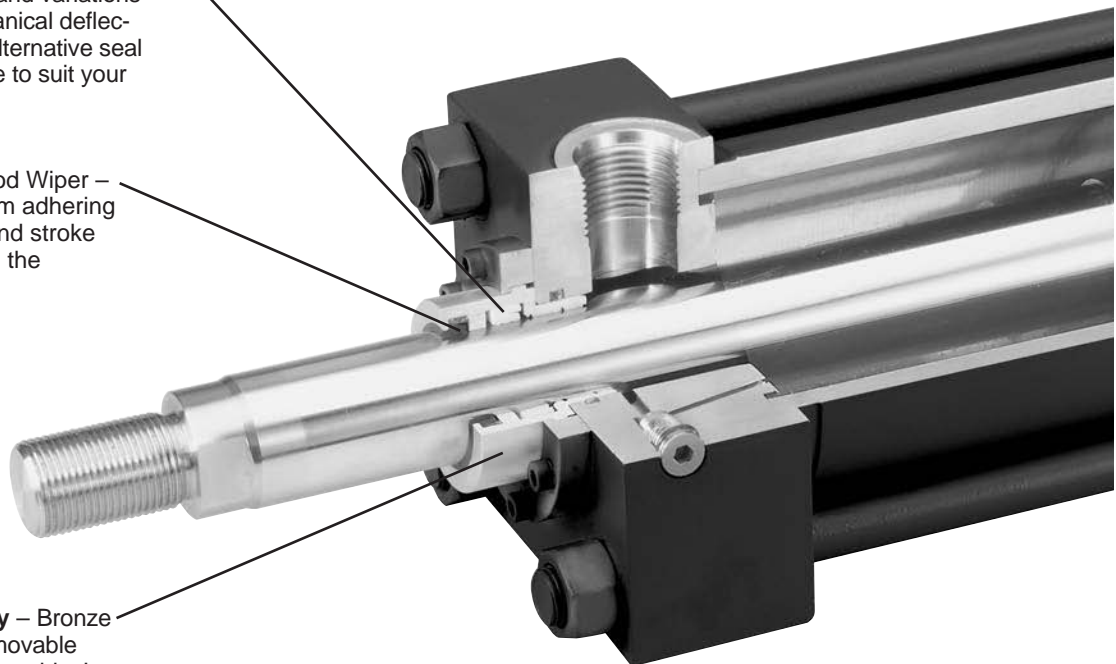
Parker Series 2HD and 3HD hydraulic cylinders offer increased durability and ease of service with the addition of a bolt-on rod gland. The 2HD/3HD rod gland was designed to withstand the toughest applications while maintaining the original dimensional envelope of the

Series 2H and 3H cylinder. When requesting this option, please take note of the following page that depicts rod gland retainer dimensions unique to the rod end of the 2HD/3HD cylinder. All other dimensions will remain the same as the standard Series 2H or 3H cylinder.

Primary Seal – Polyurethane Rod Seal is a proven leak proof design – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur. Alternative seal materials are available to suit your application.

Secondary Seal – Rod Wiper – wipes clean any oil film adhering to the rod on the extend stroke and cleans the rod on the return stroke.

Rod Gland Assembly – Bronze gland is externally removable without cylinder disassembly. Long inboard bearing surface is ahead of the seals assuring lubrication by cylinder operating fluid.

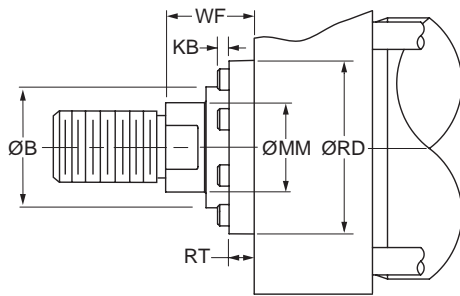


Gland Assembly

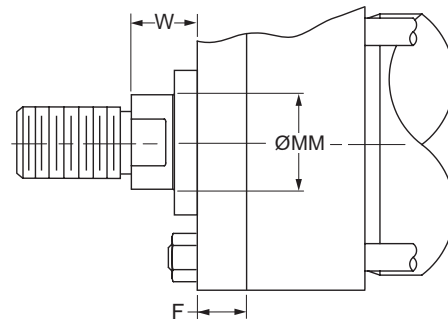
Gland Assembly is externally removable without cylinder disassembly. An O-ring is used as a seal between the gland and head. The rod seal has multiple sealing edges to produce “dry rod” performance. It is molded from a special polyurethane material that is extremely resistant to abrasion and extrusion, resulting in exceptional service life. Wiperseal cleans rod of dirt, preventing it from entering the gland and also acts as a secondary rod seal.



2HD / 3HD Rod Gland Dimensional Comparison



Bolt On Rod Gland (B)



Tie Rod Retained Gland (R)

| Bore Ø | Rod No. | MM Rod Ø | 2HD Rod Gland Retention | | | | Bolt On Rod Gland Dimensions | | | | | | | |
|--------|----------|----------|--|--------|--------------------|----|------------------------------|---------|------|------|------|------|------|------|
| | | | Mounting Style | | | | B Ø +0.000 -0.002 | RD Ø | RT | KB | VF | W | WF | F |
| | | | TC, H, HB, HH, C, F, D, DB, DD, DE, BB, SB | TB, TD | J, JB ¹ | JJ | | | | | | | | |
| 1.50 | 1 (Std.) | 0.625 | B | R | R | B | 1.124 | 1.94 | 0.38 | 0.19 | 0.25 | 0.63 | 1.00 | 0.38 |
| | 2 | 1.000 | R | R | R | B | 1.499 | 2.38 | 0.38 | 0.19 | 0.50 | 1.00 | 1.38 | 0.38 |
| 2.00 | 1 (Std.) | 1.000 | B | R | R | B | 1.499 | 2.38 | 0.38 | 0.19 | 0.50 | 0.75 | 1.38 | 0.63 |
| | 2 | 1.375 | R | R | R | B | 1.999 | 2.88 | 0.38 | 0.19 | 0.63 | 1.00 | 1.63 | 0.63 |
| 2.50 | 1 (Std.) | 1.000 | B | B | B | B | 1.499 | 2.38 | 0.38 | 0.19 | 0.50 | 0.75 | 1.38 | 0.63 |
| | 2 | 1.750 | B | B | B | B | 2.374 | 3.47 | 0.63 | 0.19 | 0.50 | 1.25 | 1.88 | 0.63 |
| | 3 | 1.375 | B | B | R | B | 1.999 | 2.88 | 0.38 | 0.19 | 0.63 | 1.00 | 1.63 | 0.63 |
| 3.25 | 1 (Std.) | 1.375 | B | B | B | B | 1.999 | 2.88 | 0.38 | 0.19 | 0.63 | 0.88 | 1.63 | 0.75 |
| | 2 | 2.000 | B | B | B | B | 2.624 | 3.72 | 0.63 | 0.19 | 0.50 | 1.25 | 2.00 | 0.75 |
| | 3 | 1.750 | B | B | B | B | 2.374 | 3.47 | 0.63 | 0.25 | 0.50 | 1.13 | 1.88 | 0.75 |
| 4.00 | 1 (Std.) | 1.750 | B | B | B | B | 2.374 | 3.47 | 0.63 | 0.19 | 0.50 | 1.00 | 1.88 | 0.88 |
| | 2 | 2.500 | B | B | B | B | 3.124 | 4.25 | 0.63 | 0.25 | 0.63 | 1.38 | 2.25 | 0.88 |
| | 3 | 2.000 | B | B | B | B | 2.624 | 3.72 | 0.63 | 0.25 | 0.50 | 1.13 | 2.00 | 0.88 |
| 5.00 | 1 (Std.) | 2.000 | B | B | B | B | 2.624 | 3.72 | 0.63 | 0.25 | 0.50 | 1.13 | 2.00 | 0.88 |
| | 2 | 3.500 | B | B | B | B | 4.249 | 5.94 | 0.94 | 0.25 | 0.31 | 1.38 | 2.25 | 0.88 |
| | 3 | 2.500 | B | B | B | B | 3.124 | 4.25 | 0.63 | - | 0.63 | 1.38 | 2.25 | 0.88 |
| | 4 | 3.000 | B | B | B | B | 3.749 | 5.44 | 0.88 | - | 0.31 | 1.38 | 2.25 | 0.88 |
| 6.00 | 1 (Std.) | 2.500 | B | B | B | B | 3.124 | 4.25 | 0.63 | 0.25 | 0.63 | 1.25 | 2.25 | 1.00 |
| | 2 | 4.000 | B | B | B | B | 4.749 | 6.31 | 0.94 | - | 0.31 | 1.25 | 2.25 | 1.00 |
| | 3 | 3.000 | B | B | B | B | 3.749 | 5.44 | 0.88 | - | 0.31 | 1.25 | 2.25 | 1.00 |
| | 4 | 3.500 | B | B | B | B | 4.249 | 5.94 | 0.94 | - | 0.31 | 1.25 | 2.25 | 1.00 |
| 7.00 | 1 (Std.) | 3.000 | B | B | B | B | 3.749 | 5.44 | 0.88 | - | 0.31 | - | 2.25 | 1.00 |
| | 2 | 5.000 | B | B | B | B | 5.749 | 7.44 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 3 | 3.500 | B | B | B | B | 4.249 | 5.94 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 4 | 4.000 | B | B | B | B | 4.749 | 6.31 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 5 | 4.500 | B | B | B | B | 5.249 | 6.94 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| 8.00 | 1 (Std.) | 3.500 | B | B | B | B | 4.249 | 5.94 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 2 | 5.500 | B | B | B | B | 6.249 | 7.94 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 3 | 4.000 | B | B | B | B | 4.749 | 6.31 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 4 | 4.500 | B | B | B | B | 5.249 | 6.94 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |
| | 5 | 5.000 | B | B | B | B | 5.749 | 7.44 | 0.94 | - | 0.31 | - | 2.25 | 1.00 |

B = Bolt-On Gland with Circular Retainer

R = Tie Rod Retained Gland

¹ 2H J & JB Mounts have reduced pressure ratings. Refer to J and JB mounts in 2H Section for de-rated operating pressure associated with the use of the 2HD gland.

Section B

Series 3H High Pressure Hydraulic Cylinders

| | 7.00" & 8.00" Bore | 10.00" through 20.00" Bore |
|---------------------------------------|--------------------|----------------------------|
| Design Features | 32 | 32 |
| Specifications, Mounting Styles | 34 | 35 |
| 3H Cylinder Model Code & How to Order | 36 | 36 |
| Rod End Styles and Dimensions | 38 | 39 |
| TB, TC and TD Dimensions | 40 | 53 |
| H Mount Dimensions | 41 | — |
| HB Mount Dimensions | 42 | 58 |
| HH Mount Dimensions | 42 | 57 |
| J Mount Dimensions | 43 | — |
| JB Mount Dimensions | 44 | 56 |
| JJ Mount Dimensions | 45 | 54, 55 |
| C Mount Dimensions | 46 | 59 |
| F Mount Dimensions | 46 | — |
| BB Mount Dimensions | 47 | 60 |
| D Mount Dimensions | 48 | 61 |
| DB Mount Dimensions | 49 | 62 |
| DD Mount Dimensions | 50 | 63 |
| DE Mount Dimensions | 51 | — |
| Double Rod End Cylinders | 52 | 64 |



The large bore, high pressure hydraulic cylinder Parker designed to meet your needs

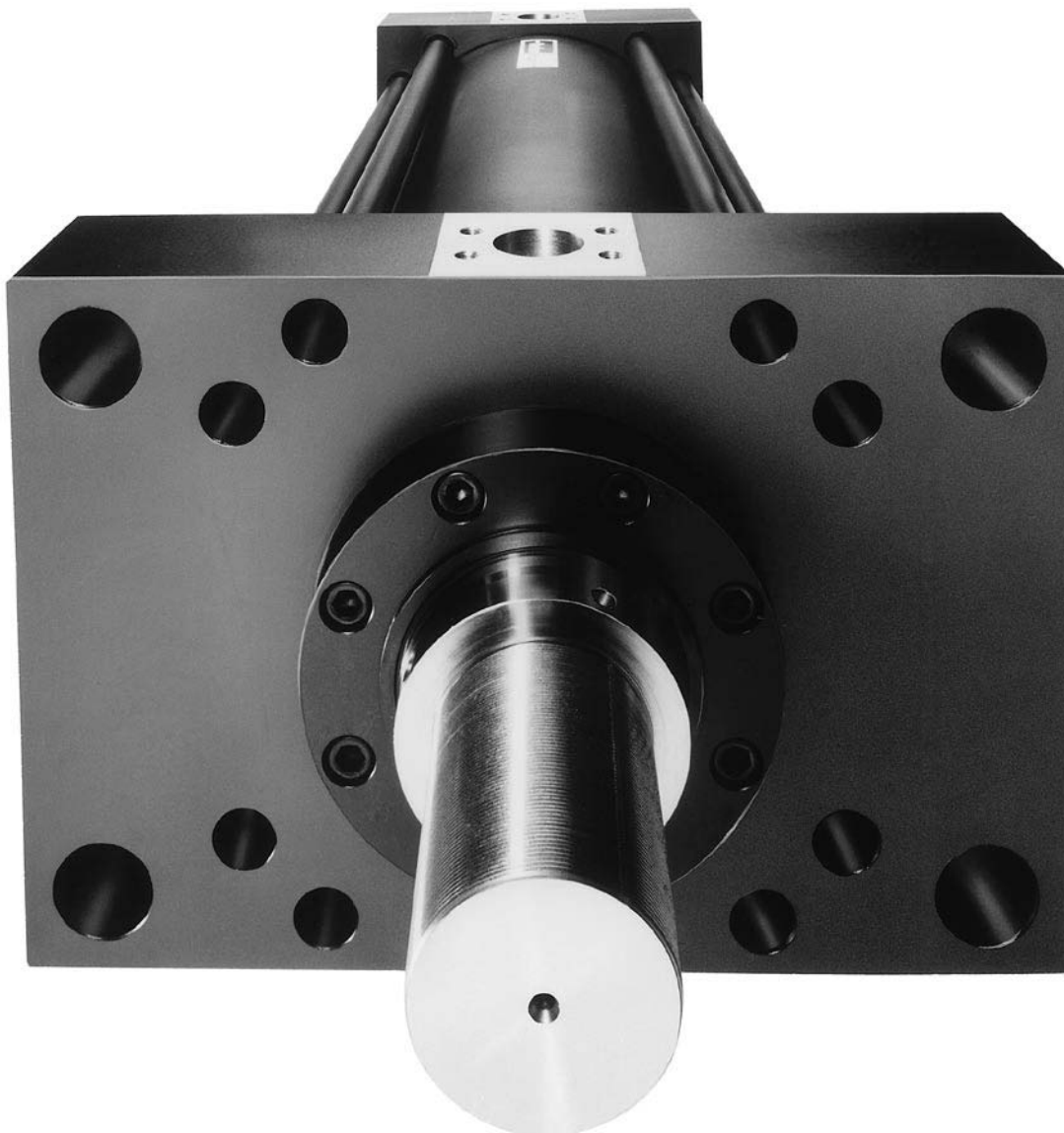
Parker Series 3H cylinders provide unmatched reliability, performance, and innovative design features that aid in increasing productivity while reducing operating costs.

Parker's externally removable bolt-on gland assembly makes preventive and routine maintenance quick and easy! In many cases, the cylinder does not have to be removed or disassembled to facilitate service. Our innovative design provides for fast turn around, reduced downtime, and increased productivity.

In addition to our removable gland assembly, Series 3H cylinders also include a multitude of innovative design

features such as: anti-extrusion body end seals, floating cushions, hi load piston (standard), and various port and rod end options to meet your application requirements.

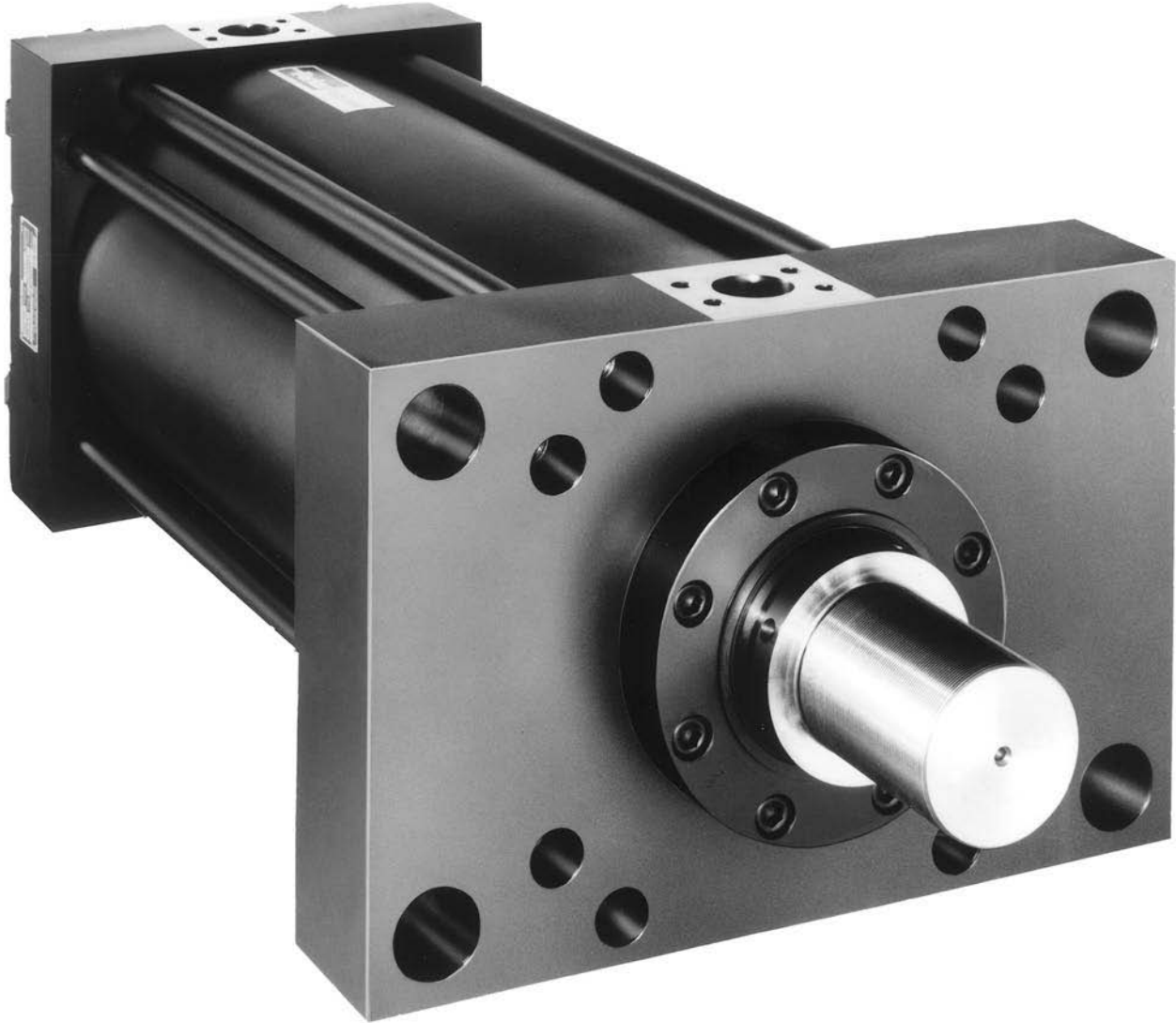
Every Series 3H cylinder is individually tested before leaving our plant to assure proper and leak free operation. All Series 3H cylinders come with an eighteen month warranty standard.



High Pressure Hydraulic Cylinders

Series 3H

7.00" through 20.00"



B

Heavy Duty Service – Industrial Tie-Rod Construction

- Nominal Pressure – 3000 psi
- Sixteen Standard Mounting Styles – 7.00" and 8.00" Bore
- Twelve Standard Mounting Styles – 10.00" through 20.00" Bore

Specifications / Mountings – 7.00" and 8.00" Series 3H

Standard Specifications

- Heavy Duty Service — ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards
- Standard Construction — Square Head – Tie Rod Design
- Nominal Pressure — 3000 psi¹
- Standard Fluid — Hydraulic Oil
- Standard Temperature — -10°F to +165°F²
- Piston Rod Diameter — 3.000" through 5.500"

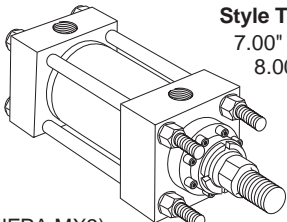
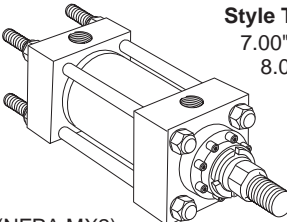
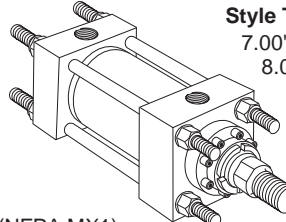
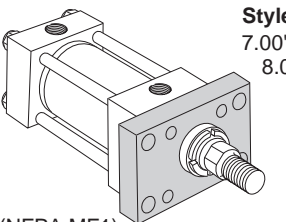
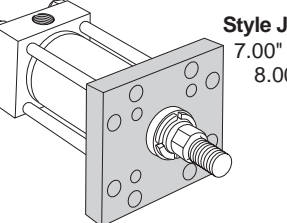
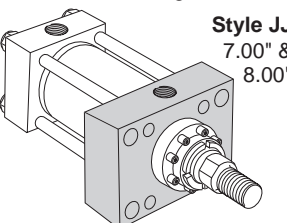
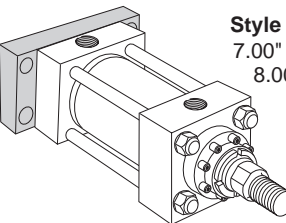
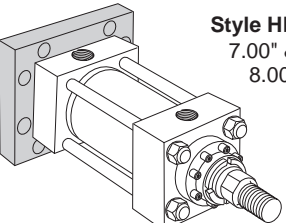
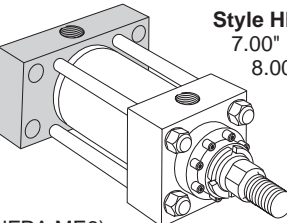
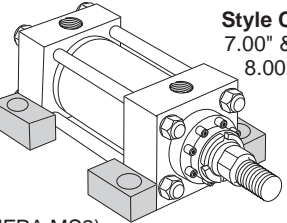
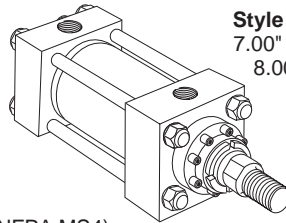
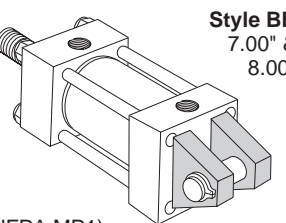
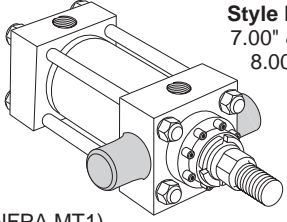
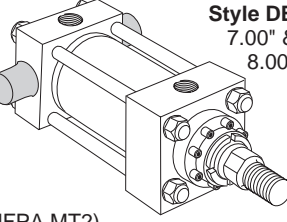
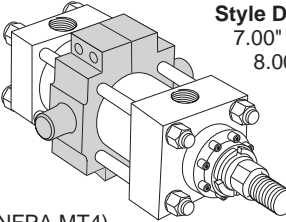
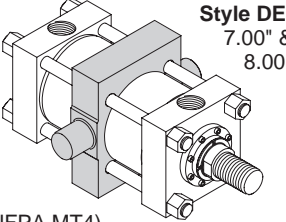
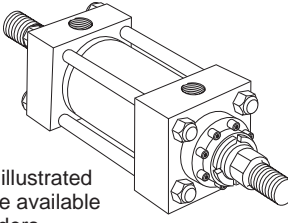
In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

- Mounting Styles — 16 standard styles at various application ratings
- Strokes — Available in any practical stroke length
- Cushions — Optional at either end or both ends of stroke
- Rod Ends — Four Standard Choices — specials to order

¹ If hydraulic operating pressure exceeds 3000 psi, send application data for engineering evaluation and recommendation. See Section E for actual design factors.

² See Section E for higher temperature service.

Available Mounting Styles

| | | | |
|--|---|--|--|
| <p>Tie Rods Extended Head End</p>  <p>Style TB 7.00" & 8.00"</p> <p>(NFPA MX3)</p> | <p>Tie Rods Extended Cap End</p>  <p>Style TC 7.00" & 8.00"</p> <p>(NFPA MX2)</p> | <p>Tie Rods Extended Both Ends</p>  <p>Style TD 7.00" & 8.00"</p> <p>(NFPA MX1)</p> | <p>Head Rectangular Flange</p>  <p>Style J 7.00" & 8.00"</p> <p>(NFPA MF1)</p> |
| <p>Head Square Flange</p>  <p>Style JB 7.00" & 8.00"</p> <p>(NFPA MF5)</p> | <p>Head Rectangular</p>  <p>Style JJ 7.00" & 8.00"</p> <p>(NFPA ME5)</p> | <p>Cap Rectangular Flange</p>  <p>Style H 7.00" & 8.00"</p> <p>(NFPA MF2)</p> | <p>Cap Square Flange</p>  <p>Style HB 7.00" & 8.00"</p> <p>(NFPA MF6)</p> |
| <p>Cap Rectangular</p>  <p>Style HH 7.00" & 8.00"</p> <p>(NFPA ME6)</p> | <p>Side Lug</p>  <p>Style C 7.00" & 8.00"</p> <p>(NFPA MS2)</p> | <p>Side Tapped</p>  <p>Style F 7.00" & 8.00"</p> <p>(NFPA MS4)</p> | <p>Cap Fixed Clevis</p>  <p>Style BB 7.00" & 8.00"</p> <p>(NFPA MP1)</p> |
| <p>Head Trunnion</p>  <p>Style D 7.00" & 8.00"</p> <p>(NFPA MT1)</p> | <p>Cap Trunnion</p>  <p>Style DB 7.00" & 8.00"</p> <p>(NFPA MT2)</p> | <p>Intermediate Fixed Trunnion</p>  <p>Style DD 7.00" & 8.00"</p> <p>(NFPA MT4)</p> | <p>HD Intermediate Trunnion Mount</p>  <p>Style DE¹ 7.00" & 8.00"</p> <p>(NFPA MT4)</p> |
| <p>Double Rod Cylinders</p>  <p>Style KT Shown</p> | | | |
| <p>Most of the above illustrated mounting styles are available in double rod cylinders.</p> | | | |
| <p>¹Style DE Mount conforms to NFPA MT4 dimensional standard. NOTE: Series 3H Hydraulic Cylinders fully meet ANSI/(NFPA) T3.6.7R2 - 1996 Specifications and Mounting Dimension Standards for Square Head Industrial Fluidpower Cylinders.</p> | | | |

Standard Specifications

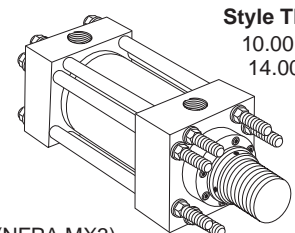
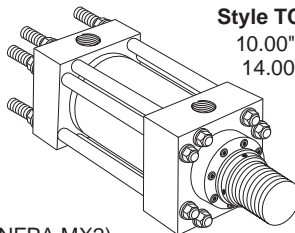
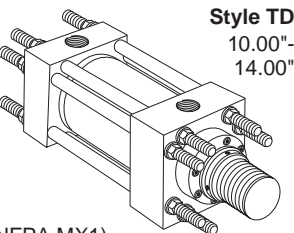
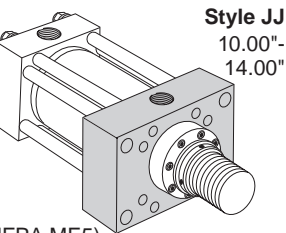
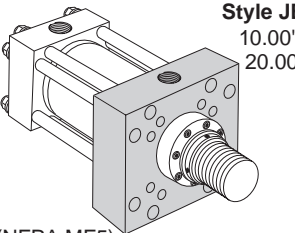
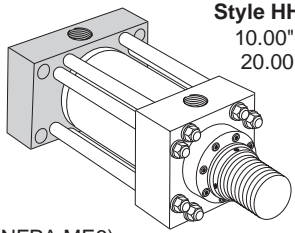
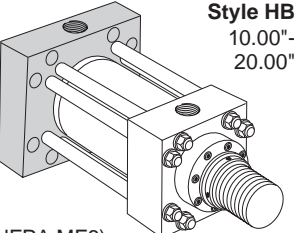
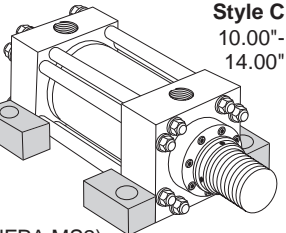
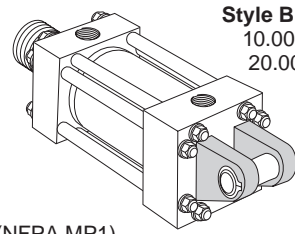
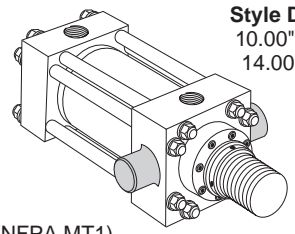
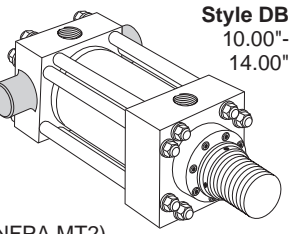
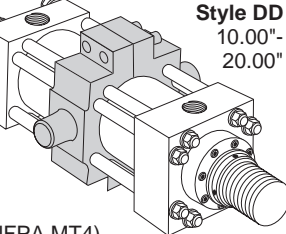
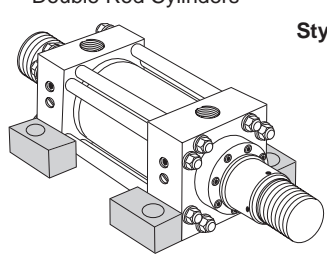
- Heavy Duty Service
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 3000 psi¹
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10°F to +165°F²
- Bore Sizes – 10.00" through 20.00" (Larger sizes available)
- Piston Rod Diameter – 4.500" through 10.000"
- Mounting Styles – 12 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke
- Rod Ends – Three Standard Choices – Specials to Order

¹ If hydraulic operating pressure exceeds 3000 psi, send application data for engineering evaluation and recommendation. See Section E for actual design factors.

² See Section E for higher temperature service.

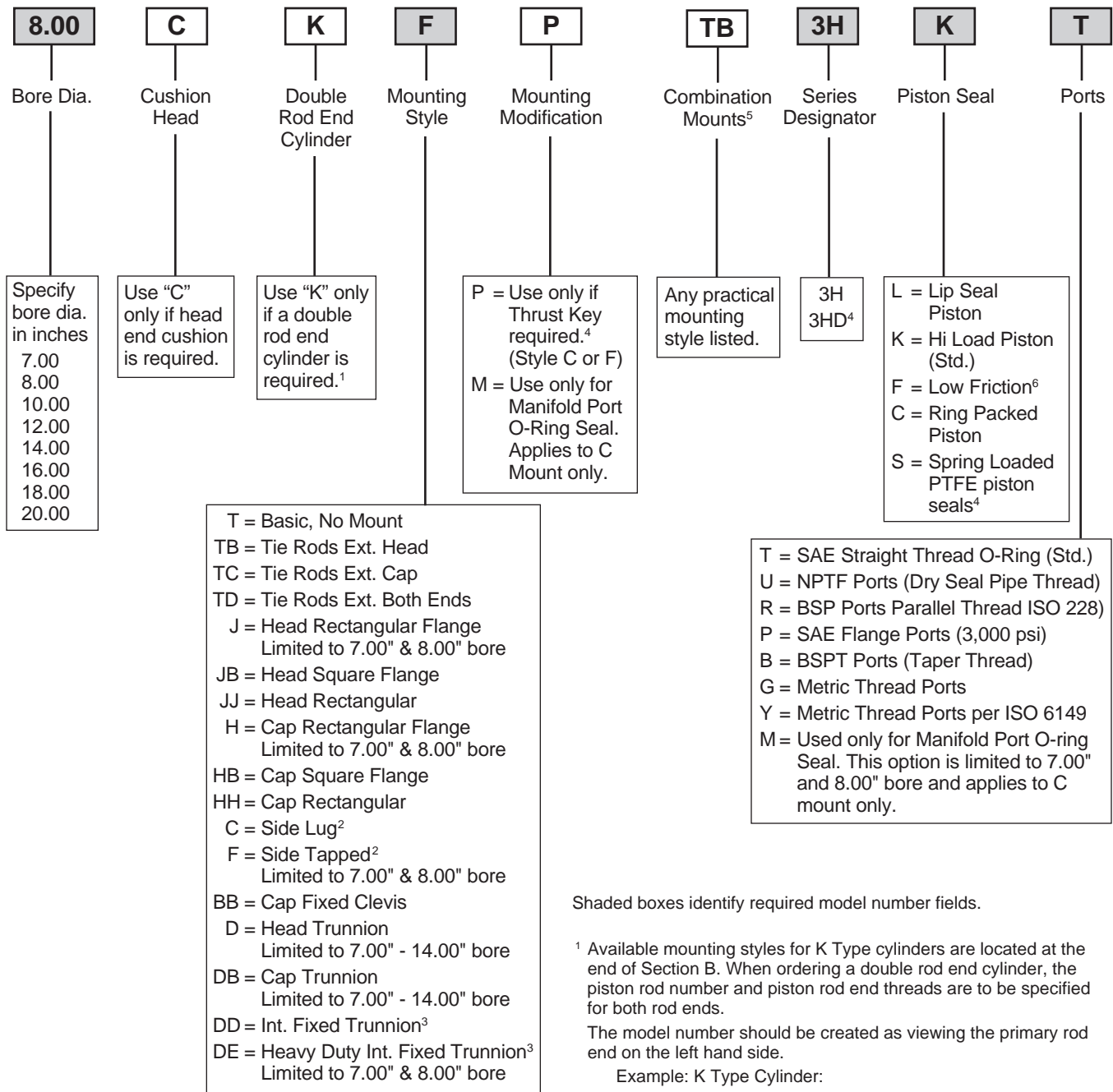
In line with our policy of continuing product improvement, specifications in this catalog are subject to change.

Available Mounting Styles

| | | | |
|--|---|--|---|
| <p>Tie Rods Extended Head End</p>  <p>Style TB 10.00"-14.00"</p> <p>(NFPA MX3)</p> | <p>Tie Rods Extended Cap End</p>  <p>Style TC 10.00"-14.00"</p> <p>(NFPA MX2)</p> | <p>Tie Rods Extended Both Ends</p>  <p>Style TD 10.00"-14.00"</p> <p>(NFPA MX1)</p> | <p>Head Rectangular</p>  <p>Style JJ 10.00"-14.00"</p> <p>(NFPA ME5)</p> |
| <p>Head Square Flange</p>  <p>Style JB 10.00"-20.00"</p> <p>(NFPA MF5)</p> | <p>Cap Rectangular</p>  <p>Style HH 10.00"-20.00"</p> <p>(NFPA ME6)</p> | <p>Cap Square Flange</p>  <p>Style HB 10.00"-20.00"</p> <p>(NFPA MF6)</p> | <p>Side Lug</p>  <p>Style C 10.00"-14.00"</p> <p>(NFPA MS2)</p> |
| <p>Cap Fixed Clevis</p>  <p>Style BB 10.00"-20.00"</p> <p>(NFPA MP1)</p> | <p>Head Trunnion</p>  <p>Style D 10.00"-14.00"</p> <p>(NFPA MT1)</p> | <p>Cap Trunnion</p>  <p>Style DB 10.00"-14.00"</p> <p>(NFPA MT2)</p> | <p>Intermediate Fixed Trunnion</p>  <p>Style DD 10.00"-20.00"</p> <p>(NFPA MT4)</p> |
| <p>Double Rod Cylinders</p>  <p>Style KC Shown</p> <p>Most of the above illustrated mounting styles are available in double rod cylinders.</p> | | | |



3H Model Code



Shaded boxes identify required model number fields.

¹ Available mounting styles for K Type cylinders are located at the end of Section B. 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:
7.00CKTD3HLT14A28AC10.000

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

³ Specify XI dimension.

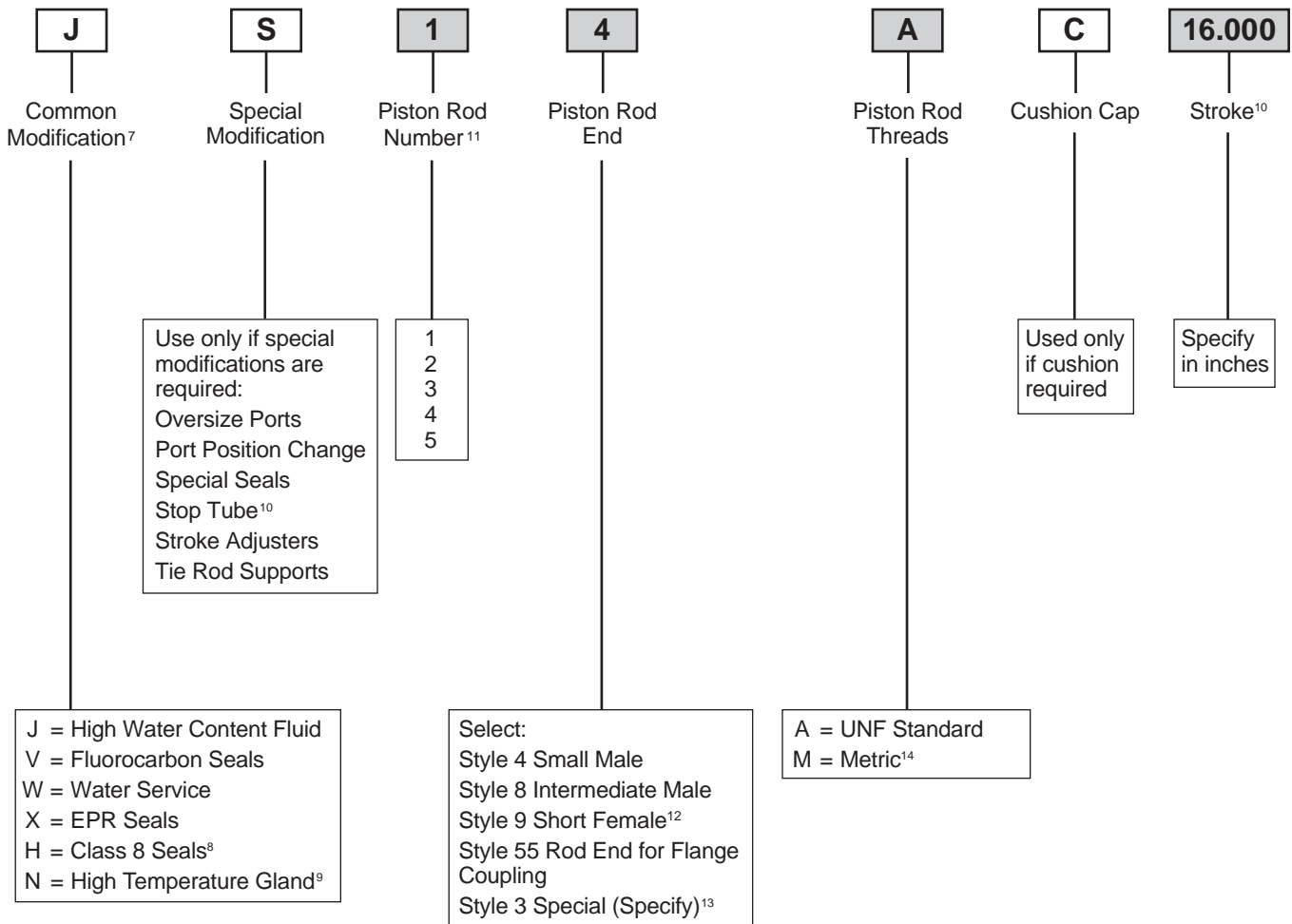
⁴ Limited to 7.00" and 8.00" bore.

⁵ 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.

⁶ Low Friction Piston Seal limited to 7.00" and 8.00" bore.

How To Order

3H Model Code



Shaded boxes identify required model number fields.

⁷ See common modifications Section D for additional options.

⁸ Class 8 seal option limited to 7.00" & 8.00" bore cylinders.

⁹ Energized PTFE rod seals & wiperseal are limited to rod sizes of 5.500" and smaller in 7.00" & 8.00" bore size. All other cylinder seals are fluorocarbon.

¹⁰ 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

¹¹ Refer to Rod buckling chart in Section E to assure rod number selected will not buckle under load.

¹² Style 9 stroke restrictions may apply. See Style 9 minimum stroke table for details.

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

¹⁴ See Section D for detailed information regarding standard metric rod end thread sizes.

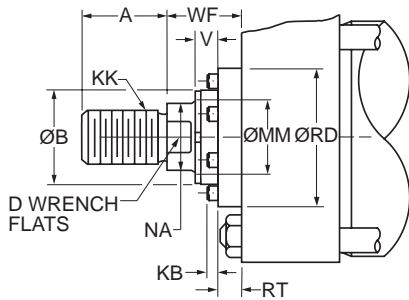
Style 9 Minimum Stroke Table

| Bore Ø | Rod Ø | Minimum Stroke |
|--------|-------|----------------|
| 7.00 | 3.000 | 1.250 |
| | 3.500 | 1.500 |
| | 4.000 | 1.500 |
| | 5.000 | 3.125 |
| 8.00 | 3.500 | 1.500 |
| | 4.000 | 1.500 |
| | 4.500 | 2.500 |
| | 5.000 | 2.875 |
| | 5.500 | 3.625 |
| 10.00 | 4.500 | 1.125 |
| | 5.000 | 1.375 |
| | 5.500 | 2.000 |
| | 7.000 | 3.125 |

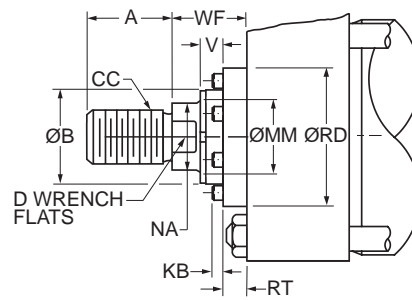
| Bore Ø | Rod Ø | Minimum Stroke |
|--------|--------|----------------|
| 12.00 | 5.500 | 1.250 |
| | 7.000 | 2.375 |
| | 8.000 | 1.125 |
| 14.00 | 7.000 | 2.000 |
| | 8.000 | 2.750 |
| | 10.000 | 4.250 |
| 16.00 | 8.000 | 1.750 |
| | 9.000 | 2.500 |
| | 10.000 | 3.250 |
| 18.00 | 9.000 | 1.500 |
| | 10.000 | 2.250 |
| 20.00 | 10.000 | 1.250 |

Rod End Dimensions – 7.00" and 8.00" Bore

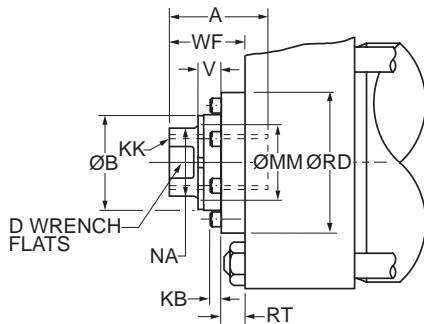
**Thread Style 4 (NFPA Style SM)
Small Male**



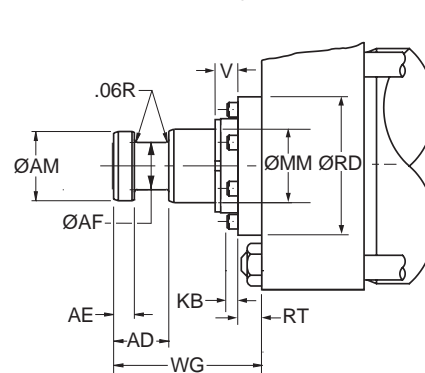
**Thread Style 8 (NFPA Style IM)
Intermediate Male**



**Thread Style 9² (NFPA Style SF)
Small Female**



Thread Style 55¹



Rod End Dimensions – 7.00" & 8.00" Bore

| Bore Ø | Rod No. | MM Rod Ø | Thread | | Rod Extensions and Pilot Dimensions | | | | | | | | |
|-----------|------------|----------------|------------------|----------------------|-------------------------------------|-----------------------|---------------|-------|------|------|---------|------|------|
| | | | Style 8 CC | Style 4 & 9 KK | A | B Ø +.000 -.002 | D | KB | NA | V | RD Ø | RT | WF |
| 7.00 | 1 (std.) | 3.000 | 2 3/4-12 | 2 1/4-12 | 3.50 | 3.749 | 2.63 | 0.250 | 2.88 | 0.63 | 5.25 | 0.63 | 2.25 |
| | 2 | 5.000 | 4 3/4-12 | 3 1/2-12 | 5.00 | 5.749 | ⁻³ | 0.000 | 4.88 | 0.25 | 7.25 | 1.00 | 2.25 |
| | 3 | 3.500 | 3 1/4-12 | 2 1/2-12 | 3.50 | 4.249 | 3.00 | 0.250 | 3.38 | 0.63 | 5.75 | 0.63 | 2.25 |
| | 4 | 4.000 | 3 3/4-12 | 3-12 | 4.00 | 4.749 | 3.38 | 0.250 | 3.88 | 0.50 | 6.50 | 0.75 | 2.25 |
| | 5 | 4.500 | 4 1/4-12 | 3 1/4-12 | 4.50 | 5.249 | ⁻³ | 0.250 | 4.38 | 0.50 | 7.00 | 0.75 | 2.25 |
| 8.00 | 1 (std.) | 3.500 | 3 1/4-12 | 2 1/2-12 | 3.50 | 4.249 | 3.00 | 0.250 | 3.38 | 0.63 | 5.75 | 0.63 | 2.25 |
| | 2 | 5.500 | 5 1/4-12 | 4-12 | 5.50 | 6.249 | ⁻³ | 0.000 | 5.38 | 0.25 | 8.25 | 1.00 | 2.25 |
| | 3 | 4.000 | 3 3/4-12 | 3-12 | 4.00 | 4.749 | 3.38 | 0.250 | 3.88 | 0.50 | 6.50 | 0.75 | 2.25 |
| | 4 | 4.500 | 4 1/4-12 | 3 1/4-12 | 4.50 | 5.249 | ⁻³ | 0.250 | 4.38 | 0.50 | 7.00 | 0.75 | 2.25 |
| | 5 | 5.000 | 4 3/4-12 | 3 1/2-12 | 5.00 | 5.749 | ⁻³ | 0.000 | 4.88 | 0.25 | 7.25 | 1.00 | 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.

¹ 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.

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

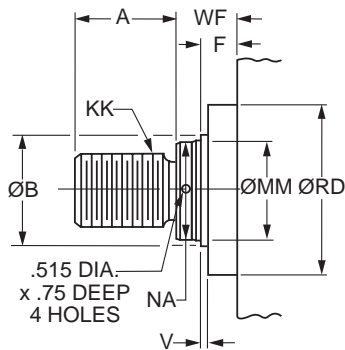
³ These piston rod numbers will have 4 spanner wrench holes instead of wrench flats. See rod drawings on next page for dimensions.

Style 55 Rod End

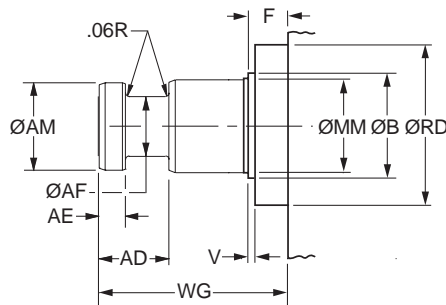
| MM Rod Ø | AD | AE +.001 -.001 | AF Ø | AM Ø | WG ¹ |
|----------------|------|----------------------|---------|---------|-----------------|
| 3.000 | 2.44 | 0.874 | 2.25 | 2.95 | 4.88 |
| 3.500 | 2.69 | 0.999 | 2.50 | 3.45 | 5.63 |
| 4.000 | 2.69 | 0.999 | 3.00 | 3.95 | 5.75 |
| 4.500 | 3.19 | 1.499 | 3.50 | 4.45 | 6.50 |
| 5.000 | 3.19 | 1.499 | 3.88 | 4.95 | 6.63 |
| 5.500 | 3.94 | 1.874 | 4.38 | 5.45 | 7.50 |

Rod End Dimensions – 10.00" - 20.00" Bore

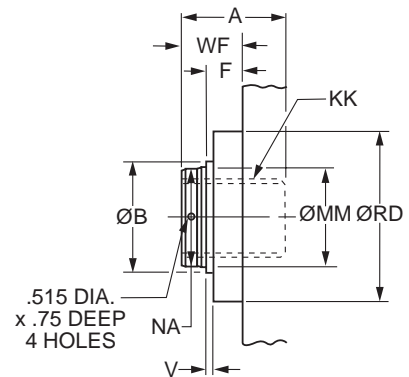
**Thread Style 4 (NFPA Style SM)
Small Male**



**Thread Style 55¹
Flanged Rod End**



**Thread Style 9² (NFPA Style SF)
Small Female**



Rod End Dimensions – 10.00" - 20.00" Bore

| Bore Ø | Rod No. | MM Rod Ø | Thread Style 4 & 9 KK | Rod Extensions and Pilot Dimensions | | | | | | |
|--------|----------|----------|-----------------------|-------------------------------------|------------------|------|------|-------|------|------|
| | | | | A | B Ø +.000 - .005 | F | NA | RD | V | WF |
| 10.00 | 1 (std.) | 4.500 | 3 1/4-12 | 4.50 | 5.249 | 1.94 | 4.38 | 8.25 | 0.25 | 2.94 |
| | 2 | 7.000 | 5-12 | 7.00 | 7.999 | 1.94 | 6.88 | 10.50 | 0.38 | 3.50 |
| | 3 | 5.000 | 3 1/2-12 | 5.00 | 5.749 | 1.94 | 4.88 | 8.88 | 0.25 | 3.19 |
| | 4 | 5.500 | 4-12 | 5.50 | 6.249 | 1.94 | 5.38 | 9.38 | 0.25 | 3.19 |
| 12.00 | 1 (std.) | 5.500 | 4-12 | 5.50 | 6.249 | 1.94 | 5.38 | 9.38 | 0.25 | 3.19 |
| | 2 | 8.000 | 5 3/4-12 | 8.00 | 8.999 | 1.94 | 7.88 | 12.50 | 0.38 | 4.00 |
| | 3 | 7.000 | 5-12 | 7.00 | 7.999 | 1.94 | 6.88 | 10.50 | 0.38 | 3.50 |
| 14.00 | 1 (std.) | 7.000 | 5-12 | 7.00 | 7.999 | 1.94 | 6.88 | 10.50 | 0.38 | 3.50 |
| | 2 | 10.000 | 7 1/4-12 | 10.00 | 10.999 | 1.94 | 9.88 | 14.50 | 0.38 | 4.50 |
| | 3 | 8.000 | 5 3/4-12 | 8.00 | 8.999 | 1.94 | 7.88 | 12.50 | 0.38 | 4.00 |
| 16.00 | 1 | 8.000 | 5 3/4-12 | 8.00 | 8.999 | 1.94 | 7.88 | 12.50 | 0.38 | 4.00 |
| | 3 | 9.000 | 6 1/2-12 | 9.00 | 9.999 | 1.94 | 8.88 | 13.50 | 0.38 | 4.25 |
| | 4 | 10.000 | 7 1/4-12 | 10.00 | 10.999 | 1.94 | 9.88 | 14.50 | 0.38 | 4.50 |
| 18.00 | 1 | 9.000 | 6 1/2-12 | 9.00 | 9.999 | 1.94 | 8.88 | 13.50 | 0.38 | 4.25 |
| | 3 | 10.000 | 7 1/4-12 | 10.00 | 10.999 | 1.94 | 9.88 | 14.50 | 0.38 | 4.50 |
| 20.00 | 1 | 10.000 | 7 1/4-12 | 10.00 | 10.999 | 1.94 | 9.88 | 14.50 | 0.38 | 4.50 |

“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.

¹ 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.

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

Style 55 Rod End

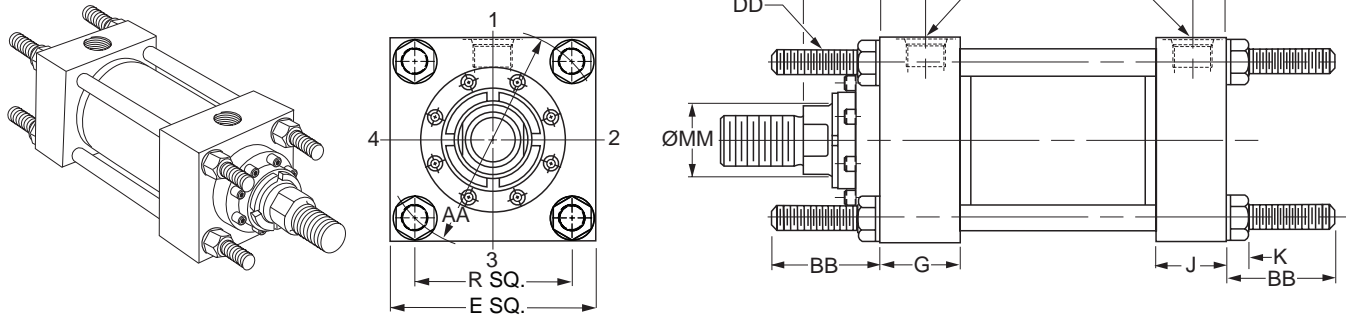
| MM Rod Ø | AD | AE +.001 - .001 | AF Ø | AM Ø | WG ¹ |
|----------|------|-----------------|------|------|-----------------|
| 4.500 | 3.19 | 1.499 | 3.50 | 4.45 | 6.50 |
| 5.000 | 3.19 | 1.499 | 3.88 | 4.95 | 6.63 |
| 5.500 | 3.94 | 1.874 | 4.38 | 5.45 | 7.50 |
| 7.000 | 4.06 | 1.999 | 5.75 | 6.95 | 8.44 |
| 8.000 | 4.06 | 1.999 | 6.50 | 7.95 | 8.69 |
| 9.000 | 4.63 | 2.374 | 7.25 | 8.95 | 8.75 |
| 10.000 | 4.63 | 2.374 | 8.00 | 9.95 | 9.75 |



Mounting Information – 7.00" and 8.00" Bore Series 3H

Tie Rods Extended Both Ends

Style TD
(NFFA Style MX1)



Basic Mounting (T) – NFFA MXO – Not shown is no tie rod extended and can be supplied upon request.

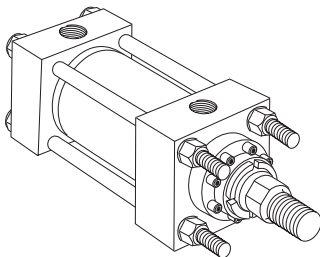
Style TD – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | AA | BB | DD | E | EE | | G | J | K | R | WF | Y | Add Stroke | | |
|--------|----------|----------|-------|------|----------|------|-------------------|------------------|------|------|------|------|------|------|------------|------|-------|
| | | | | | | | NPTF ¹ | SAE ² | | | | | | | LG | P | ZJ |
| 7.00 | 1 (std.) | 3.000 | 9.31 | 4.13 | 1 1/8-12 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 6.58 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 2 | 5.000 | 9.31 | 4.13 | 1 1/8-12 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 6.58 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 3 | 3.500 | 9.31 | 4.13 | 1 1/8-12 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 6.58 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 4 | 4.000 | 9.31 | 4.13 | 1 1/8-12 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 6.58 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 5 | 4.500 | 9.31 | 4.13 | 1 1/8-12 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 6.58 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| 8.00 | 1 (std.) | 3.500 | 10.61 | 4.50 | 1 1/4-12 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 7.50 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 2 | 5.500 | 10.61 | 4.50 | 1 1/4-12 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 7.50 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 3 | 4.000 | 10.61 | 4.50 | 1 1/4-12 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 7.50 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 4 | 4.500 | 10.61 | 4.50 | 1 1/4-12 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 7.50 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 5 | 5.000 | 10.61 | 4.50 | 1 1/4-12 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 7.50 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |

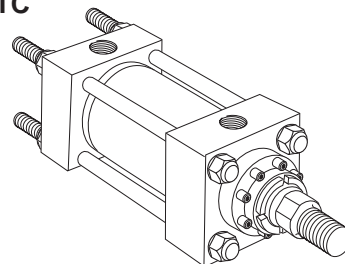
¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style TB



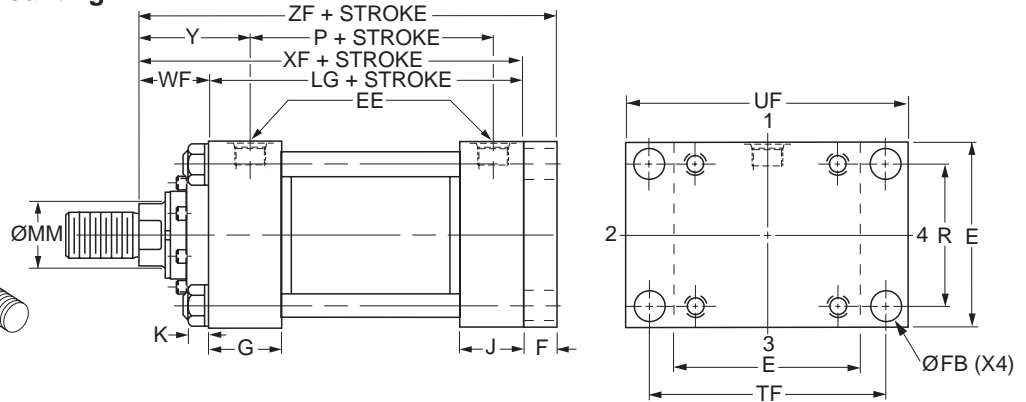
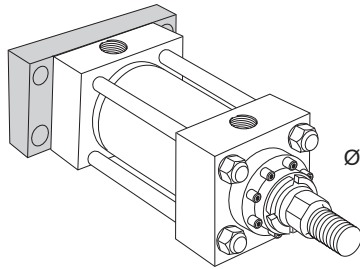
Style TC



Dimensions for TB and TC Mount may be obtained from the above dimensional table.

Mounting Information – 7.00" and 8.00" Bore Series 3H

Cap Rectangular Flange Mounting
 Style H
 (NFPA Style MF2)



Style H – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | WF | Y | Add Stroke | | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|------|-------|-------|------|------|------------|------|-------|-------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | | LG | P | XF | ZF |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style H – Maximum Operating Pressure / 3H & 3HD

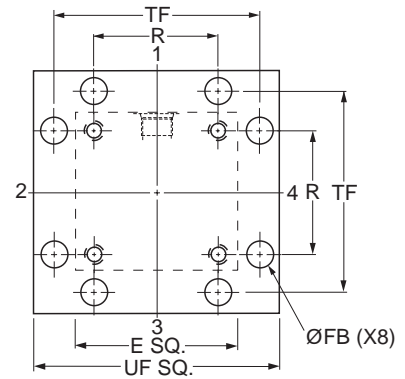
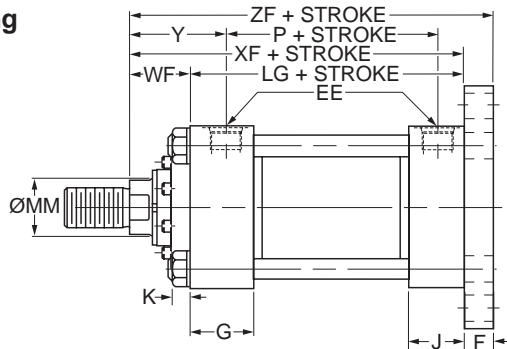
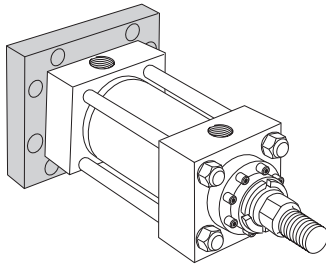
| Bore Ø | Max. psi Pull ³ | | | | |
|--------|----------------------------|------|------|------|------|
| | Rod Code | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 7.00 | 2000 | 3000 | 2000 | 2500 | 2800 |
| 8.00 | 1700 | 2500 | 1700 | 1800 | 2200 |

³Maximum pressure rating – pull application.



Mounting Information – 7.00" and 8.00" Bore Series 3H

Cap Square Flange Mounting
Style HB
(NFPA Style MF6)



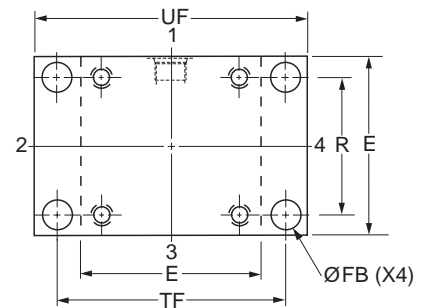
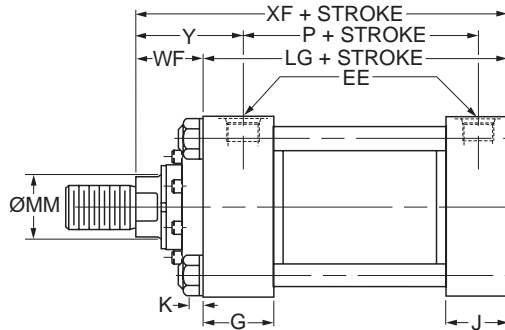
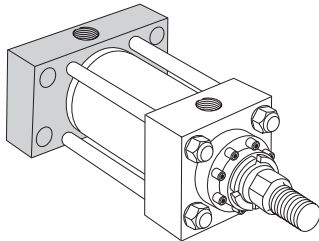
Style HB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | WF | Y | Add Stroke | | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|------|-------|-------|------|------|------------|------|-------|-------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | | LG | P | XF | ZF |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 | 11.75 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 | 12.75 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Cap Rectangular Mounting
Style HH
(NFPA Style ME6)



Style HH – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | FB Ø | G | J | K | R | TF | UF | WF | Y | Add Stroke | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|-------|-------|------|------|------------|------|-------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | LG | P | XF |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 10.75 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 11.75 |

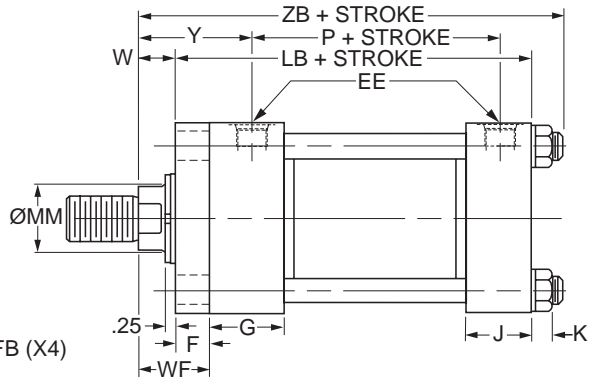
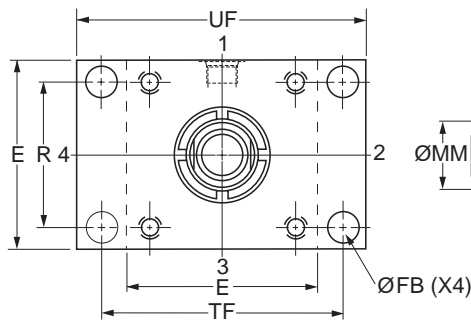
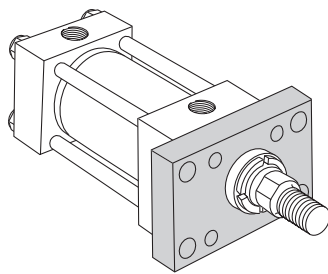
¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Mounting Information – 7.00" and 8.00" Bore Series 3H

Head Rectangular Flange Mounting

Style J
(NFPA Style MF1)



Style J – Dimensional and Mounting Data

For pressures exceeding those shown use mounting styles JB or JJ.

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | W | WF | Y | Add Stroke | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|------|-------|-------|------|------|------|------------|------|---------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | | | LB | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style J – Maximum Operating Pressure / 3H

| Bore Ø | Max. psi Push ³ | | | | |
|--------|----------------------------|-----|------|------|------|
| | Rod Code | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 7.00 | 1400 | 800 | 1200 | 1100 | 1000 |
| 8.00 | 1100 | 800 | 1000 | 1000 | 800 |

³Maximum pressure rating – push application.

Style J – Maximum Operating Pressure / 3HD

| Bore Ø | Max. psi Push ³ | | | | |
|--------|----------------------------|-----|-----|-----|-----|
| | Rod Code | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 7.00 | 1000 | 400 | 800 | 400 | 400 |
| 8.00 | 800 | 400 | 700 | 400 | 400 |

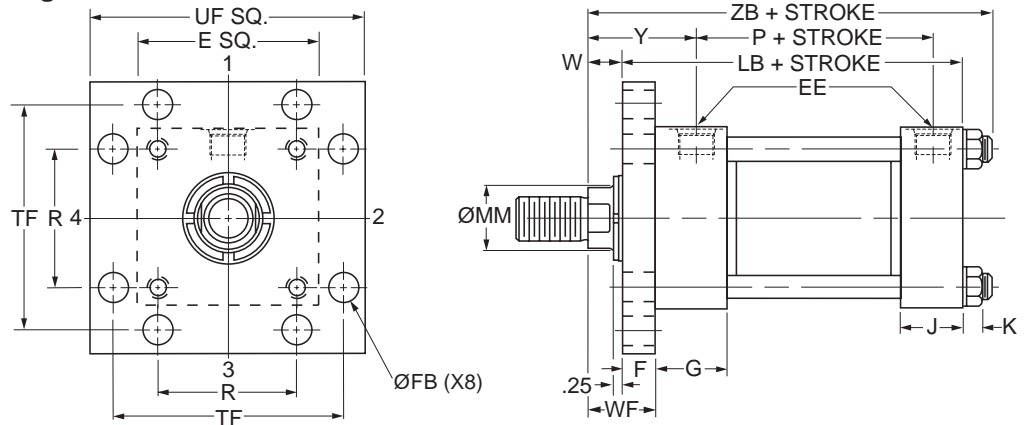
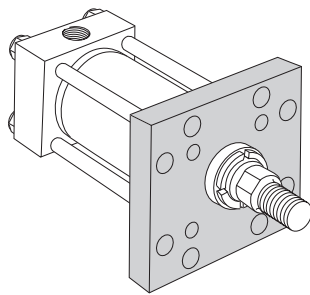
³Maximum pressure rating – push application.



Mounting Information – 7.00" and 8.00" Bore Series 3H

Head Square Flange Mounting

Style JB
(NFPA Style MF5)



Style JB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | F | FB Ø | G | J | K | R | TF | UF | W | WF | Y | Add Stroke | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|------|-------|-------|------|------|------|------------|------|---------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | | | LB | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.00 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 1.25 | 2.25 | 3.69 | 9.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.00 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 1.25 | 2.25 | 3.81 | 10.50 | 6.38 | 13.56 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style JB – Maximum Operating Pressure / 3H

| Bore Ø | Max. psi Push ³ | | | | |
|--------|----------------------------|------|------|------|------|
| | Rod Code | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 7.00 | 3000 | 2700 | 3000 | 3000 | 3000 |
| 8.00 | 3000 | 2300 | 2500 | 2500 | 2500 |

³Maximum pressure rating – push application.

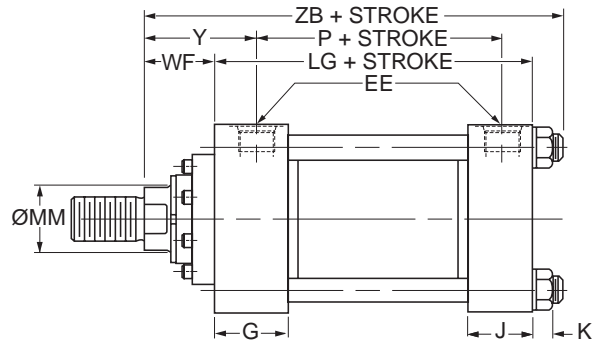
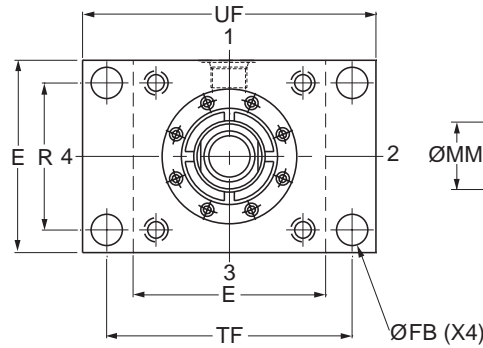
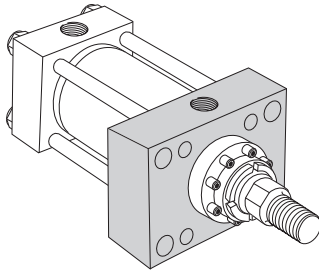
Style JB – Maximum Operating Pressure / 3HD

| Bore Ø | Max. psi Push ³ | | | | |
|--------|----------------------------|------|------|------|------|
| | Rod Code | | | | |
| | 1 | 2 | 3 | 4 | 5 |
| 7.00 | 2500 | 1500 | 2200 | 1500 | 1500 |
| 8.00 | 2000 | 1400 | 2000 | 1400 | 1400 |

³Maximum pressure rating – push application.

Mounting Information – 7.00" and 8.00" Bore Series 3H

Head Rectangular Mounting
Style JJ
 (NFA Style ME5)



Style JJ – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | FB Ø | G | J | K | R | TF | UF | WF | Y | Add Stroke | | |
|-----------|------------|----------------|------|-------------------|------------------|---------|------|------|------|------|-------|-------|------|------|------------|------|------------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | LG | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 1.19 | 2.75 | 2.75 | 1.16 | 6.58 | 10.63 | 12.63 | 2.25 | 3.69 | 8.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 1.31 | 3.00 | 3.00 | 1.28 | 7.50 | 11.81 | 14.00 | 2.25 | 3.81 | 9.50 | 6.38 | 13.56 |

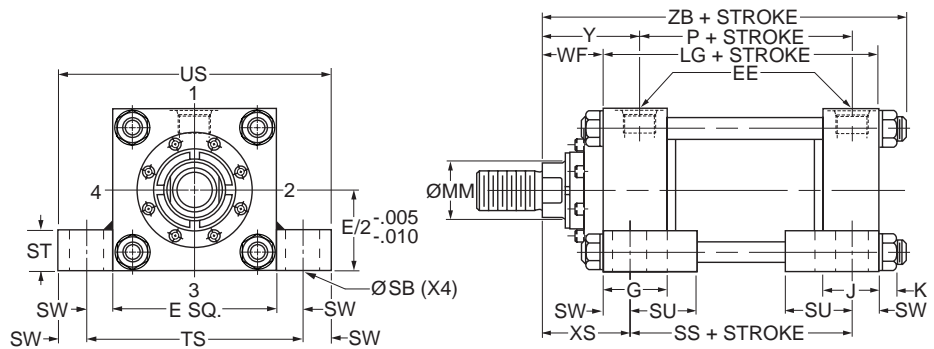
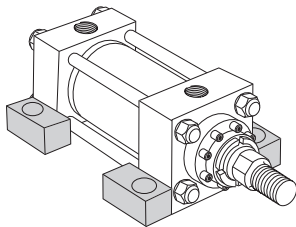
¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.



Mounting Information – 7.00" and 8.00" Bore Series 3H

Side Lug Mounting
Style C
(NFPA Style MS2)



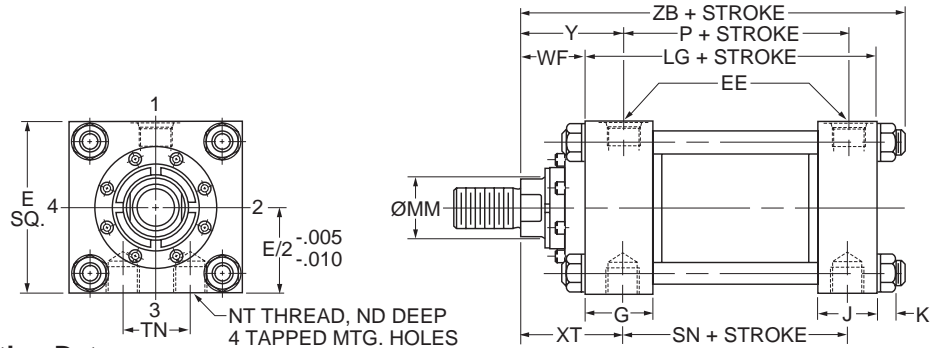
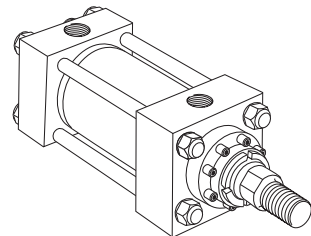
Style C – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | G | J | K | SB Ø | ST | SU | SW | TS | US | WF | XS | Y | Add Stroke | | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|------|------|------|-------|-------|------|------|------|------------|------|------|---------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | | | | LG | P | SS | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.56 | 1.75 | 2.88 | 1.38 | 11.25 | 14.00 | 2.25 | 3.63 | 3.69 | 8.50 | 5.63 | 5.75 | 12.31 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.56 | 1.75 | 2.88 | 1.38 | 11.25 | 14.00 | 2.25 | 3.63 | 3.69 | 8.50 | 5.63 | 5.75 | 12.31 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.56 | 1.75 | 2.88 | 1.38 | 11.25 | 14.00 | 2.25 | 3.63 | 3.69 | 8.50 | 5.63 | 5.75 | 12.31 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.56 | 1.75 | 2.88 | 1.38 | 11.25 | 14.00 | 2.25 | 3.63 | 3.69 | 8.50 | 5.63 | 5.75 | 12.31 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.56 | 1.75 | 2.88 | 1.38 | 11.25 | 14.00 | 2.25 | 3.63 | 3.69 | 8.50 | 5.63 | 5.75 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.56 | 1.75 | 2.88 | 1.38 | 12.25 | 15.00 | 2.25 | 3.63 | 3.81 | 9.50 | 6.38 | 6.75 | 13.56 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.56 | 1.75 | 2.88 | 1.38 | 12.25 | 15.00 | 2.25 | 3.63 | 3.81 | 9.50 | 6.38 | 6.75 | 13.56 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.56 | 1.75 | 2.88 | 1.38 | 12.25 | 15.00 | 2.25 | 3.63 | 3.81 | 9.50 | 6.38 | 6.75 | 13.56 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.56 | 1.75 | 2.88 | 1.38 | 12.25 | 15.00 | 2.25 | 3.63 | 3.81 | 9.50 | 6.38 | 6.75 | 13.56 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.56 | 1.75 | 2.88 | 1.38 | 12.25 | 15.00 | 2.25 | 3.63 | 3.81 | 9.50 | 6.38 | 6.75 | 13.56 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Side Tapped Mounting
Style F
(NFPA Style MS4)



Style F – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | G | J | K | ND | NT | TN | WF | XT | Y | Add Stroke | | | |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------|---------|------|------|------|------|------------|------|------|---------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | | LG | P | SN | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.13 | 1 1/2-6 | 3.75 | 2.25 | 3.81 | 3.69 | 8.50 | 5.63 | 5.88 | 12.31 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.13 | 1 1/2-6 | 3.75 | 2.25 | 3.81 | 3.69 | 8.50 | 5.63 | 5.88 | 12.31 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.13 | 1 1/2-6 | 3.75 | 2.25 | 3.81 | 3.69 | 8.50 | 5.63 | 5.88 | 12.31 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.13 | 1 1/2-6 | 3.75 | 2.25 | 3.81 | 3.69 | 8.50 | 5.63 | 5.88 | 12.31 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 1.13 | 1 1/2-6 | 3.75 | 2.25 | 3.81 | 3.69 | 8.50 | 5.63 | 5.88 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.50 | 1 1/2-6 | 4.25 | 2.25 | 3.94 | 3.81 | 9.50 | 6.38 | 6.63 | 13.56 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.50 | 1 1/2-6 | 4.25 | 2.25 | 3.94 | 3.81 | 9.50 | 6.38 | 6.63 | 13.56 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.50 | 1 1/2-6 | 4.25 | 2.25 | 3.94 | 3.81 | 9.50 | 6.38 | 6.63 | 13.56 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.50 | 1 1/2-6 | 4.25 | 2.25 | 3.94 | 3.81 | 9.50 | 6.38 | 6.63 | 13.56 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 1.50 | 1 1/2-6 | 4.25 | 2.25 | 3.94 | 3.81 | 9.50 | 6.38 | 6.63 | 13.56 |

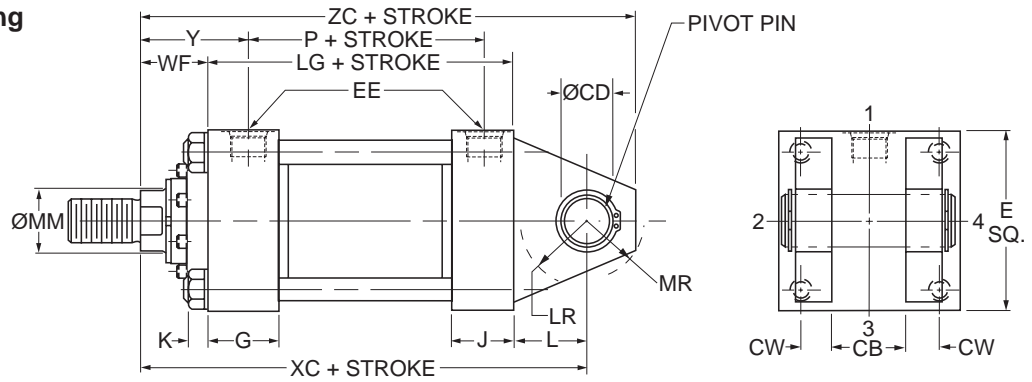
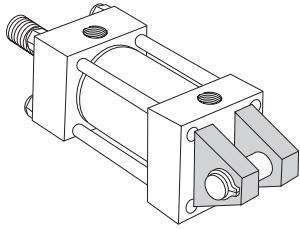
¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.



Mounting Information – 7.00" and 8.00" Bore Series 3H

Cap Fixed Clevis Mounting
Style BB
(NFPA Style MP1)



Style BB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | CB | CD ³ Ø +0.000 -0.002 | CW | E | EE | | G | J | K | L | LR | MR | WF | Y |
|--------|----------|----------|------|---------------------------------------|------|------|-------------------|------------------|------|------|------|------|------|------|------|------|
| | | | | | | | NPTF ¹ | SAE ² | | | | | | | | |
| 7.00 | 1 (std.) | 3.000 | 3.00 | 2.501 | 1.50 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.00 | 2.75 | 2.88 | 2.25 | 3.69 |
| | 2 | 5.000 | 3.00 | 2.501 | 1.50 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.00 | 2.75 | 2.88 | 2.25 | 3.69 |
| | 3 | 3.500 | 3.00 | 2.501 | 1.50 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.00 | 2.75 | 2.88 | 2.25 | 3.69 |
| | 4 | 4.000 | 3.00 | 2.501 | 1.50 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.00 | 2.75 | 2.88 | 2.25 | 3.69 |
| | 5 | 4.500 | 3.00 | 2.501 | 1.50 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.00 | 2.75 | 2.88 | 2.25 | 3.69 |
| 8.00 | 1 (std.) | 3.500 | 3.00 | 3.001 | 1.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.25 | 3.25 | 3.13 | 2.25 | 3.81 |
| | 2 | 5.500 | 3.00 | 3.001 | 1.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.25 | 3.25 | 3.13 | 2.25 | 3.81 |
| | 3 | 4.000 | 3.00 | 3.001 | 1.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.25 | 3.25 | 3.13 | 2.25 | 3.81 |
| | 4 | 4.500 | 3.00 | 3.001 | 1.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.25 | 3.25 | 3.13 | 2.25 | 3.81 |
| | 5 | 5.000 | 3.00 | 3.001 | 1.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.25 | 3.25 | 3.13 | 2.25 | 3.81 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

³Dimension CD is pin diameter.

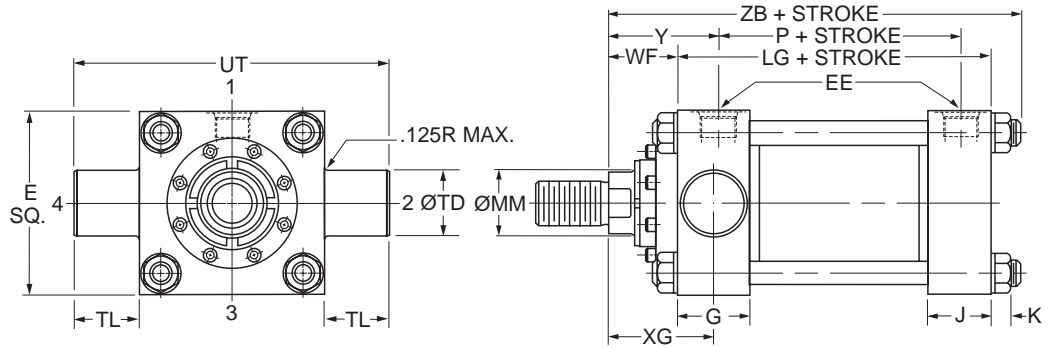
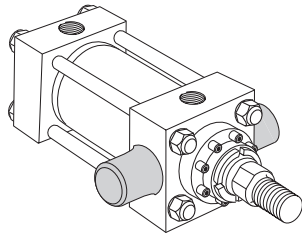
Style BB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | WF | Add Stroke | | | |
|--------|----------|----------|------|------------|------|-------|-------|
| | | | | LG | P | XC | ZC |
| 7.00 | 1 (std.) | 3.000 | 2.25 | 8.50 | 5.63 | 13.75 | 16.25 |
| | 2 | 5.000 | 2.25 | 8.50 | 5.63 | 13.75 | 16.25 |
| | 3 | 3.500 | 2.25 | 8.50 | 5.63 | 13.75 | 16.25 |
| | 4 | 4.000 | 2.25 | 8.50 | 5.63 | 13.75 | 16.25 |
| | 5 | 4.500 | 2.25 | 8.50 | 5.63 | 13.75 | 16.25 |
| 8.00 | 1 (std.) | 3.500 | 2.25 | 9.50 | 6.38 | 15.00 | 17.75 |
| | 2 | 5.500 | 2.25 | 9.50 | 6.38 | 15.00 | 17.75 |
| | 3 | 4.000 | 2.25 | 9.50 | 6.38 | 15.00 | 17.75 |
| | 4 | 4.500 | 2.25 | 9.50 | 6.38 | 15.00 | 17.75 |
| | 5 | 5.000 | 2.25 | 9.50 | 6.38 | 15.00 | 17.75 |



Mounting Information – 7.00" and 8.00" Bore Series 3H

Head Trunnion Mounting
Style D
 (NFA Style MT1)



Style D – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | G | J | K | TD Ø +0.000 -0.002 | TL | UT | WF | Y | XG |
|--------|----------|----------|------|-------------------|------------------|------|------|------|--------------------------|------|-------|------|------|------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | | |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 | 3.63 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 | 3.63 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 | 3.63 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 | 3.63 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 | 3.63 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 | 3.75 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 | 3.75 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 | 3.75 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 | 3.75 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 | 3.75 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

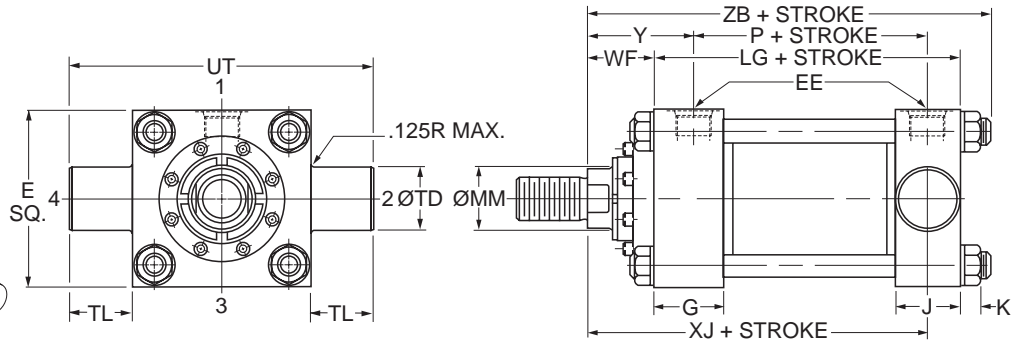
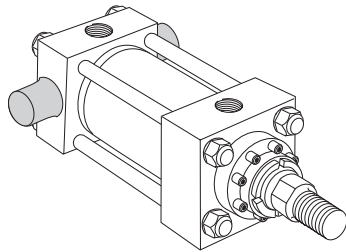
Style D – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | Add Stroke | | |
|--------|----------|----------|------------|------|---------|
| | | | LG | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 8.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 8.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 8.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 8.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 9.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 9.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 9.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 9.50 | 6.38 | 13.56 |

Mounting Information – 7.00" and 8.00" Bore Series 3H

Cap Trunnion Mounting

Style DB
(NFPA Style MT2)



Style DB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE | | G | J | K | TD Ø +.000 -.002 | TL | UT | WF | Y |
|--------|----------|----------|------|-------------------|------------------|------|------|------|------------------------|------|-------|------|------|
| | | | | NPTF ¹ | SAE ² | | | | | | | | |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 |
| | 2 | 5.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 |
| | 3 | 3.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 |
| | 4 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 |
| | 5 | 4.500 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 13.50 | 2.25 | 3.69 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 |
| | 2 | 5.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 |
| | 3 | 4.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 |
| | 4 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 |
| | 5 | 5.000 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 15.50 | 2.25 | 3.81 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

Style DB – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | Add Stroke | | | |
|--------|----------|----------|------------|------|-------|--------|
| | | | LG | P | XJ | ZB Max |
| 7.00 | 1 (std.) | 3.000 | 8.50 | 5.63 | 9.38 | 12.31 |
| | 2 | 5.000 | 8.50 | 5.63 | 9.38 | 12.31 |
| | 3 | 3.500 | 8.50 | 5.63 | 9.38 | 12.31 |
| | 4 | 4.000 | 8.50 | 5.63 | 9.38 | 12.31 |
| | 5 | 4.500 | 8.50 | 5.63 | 9.38 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 9.50 | 6.38 | 10.25 | 13.56 |
| | 2 | 5.500 | 9.50 | 6.38 | 10.25 | 13.56 |
| | 3 | 4.000 | 9.50 | 6.38 | 10.25 | 13.56 |
| | 4 | 4.500 | 9.50 | 6.38 | 10.25 | 13.56 |
| | 5 | 5.000 | 9.50 | 6.38 | 10.25 | 13.56 |

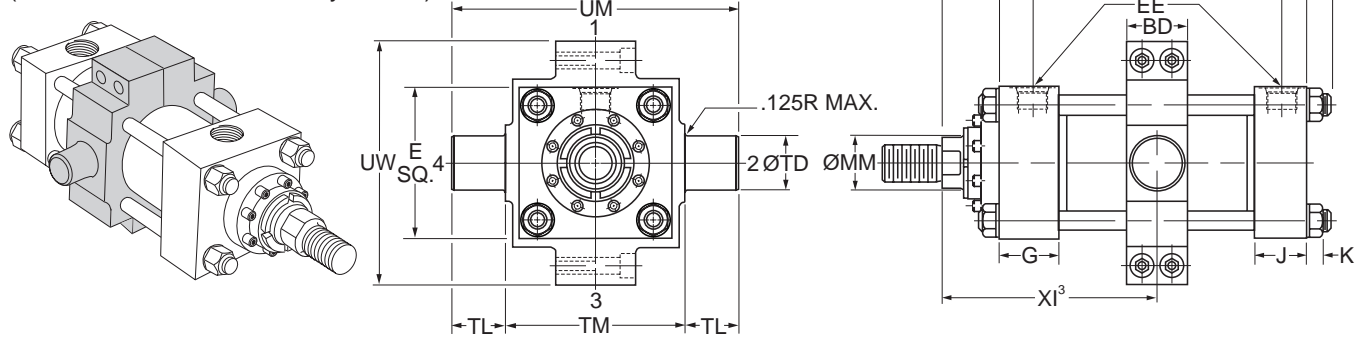


Mounting Information – 7.00" and 8.00" Bore Series 3H

Intermediate Fixed Trunnion Mounting

Style DD

(NFPA Former Standard Style MT4)



Style DD – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | BD | E | EE | | G | J | K | TD Ø +0.000 -0.002 | TL | TM | UM | UW | WF | Y | Min. XI ³ |
|--------|----------|----------|------|------|-------------------|------------------|------|------|------|--------------------------|------|-------|-------|-------|------|------|----------------------|
| | | | | | NPTF ¹ | SAE ² | | | | | | | | | | | |
| 7.00 | 1 (std.) | 3.000 | 3.00 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 9.75 | 14.75 | 11.50 | 2.25 | 3.69 | 6.56 |
| | 2 | 5.000 | 3.00 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 9.75 | 14.75 | 11.50 | 2.25 | 3.69 | 6.56 |
| | 3 | 3.500 | 3.00 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 9.75 | 14.75 | 11.50 | 2.25 | 3.69 | 6.56 |
| | 4 | 4.000 | 3.00 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 9.75 | 14.75 | 11.50 | 2.25 | 3.69 | 6.56 |
| | 5 | 4.500 | 3.00 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 2.500 | 2.50 | 9.75 | 14.75 | 11.50 | 2.25 | 3.69 | 6.56 |
| 8.00 | 1 (std.) | 3.500 | 3.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 11.00 | 17.00 | 13.38 | 2.25 | 3.81 | 7.06 |
| | 2 | 5.500 | 3.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 11.00 | 17.00 | 13.38 | 2.25 | 3.81 | 7.06 |
| | 3 | 4.000 | 3.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 11.00 | 17.00 | 13.38 | 2.25 | 3.81 | 7.06 |
| | 4 | 4.500 | 3.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 11.00 | 17.00 | 13.38 | 2.25 | 3.81 | 7.06 |
| | 5 | 5.000 | 3.50 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 3.000 | 3.00 | 11.00 | 17.00 | 13.38 | 2.25 | 3.81 | 7.06 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

³Dimension XI to be specified by customer.

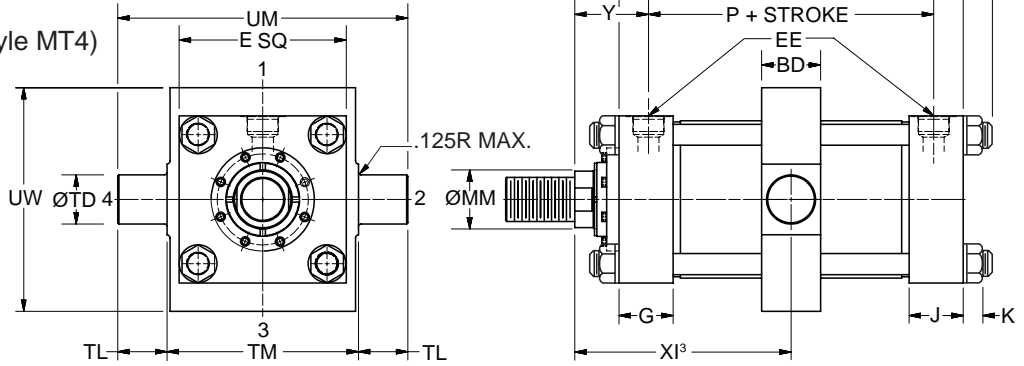
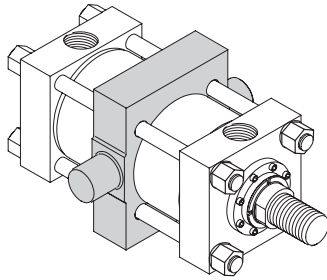
Style DD – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | Style DD Minimum Stroke | Add Stroke | | |
|--------|----------|----------|-------------------------|------------|------|---------|
| | | | | LG | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 0.13 | 8.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 0.13 | 8.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 0.13 | 8.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 0.13 | 8.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 0.13 | 8.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 0.13 | 9.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 0.13 | 9.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 0.13 | 9.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 0.13 | 9.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 0.13 | 9.50 | 6.38 | 13.56 |

Mounting Information – 7.00" and 8.00" Bore Series 3H

Heavy Duty Intermediate Fixed Trunnion Mounting

Style DE
(NFPA Current Standard Style MT4)



Style DE – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | BD | E | EE | | G | J | K | TD Ø +.000 -.002 | TL | TM | UM | UW | WF | Y | Min XI ³ |
|--------|----------|----------|-------|------|-------------------|------------------|------|------|------|------------------------|------|-------|-------|-------|------|------|---------------------|
| | | | | | NPTF ¹ | SAE ² | | | | | | | | | | | |
| 7.00 | 1 (std.) | 3.000 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.500 | 2.50 | 9.75 | 14.75 | 11.38 | 2.25 | 3.69 | 7.06 |
| | 2 | 5.000 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.500 | 2.50 | 9.75 | 14.75 | 11.38 | 2.25 | 3.69 | 7.06 |
| | 3 | 3.500 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.500 | 2.50 | 9.75 | 14.75 | 11.38 | 2.25 | 3.69 | 7.06 |
| | 4 | 4.000 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.500 | 2.50 | 9.75 | 14.75 | 11.38 | 2.25 | 3.69 | 7.06 |
| | 5 | 4.500 | 4.000 | 8.50 | 1 1/4 | 20 | 2.75 | 2.75 | 1.16 | 3.500 | 2.50 | 9.75 | 14.75 | 11.38 | 2.25 | 3.69 | 7.06 |
| 8.00 | 1 (std.) | 3.500 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 4.000 | 3.00 | 11.00 | 17.00 | 12.00 | 2.25 | 3.81 | 7.56 |
| | 2 | 5.500 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 4.000 | 3.00 | 11.00 | 17.00 | 12.00 | 2.25 | 3.81 | 7.56 |
| | 3 | 4.000 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 4.000 | 3.00 | 11.00 | 17.00 | 12.00 | 2.25 | 3.81 | 7.56 |
| | 4 | 4.500 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 4.000 | 3.00 | 11.00 | 17.00 | 12.00 | 2.25 | 3.81 | 7.56 |
| | 5 | 5.000 | 4.500 | 9.50 | 1 1/2 | 24 | 3.00 | 3.00 | 1.28 | 4.000 | 3.00 | 11.00 | 17.00 | 12.00 | 2.25 | 3.81 | 7.56 |

¹NPTF ports are available at no extra charge.

²SAE straight thread ports are standard and are indicated by port number.

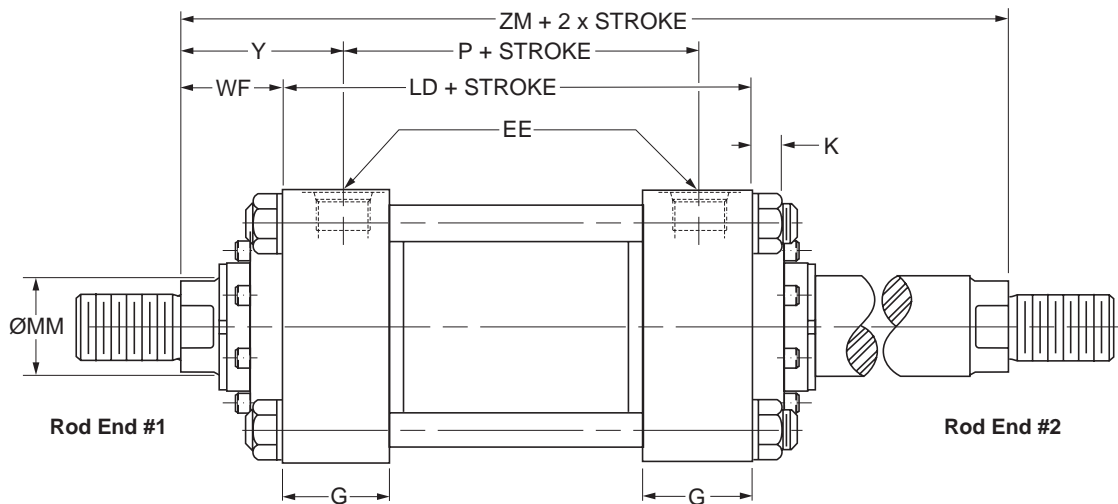
³Dimension XI to be specified by customer.

Style DE – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | Style DE Minimum Stroke | Add Stroke | | |
|--------|----------|----------|-------------------------|------------|------|---------|
| | | | | LG | P | ZB Max. |
| 7.00 | 1 (std.) | 3.000 | 1.13 | 8.50 | 5.63 | 12.31 |
| | 2 | 5.000 | 1.13 | 8.50 | 5.63 | 12.31 |
| | 3 | 3.500 | 1.13 | 8.50 | 5.63 | 12.31 |
| | 4 | 4.000 | 1.13 | 8.50 | 5.63 | 12.31 |
| | 5 | 4.500 | 1.13 | 8.50 | 5.63 | 12.31 |
| 8.00 | 1 (std.) | 3.500 | 1.13 | 9.50 | 6.38 | 13.56 |
| | 2 | 5.500 | 1.13 | 9.50 | 6.38 | 13.56 |
| | 3 | 4.000 | 1.13 | 9.50 | 6.38 | 13.56 |
| | 4 | 4.500 | 1.13 | 9.50 | 6.38 | 13.56 |
| | 5 | 5.000 | 1.13 | 9.50 | 6.38 | 13.56 |



Double Rod Cylinder
Style K



| Mounting Styles for Single Rod Models | Mounting Styles for Corresponding Double Rod Models ¹ | Dimensions Shown on This Page Supplement Dimensions on Pages Listed Below for 7.00" - 8.00" Bores |
|---------------------------------------|--|---|
| TB | KTB | 40 |
| TD | KTD | 40 |
| J | KJ | 43 |
| JB | KJB | 44 |
| JJ | KJJ | 45 |
| C | KC | 46 |
| F | KF | 46 |
| D | KD | 48 |
| DD | KDD ² | 50 |
| DE | KDE ² | 51 |

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

² Specify XI dimension from rod end #1.

| Bore Ø | Rod No. | MM Rod Ø | WF | Add Stroke | | | Add 2X Stroke |
|--|----------|----------|------|-----------------|------|------|-----------------|
| | | | | LD | SNK | SSK | ZM |
| 7.00 | 1 (std.) | 3.00 | 2.25 | 8.50 | 5.38 | 5.75 | 13.00 |
| | 2 | 5.00 | 2.25 | 8.50 | 5.38 | 5.75 | 13.00 |
| | 3 | 3.50 | 2.25 | 8.50 | 5.38 | 5.75 | 13.00 |
| | 4 | 4.00 | 2.25 | 8.50 | 5.38 | 5.75 | 13.00 |
| | 5 | 4.50 | 2.25 | 8.50 | 5.38 | 5.75 | 13.00 |
| 8.00 | 1 (std.) | 3.50 | 2.25 | 9.50 | 6.13 | 6.75 | 14.00 |
| | 2 | 5.50 | 2.25 | 9.50 | 6.13 | 6.75 | 14.00 |
| | 3 | 4.00 | 2.25 | 9.50 | 6.13 | 6.75 | 14.00 |
| | 4 | 4.50 | 2.25 | 9.50 | 6.13 | 6.75 | 14.00 |
| | 5 | 5.00 | 2.25 | 9.50 | 6.13 | 6.75 | 14.00 |
| Replaces On single rod mounting styles: | | | | LB | SN | SS | - |
| | | | | All Mtg. Styles | F | C | All Mtg. Styles |

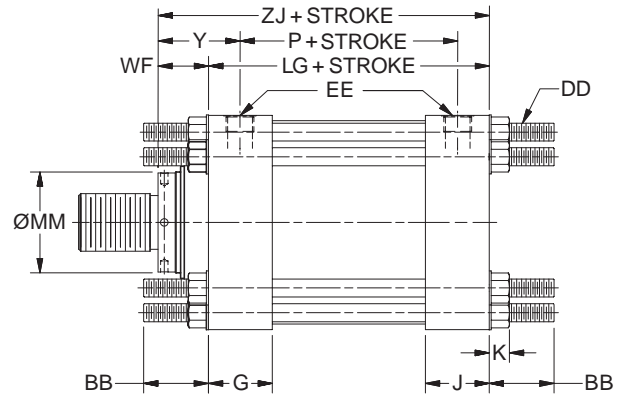
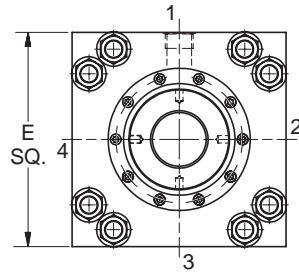
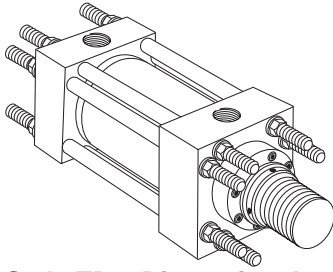
How to Use Double Rod Cylinder Dimension Drawings

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 supplement the single rod dimensions with those shown on drawing at right 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 E.

**Tie Rods Extended Both Ends Mounting
Style TD
(NFPA Style MX1)**



Style TD – Dimensional and Mounting Data

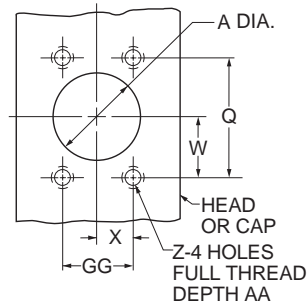
| Bore Ø | Rod No. | MM Rod Ø | BB | DD | E | EE | | | G | J | K | WF | Y | Add Stroke | | |
|--------|----------|----------|------|----------|-------|-------------------|-------------------------------|----------------------------------|------|------|------|------|------|------------|-------|-------|
| | | | | | | NPTF ¹ | SAE Flange Ports ² | SAE Straight Thread ³ | | | | | | LG | P | ZJ |
| 10.00 | 1 (std.) | 4.500 | 4.13 | 1 1/8-12 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 2.94 | 4.75 | 12.13 | 8.50 | 15.06 |
| | 2 | 7.000 | 4.13 | 1 1/8-12 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.50 | 5.31 | 12.13 | 8.50 | 15.63 |
| | 3 | 5.000 | 4.13 | 1 1/8-12 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| | 4 | 5.500 | 4.13 | 1 1/8-12 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| 12.00 | 1 (std.) | 5.500 | 4.50 | 1 1/4-12 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 3.19 | 5.38 | 14.50 | 10.13 | 17.69 |
| | 2 | 8.000 | 4.50 | 1 1/4-12 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.00 | 6.19 | 14.50 | 10.13 | 18.50 |
| | 3 | 7.000 | 4.50 | 1 1/4-12 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 3.50 | 5.69 | 14.50 | 10.13 | 18.00 |
| 14.00 | 1 (std.) | 7.000 | 4.50 | 1 1/4-12 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 3.50 | 5.88 | 15.63 | 10.88 | 19.13 |
| | 2 | 10.000 | 4.50 | 1 1/4-12 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.50 | 6.88 | 15.63 | 10.88 | 20.13 |
| | 3 | 8.000 | 4.50 | 1 1/4-12 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.00 | 6.38 | 15.63 | 10.88 | 19.63 |

¹ NPTF ports are available at no extra charge.

² Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

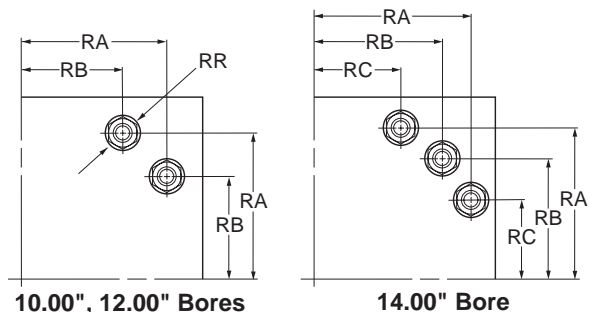
³ SAE straight thread ports are standard and are indicated by port number.

Optional SAE Flange Port Pattern



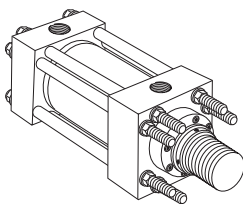
| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |

Style TD – Tie Rod Information

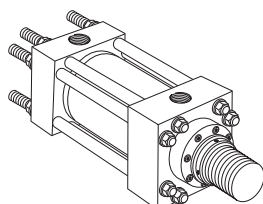


| Bore Ø | 10.00 | 12.00 | 14.00 |
|----------------|----------|----------|----------|
| Tie Rod Thread | 1 1/8-12 | 1 1/4-12 | 1 1/4-12 |
| RA | 5.291 | 6.270 | 7.485 |
| RB | 3.775 | 4.555 | 6.143 |
| RC | — | — | 4.409 |
| RR | 2.13 | 2.38 | 2.25 |

Style TB



Style TC



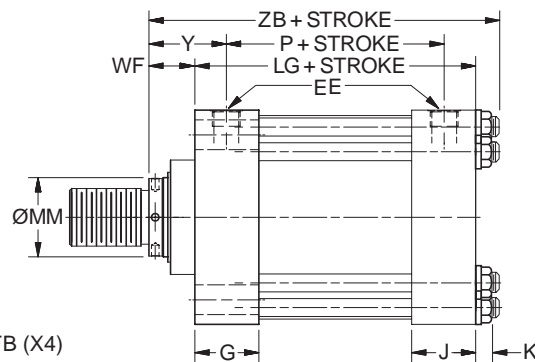
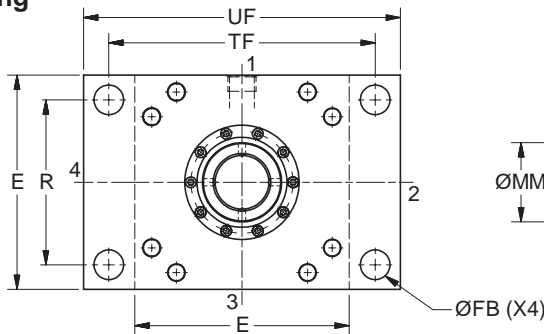
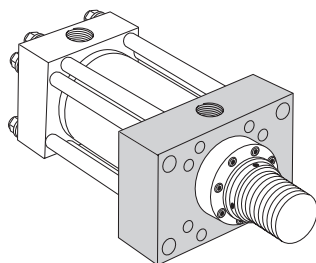
Dimensions for TB and TC Mount may be obtained from the above dimensional table.



Mounting Information – Large Bore

Head Rectangular Mounting

Style JJ (10"-14" Bore)
(NFPA Style ME5)



Style JJ (10"-14" Bore) – Dimensional and Mounting Data

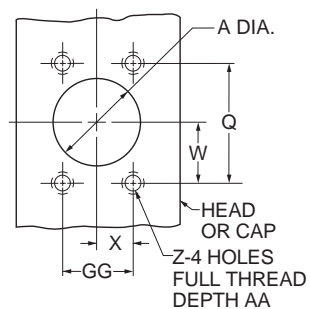
| Bore Ø | Rod No. | MM Rod Ø | E | Ports (EE) | | | FB Ø | G | J | K | R | TF | UF | WF | Y | Add Stroke | | |
|-----------|------------|----------------|-------|-------------------|------------------------------------|--|---------|------|------|------|-------|-------|-------|------|------|------------|-------|------------|
| | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | | LG | P | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | 15.88 | 19.00 | 2.94 | 4.75 | 12.13 | 8.50 | 16.69 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | 15.88 | 19.00 | 3.50 | 5.31 | 12.13 | 8.50 | 17.25 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | 15.88 | 19.00 | 3.19 | 5.00 | 12.13 | 8.50 | 16.94 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | 15.88 | 19.00 | 3.19 | 5.00 | 12.13 | 8.50 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | 18.50 | 22.00 | 3.19 | 5.38 | 14.50 | 10.13 | 19.44 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | 18.50 | 22.00 | 4.00 | 6.19 | 14.50 | 10.13 | 20.25 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | 18.50 | 22.00 | 3.50 | 5.69 | 14.50 | 10.13 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | 21.00 | 25.00 | 3.50 | 5.88 | 15.63 | 10.88 | 20.88 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | 21.00 | 25.00 | 4.50 | 6.88 | 15.63 | 10.88 | 21.88 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | 21.00 | 25.00 | 4.00 | 6.38 | 15.63 | 10.88 | 21.38 |

¹ NPTF ports are available at no extra charge.

² Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

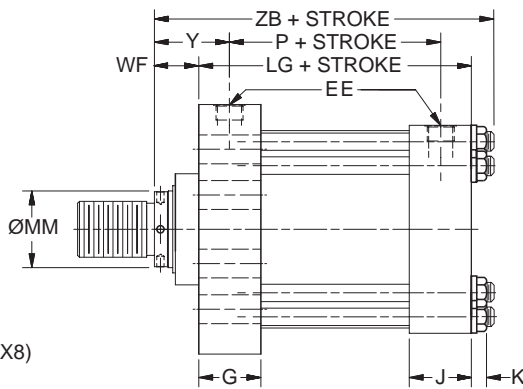
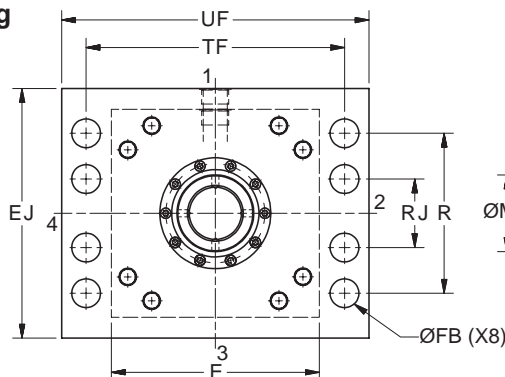
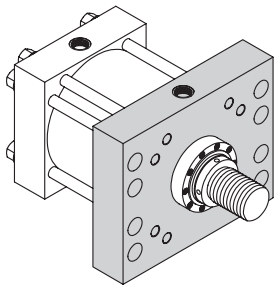
³ SAE straight thread ports are standard and are indicated by port number.

Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |

**Head Rectangular Mounting
Style JJ (16"-20" Bore)
(NFPA Style ME5)**



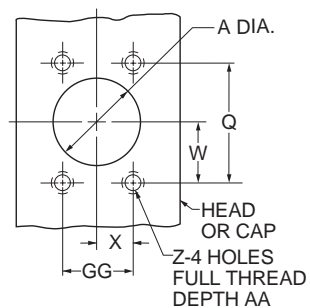
Style JJ (16"-20" Bore) – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EJ | Ports (EE) | | FB Ø | G | J | K | R | RJ | TF | UF | WF | Y | Add Stroke | | |
|--------|----------|----------|-------|-------|------------------------------|---------------------------------------|------|------|------|------|-------|------|-------|-------|------|------|------------|-------|---------|
| | | | | | SAE Flange Port ¹ | SAE Straight Thread Port ² | | | | | | | | | | | LG | P | ZB Max. |
| 16.00 | 1 (std.) | 8.000 | 19.00 | 20.00 | 3.00 | 24 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.00 | 7.00 | 18.13 | 12.13 | 24.38 |
| | 3 | 9.000 | 19.00 | 20.00 | 3.00 | 24 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.25 | 7.25 | 18.13 | 12.13 | 24.63 |
| | 4 | 10.000 | 19.00 | 20.00 | 3.00 | 24 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.50 | 7.50 | 18.13 | 12.13 | 24.88 |
| 18.00 | 1 (std.) | 9.000 | 22.00 | 23.00 | 3.00 | 24 | 2.06 | 6.88 | 6.88 | 1.91 | 18.00 | 7.25 | 24.25 | 28.25 | 4.25 | 7.25 | 21.13 | 15.13 | 27.63 |
| | 3 | 10.000 | 22.00 | 23.00 | 3.00 | 24 | 2.06 | 6.88 | 6.88 | 1.91 | 18.00 | 7.25 | 24.25 | 28.25 | 4.50 | 7.50 | 21.13 | 15.13 | 27.88 |
| 20.00 | 1 (std.) | 10.000 | 24.00 | 25.00 | 3.00 | 24 | 2.06 | 7.88 | 7.88 | 1.91 | 20.00 | 8.00 | 26.50 | 30.50 | 4.50 | 7.50 | 23.63 | 17.63 | 30.38 |

¹Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

²SAE straight thread ports are standard and are indicated by port number.

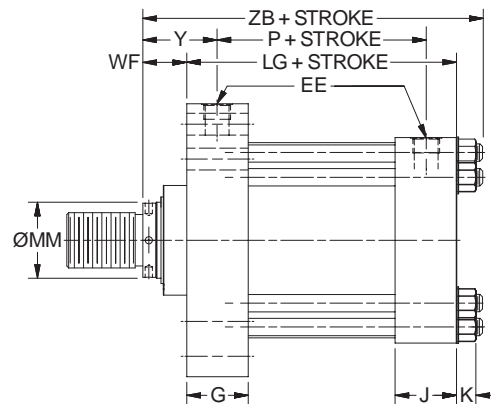
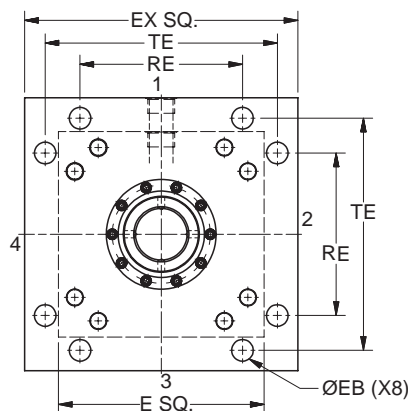
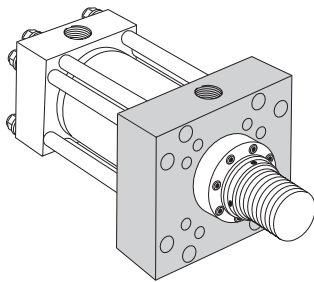
Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |



Head Square Flange Mounting
Style JB
(NFPA Style MF5)



Style JB – Dimensional and Mounting Data

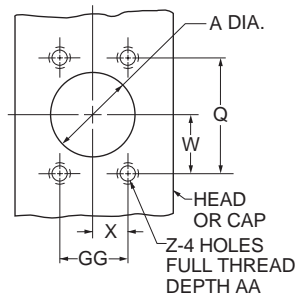
| Bore Ø | Rod No. | MM Rod Ø | E | EB Ø | Ports (EE) | | | EX | G | J | K | RE | TE | WF | Y | Add Stroke | | |
|-----------|------------|----------------|-------|---------|-------------------|------------------------------------|--|-------|------|------|------|-------|-------|------|------|------------|-------|------------|
| | | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | LG | P | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 2.94 | 4.75 | 12.13 | 8.50 | 16.69 |
| | 2 | 7.000 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.50 | 5.31 | 12.13 | 8.50 | 17.25 |
| | 3 | 5.000 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.19 | 5.00 | 12.13 | 8.50 | 16.94 |
| | 4 | 5.500 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.19 | 5.00 | 12.13 | 8.50 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 3.19 | 5.38 | 14.50 | 10.13 | 19.44 |
| | 2 | 8.000 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 4.00 | 6.19 | 14.50 | 10.13 | 20.25 |
| | 3 | 7.000 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 3.50 | 5.69 | 14.50 | 10.13 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 3.50 | 5.88 | 15.63 | 10.88 | 20.88 |
| | 2 | 10.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 4.50 | 6.88 | 15.63 | 10.88 | 21.88 |
| | 3 | 8.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 4.00 | 6.38 | 15.63 | 10.88 | 21.38 |
| 16.00 | 1 (std.) | 8.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.00 | 7.00 | 18.13 | 12.13 | 24.38 |
| | 3 | 9.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.25 | 7.25 | 18.13 | 12.13 | 24.63 |
| | 4 | 10.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.50 | 7.50 | 18.13 | 12.13 | 24.88 |
| 18.00 | 1 (std.) | 9.000 | 22.00 | 2.06 | - | 3.00 | 24 | 26.50 | 6.88 | 6.88 | 1.91 | 16.45 | 22.65 | 4.25 | 7.25 | 21.13 | 15.13 | 27.63 |
| | 3 | 10.000 | 22.00 | 2.06 | - | 3.00 | 24 | 26.50 | 6.88 | 6.88 | 1.91 | 16.45 | 22.65 | 4.50 | 7.50 | 21.13 | 15.13 | 27.88 |
| 20.00 | 1 (std.) | 10.000 | 24.00 | 2.06 | - | 3.00 | 24 | 29.00 | 7.88 | 7.88 | 1.91 | 18.07 | 24.87 | 4.50 | 7.50 | 23.63 | 17.63 | 30.38 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

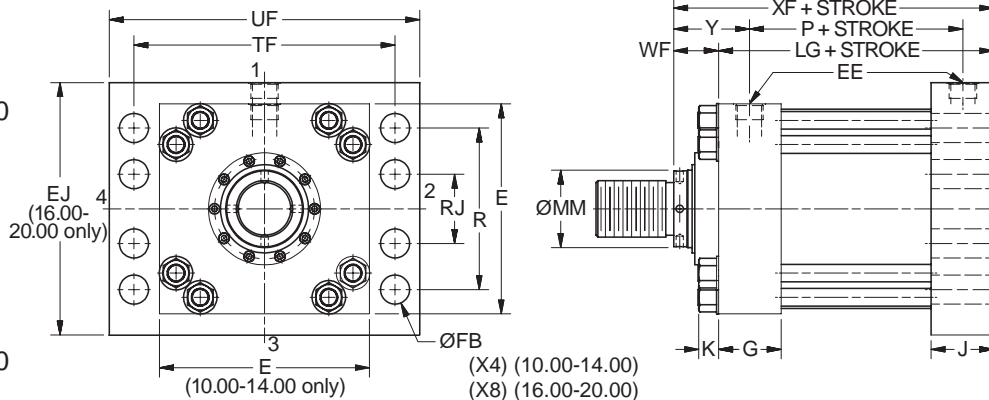
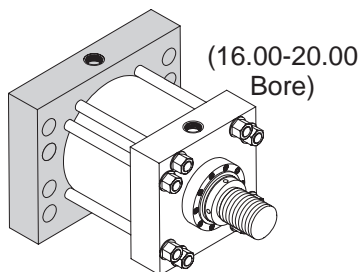
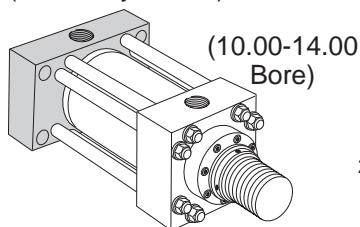
Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |

Cap Rectangular Mounting

Style HH
(NFPA Style ME6)



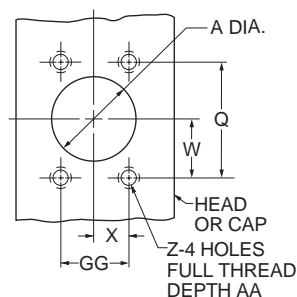
Style HH – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | Ports (EE) | | | EJ | FB Ø | G | J | K | R | R _J | TF | UF | WF | Y | Add Stroke | | |
|--------|----------|----------|-------|-------------------|------------------------------|---------------------------------------|-------|------|------|------|------|-------|----------------|-------|-------|------|------|------------|-------|-------|
| | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | | | | LG | P | XF |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | - | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | - | 15.88 | 19.00 | 2.94 | 4.75 | 12.13 | 8.50 | 15.06 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | - | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | - | 15.88 | 19.00 | 3.50 | 5.31 | 12.13 | 8.50 | 15.63 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | - | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | - | 15.88 | 19.00 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | - | 1.81 | 3.69 | 3.69 | 1.28 | 9.62 | - | 15.88 | 19.00 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | - | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | - | 18.50 | 22.00 | 3.19 | 5.38 | 14.50 | 10.13 | 17.69 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | - | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | - | 18.50 | 22.00 | 4.00 | 6.19 | 14.50 | 10.13 | 18.50 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | - | 2.06 | 4.44 | 4.44 | 1.41 | 11.45 | - | 18.50 | 22.00 | 3.50 | 5.69 | 14.50 | 10.13 | 18.00 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | - | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | - | 21.00 | 25.00 | 3.50 | 5.88 | 15.63 | 10.88 | 19.13 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | - | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | - | 21.00 | 25.00 | 4.50 | 6.88 | 15.63 | 10.88 | 20.13 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | - | 2.31 | 4.88 | 4.88 | 1.41 | 13.26 | - | 21.00 | 25.00 | 4.00 | 6.38 | 15.63 | 10.88 | 19.63 |
| 16.00 | 1 (std.) | 8.000 | - | - | 3.00 | 24 | 20.00 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.00 | 7.00 | 18.13 | 12.13 | 22.13 |
| | 3 | 9.000 | - | - | 3.00 | 24 | 20.00 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.25 | 7.25 | 18.13 | 12.13 | 22.38 |
| | 4 | 10.000 | - | - | 3.00 | 24 | 20.00 | 1.81 | 5.88 | 5.88 | 1.91 | 15.50 | 8.00 | 21.00 | 24.50 | 4.50 | 7.50 | 18.13 | 12.13 | 22.63 |
| 18.00 | 1 (std.) | 9.000 | - | - | 3.00 | 24 | 23.00 | 2.06 | 6.88 | 6.88 | 1.91 | 18.00 | 7.25 | 24.25 | 28.25 | 4.25 | 7.25 | 21.13 | 15.13 | 25.38 |
| | 3 | 10.000 | - | - | 3.00 | 24 | 23.00 | 2.06 | 6.88 | 6.88 | 1.91 | 18.00 | 7.25 | 24.25 | 28.25 | 4.50 | 7.50 | 21.13 | 15.13 | 25.63 |
| 20.00 | 1 (std.) | 10.000 | - | - | 3.00 | 24 | 25.00 | 2.06 | 7.88 | 7.88 | 1.91 | 20.00 | 8.00 | 26.50 | 30.50 | 4.50 | 7.50 | 23.63 | 17.63 | 28.13 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

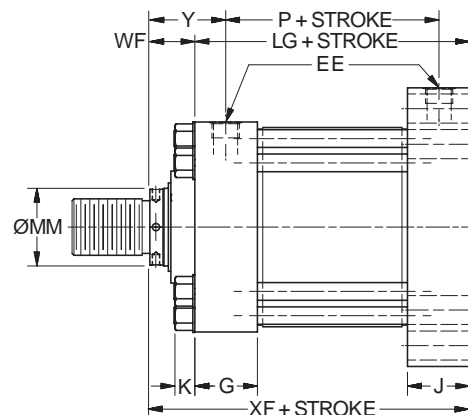
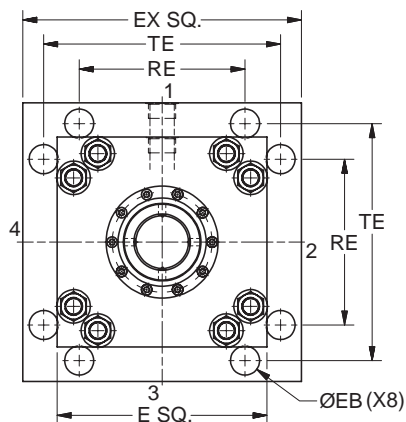
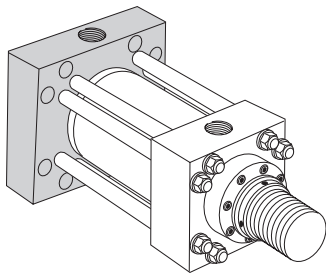


Optional SAE Flange Port Pattern

| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |



Cap Square Flange Mounting
Style HB
(NFA Style MF6)



Style HB – Dimensional and Mounting Data

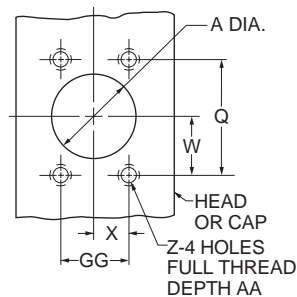
| Bore Ø | Rod No. | MM Rod Ø | E | EB Ø | Ports (EE) | | | EX | G | J | K | RE | TE | WF | Y | Add Stroke | | |
|-----------|------------|----------------|-------|---------|-------------------|------------------------------------|--|-------|------|------|------|-------|-------|------|------|------------|-------|-------|
| | | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | LG | P | XF |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 2.94 | 4.75 | 12.13 | 8.50 | 15.06 |
| | 2 | 7.000 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.50 | 5.31 | 12.13 | 8.50 | 15.63 |
| | 3 | 5.000 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| | 4 | 5.500 | 12.63 | 1.31 | 2.00 | 2.00 | 24 | 16.63 | 3.69 | 3.69 | 1.28 | 9.89 | 14.13 | 3.19 | 5.00 | 12.13 | 8.50 | 15.31 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 3.19 | 5.38 | 14.50 | 10.13 | 17.69 |
| | 2 | 8.000 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 4.00 | 6.19 | 14.50 | 10.13 | 18.50 |
| | 3 | 7.000 | 14.88 | 1.56 | 2.50 | 2.50 | 24 | 19.75 | 4.44 | 4.44 | 1.41 | 11.75 | 16.79 | 3.50 | 5.69 | 14.50 | 10.13 | 18.00 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 3.50 | 5.88 | 15.63 | 10.88 | 19.13 |
| | 2 | 10.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 4.50 | 6.88 | 15.63 | 10.88 | 20.13 |
| | 3 | 8.000 | 17.13 | 1.81 | 2.50 | 2.50 | 24 | 21.75 | 4.88 | 4.88 | 1.41 | 12.90 | 18.43 | 4.00 | 6.38 | 15.63 | 10.88 | 19.63 |
| 16.00 | 1 (std.) | 8.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.00 | 7.00 | 18.13 | 12.13 | 22.13 |
| | 3 | 9.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.25 | 7.25 | 18.13 | 12.13 | 22.38 |
| | 4 | 10.000 | 19.00 | 1.81 | - | 3.00 | 24 | 24.50 | 5.88 | 5.88 | 1.91 | 15.28 | 21.03 | 4.50 | 7.50 | 18.13 | 12.13 | 22.63 |
| 18.00 | 1 (std.) | 9.000 | 22.00 | 2.06 | - | 3.00 | 24 | 26.50 | 6.88 | 6.88 | 1.91 | 16.45 | 22.65 | 4.25 | 7.25 | 21.13 | 15.13 | 25.38 |
| | 3 | 10.000 | 22.00 | 2.06 | - | 3.00 | 24 | 26.50 | 6.88 | 6.88 | 1.91 | 16.45 | 22.65 | 4.50 | 7.50 | 21.13 | 15.13 | 25.63 |
| 20.00 | 1 (std.) | 10.000 | 24.00 | 2.06 | - | 3.00 | 24 | 29.00 | 7.88 | 7.88 | 1.91 | 18.07 | 24.87 | 4.50 | 7.50 | 23.63 | 17.63 | 28.13 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

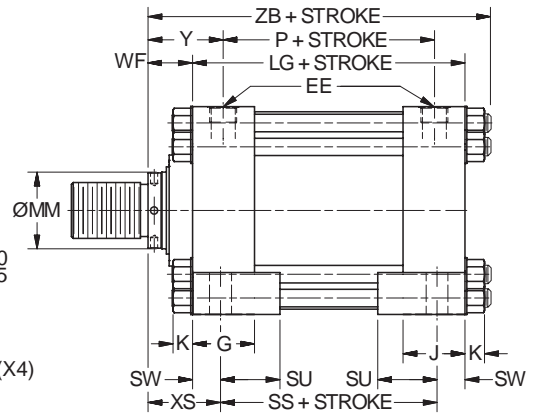
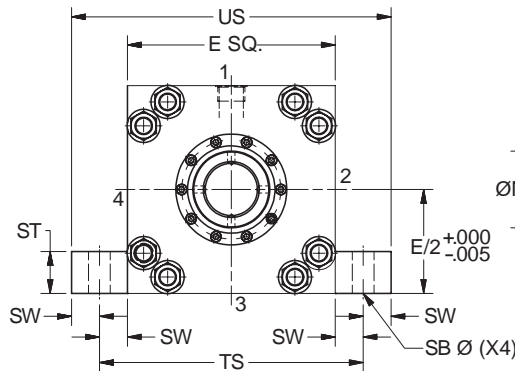
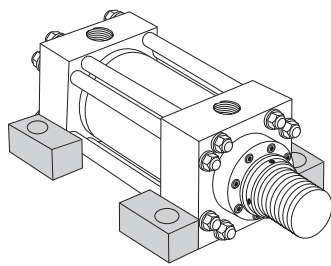
³SAE straight thread ports are standard and are indicated by port number.

Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |

Side Lugs Mounting
Style C
(NFPA Style MS2)



Style C – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | Ports (EE) | | | G | J | K | SB Ø | ST | SU | SW | Y | TS | US | WF | XS |
|--------|----------|----------|-------|-------------------|------------------------------|---------------------------------------|------|------|------|-------|------|------|------|------|-------|-------|------|------|
| | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | | | | |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 1.563 | 2.25 | 3.50 | 1.63 | 4.75 | 15.88 | 19.13 | 2.94 | 4.56 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 1.563 | 2.25 | 3.50 | 1.63 | 5.31 | 15.88 | 19.13 | 3.50 | 5.13 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 1.563 | 2.25 | 3.50 | 1.63 | 5.00 | 15.88 | 19.13 | 3.19 | 4.81 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 1.563 | 2.25 | 3.50 | 1.63 | 5.00 | 15.88 | 19.13 | 3.19 | 4.81 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 1.563 | 3.00 | 4.25 | 2.00 | 5.38 | 18.88 | 22.88 | 3.19 | 5.19 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 1.563 | 3.00 | 4.25 | 2.00 | 6.19 | 18.88 | 22.88 | 4.00 | 6.00 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 1.563 | 3.00 | 4.25 | 2.00 | 5.69 | 18.88 | 22.88 | 3.50 | 5.50 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 2.313 | 4.00 | 4.75 | 2.25 | 5.88 | 21.63 | 26.13 | 3.50 | 5.75 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 2.313 | 4.00 | 4.75 | 2.25 | 6.88 | 21.63 | 26.13 | 4.50 | 6.75 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 2.313 | 4.00 | 4.75 | 2.25 | 6.38 | 21.63 | 26.13 | 4.00 | 6.25 |

¹NPTF ports are available at no extra charge.

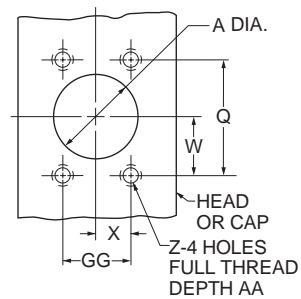
²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

Style C – Dimensional and Mounting Data (cont.)

| Bore Ø | Rod No. | MM Rod Ø | Add Stroke | | | |
|--------|----------|----------|------------|-------|-------|---------|
| | | | LG | P | SS | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.13 | 8.50 | 8.88 | 16.69 |
| | 2 | 7.000 | 12.13 | 8.50 | 8.88 | 17.25 |
| | 3 | 5.000 | 12.13 | 8.50 | 8.88 | 16.94 |
| | 4 | 5.500 | 12.13 | 8.50 | 8.88 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.50 | 10.13 | 10.50 | 19.44 |
| | 2 | 8.000 | 14.50 | 10.13 | 10.50 | 20.25 |
| | 3 | 7.000 | 14.50 | 10.13 | 10.50 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 15.63 | 10.88 | 11.13 | 20.88 |
| | 2 | 10.000 | 15.63 | 10.88 | 11.13 | 21.88 |
| | 3 | 8.000 | 15.63 | 10.88 | 11.13 | 21.38 |

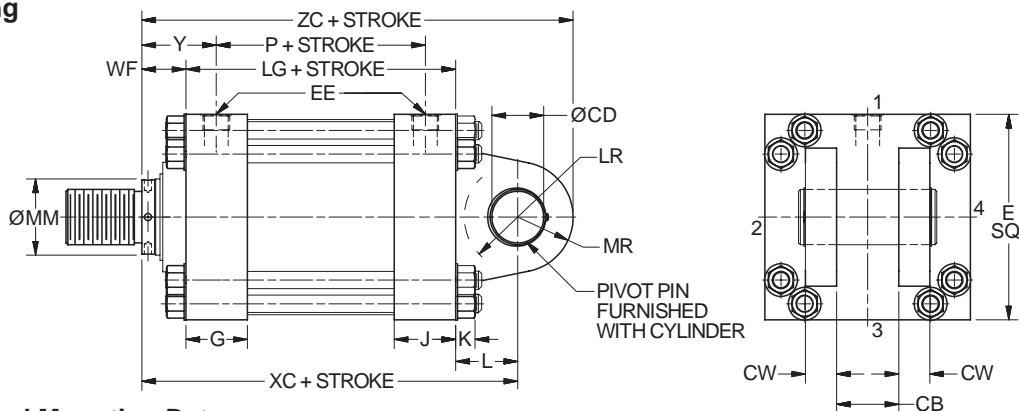
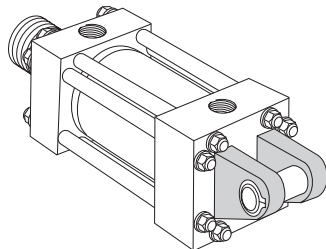
Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |



Cap Fixed Clevis Mounting
Style BB
(NFPA Style MP1)



Style BB – Dimensional and Mounting Data

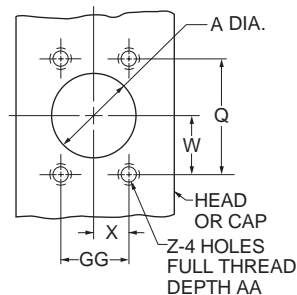
| Bore Ø | Rod No. | MM Rod Ø | CB | CD Ø +.001 -.003 | CW | E | EE Ports | | | G | J | K | L | LR | MR | WF | Y | Add Stroke | | | |
|-----------|------------|----------------|------|------------------------|------|-------|-------------------|------------------------------------|--|------|------|------|------|------|------|------|------|------------|-------|-------|-------|
| | | | | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | LG | P | XC | ZC |
| 10.00 | 1 (std.) | 4.500 | 4.00 | 3.500 | 2.00 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 4.00 | 3.38 | 3.50 | 2.94 | 4.75 | 12.13 | 8.50 | 19.06 | 22.56 |
| | 2 | 7.000 | 4.00 | 3.500 | 2.00 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 4.00 | 3.38 | 3.50 | 3.50 | 5.31 | 12.13 | 8.50 | 19.63 | 23.13 |
| | 3 | 5.000 | 4.00 | 3.500 | 2.00 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 4.00 | 3.38 | 3.50 | 3.19 | 5.00 | 12.13 | 8.50 | 19.31 | 22.81 |
| | 4 | 5.500 | 4.00 | 3.500 | 2.00 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 4.00 | 3.38 | 3.50 | 3.19 | 5.00 | 12.13 | 8.50 | 19.31 | 22.81 |
| 12.00 | 1 (std.) | 5.500 | 4.50 | 4.000 | 2.25 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.50 | 3.88 | 4.00 | 3.19 | 5.38 | 14.50 | 10.13 | 22.19 | 26.19 |
| | 2 | 8.000 | 4.50 | 4.000 | 2.25 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.50 | 3.88 | 4.00 | 4.00 | 6.19 | 14.50 | 10.13 | 23.00 | 27.00 |
| | 3 | 7.000 | 4.50 | 4.000 | 2.25 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.50 | 3.88 | 4.00 | 3.50 | 5.69 | 14.50 | 10.13 | 22.50 | 26.50 |
| 14.00 | 1 (std.) | 7.000 | 6.00 | 5.000 | 3.00 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 5.75 | 4.19 | 5.00 | 3.50 | 5.88 | 15.63 | 10.88 | 24.88 | 29.88 |
| | 2 | 10.000 | 6.00 | 5.000 | 3.00 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 5.75 | 4.19 | 5.00 | 4.50 | 6.88 | 15.63 | 10.88 | 25.88 | 30.88 |
| | 3 | 8.000 | 6.00 | 5.000 | 3.00 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 5.75 | 4.19 | 5.00 | 4.00 | 6.38 | 15.63 | 10.88 | 25.38 | 30.38 |
| 16.00 | 1 (std.) | 8.000 | 7.00 | 6.000 | 3.50 | 19.00 | - | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 7.00 | 6.25 | 6.00 | 4.00 | 7.00 | 18.13 | 12.13 | 29.13 | 35.13 |
| | 3 | 9.000 | 7.00 | 6.000 | 3.50 | 19.00 | - | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 7.00 | 6.25 | 6.00 | 4.25 | 7.25 | 18.13 | 12.13 | 29.38 | 35.38 |
| | 4 | 10.000 | 7.00 | 6.000 | 3.50 | 19.00 | - | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 7.00 | 6.25 | 6.00 | 4.50 | 7.50 | 18.13 | 12.13 | 29.63 | 35.63 |
| 18.00 | 1 (std.) | 9.000 | 8.00 | 6.500 | 4.00 | 22.00 | - | 3.00 | 24 | 6.88 | 6.88 | 1.91 | 7.63 | 6.75 | 6.50 | 4.25 | 7.25 | 21.13 | 15.13 | 33.00 | 39.50 |
| | 3 | 10.000 | 8.00 | 6.500 | 4.00 | 22.00 | - | 3.00 | 24 | 6.88 | 6.88 | 1.91 | 7.63 | 6.75 | 6.50 | 4.50 | 7.50 | 21.13 | 15.13 | 33.25 | 39.75 |
| 20.00 | 1 (std.) | 10.000 | 9.00 | 7.500 | 4.50 | 24.00 | - | 3.00 | 24 | 7.88 | 7.88 | 1.91 | 8.75 | 7.75 | 7.50 | 4.50 | 7.50 | 23.63 | 17.63 | 36.88 | 44.38 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

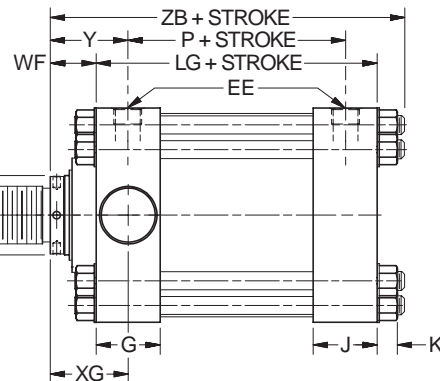
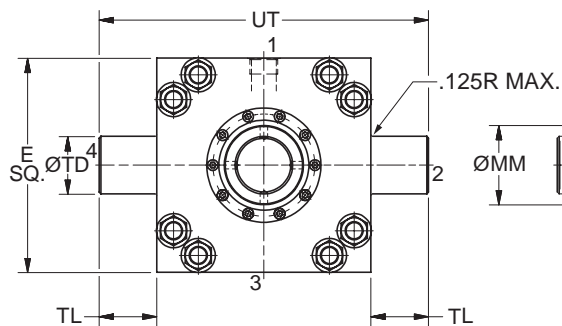
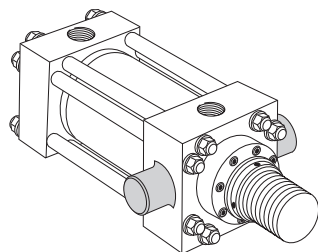
Optional SAE Flange Port Pattern



| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |

Head Trunnion Mounting

Style D
(NFA Style MT1)



Style D – Dimensional and Mounting Data

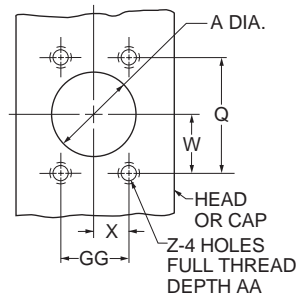
| Bore Ø | Rod No. | MM Rod Ø | E | Ports (EE) | | | G | J | K | TD Ø +0.000 -0.001 | TL | UT | WF | XG | Y | Add Stroke | | |
|-----------|------------|----------------|-------|-------------------|------------------------------------|--|------|------|------|--------------------------|------|-------|------|------|------|------------|-------|------------|
| | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | | LG | P | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 2.94 | 4.75 | 4.75 | 12.13 | 8.50 | 16.69 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.50 | 5.31 | 5.31 | 12.13 | 8.50 | 17.25 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.19 | 5.00 | 5.00 | 12.13 | 8.50 | 16.94 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.19 | 5.00 | 5.00 | 12.13 | 8.50 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 3.19 | 5.38 | 5.38 | 14.50 | 10.13 | 19.44 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 4.00 | 6.19 | 6.19 | 14.50 | 10.13 | 20.25 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 3.50 | 5.69 | 5.69 | 14.50 | 10.13 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 3.50 | 5.94 | 5.88 | 15.63 | 10.88 | 20.88 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 4.50 | 6.94 | 6.88 | 15.63 | 10.88 | 21.88 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 4.00 | 6.44 | 6.38 | 15.63 | 10.88 | 21.38 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

Optional SAE Flange Port Pattern



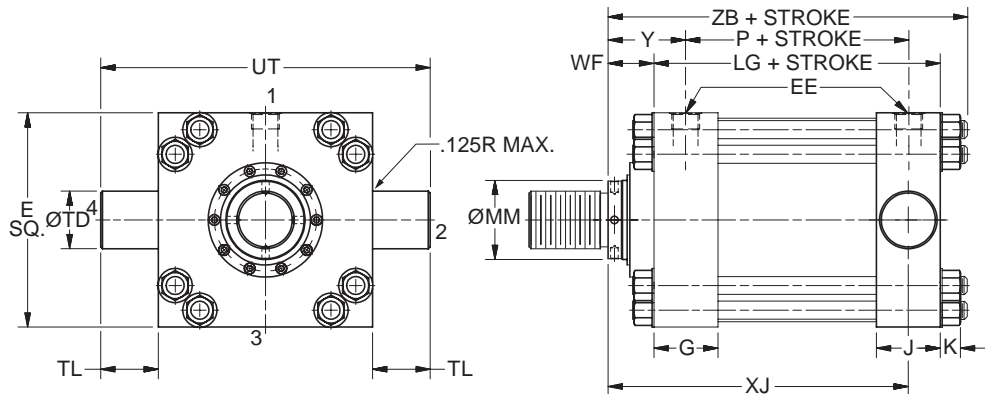
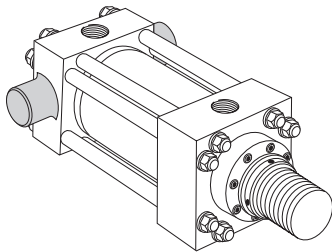
| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |

Style D – Maximum Operating Pressure

| Bore Ø | psi |
|--------|------|
| 10.00 | 2800 |
| 12.00 | 2350 |
| 14.00 | 2200 |



Cap Trunnion Mounting
Style DB
(NFA Style MT2)



Style DB – Dimensional and Mounting Data

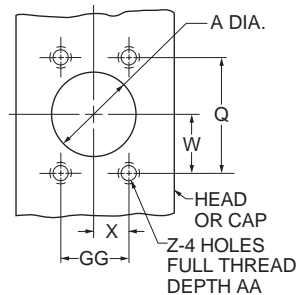
| Bore Ø | Rod No. | MM Rod Ø | E | Ports (EE) | | | G | J | K | TD Ø +.000 -.001 | TL | UT | WF | Y | Add Stroke | | | |
|--------|----------|----------|-------|-------------------|------------------------------|---------------------------------------|------|------|------|------------------------|------|-------|------|------|------------|-------|-------|---------|
| | | | | NPTF ¹ | SAE Flange Port ² | SAE Straight Thread Port ³ | | | | | | | | | LG | P | XJ | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 2.94 | 4.75 | 12.13 | 8.50 | 13.38 | 16.69 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.50 | 5.31 | 12.13 | 8.50 | 13.94 | 17.25 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.19 | 5.00 | 12.13 | 8.50 | 13.63 | 16.94 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 19.63 | 3.19 | 5.00 | 12.13 | 8.50 | 13.63 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 3.19 | 5.38 | 14.50 | 10.13 | 15.50 | 19.44 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 4.00 | 6.19 | 14.50 | 10.13 | 16.31 | 20.25 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 22.88 | 3.50 | 5.69 | 14.50 | 10.13 | 15.81 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 3.50 | 5.88 | 15.63 | 10.88 | 16.69 | 20.88 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 4.50 | 6.88 | 15.63 | 10.88 | 17.69 | 21.88 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 26.13 | 4.00 | 6.38 | 15.63 | 10.88 | 17.19 | 21.38 |

¹NPTF ports are available at no extra charge.

²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

Optional SAE Flange Port Pattern



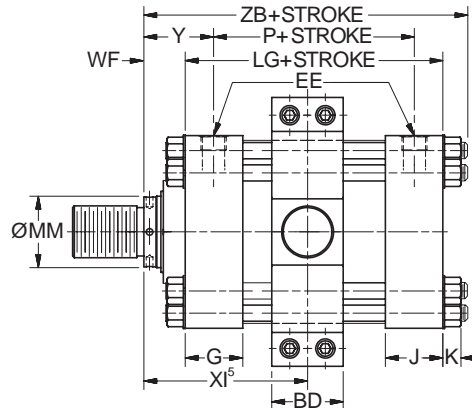
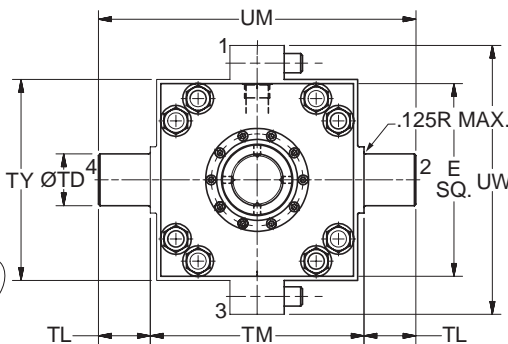
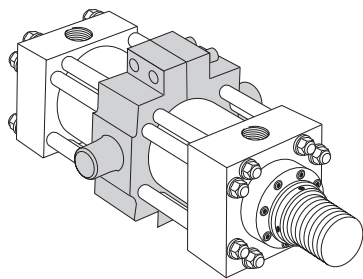
| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |

Style DB – Maximum Operating Pressure

| Bore Ø | psi |
|--------|------|
| 10.00 | 2800 |
| 12.00 | 2350 |
| 14.00 | 2200 |

Intermediate Fixed Trunnion Mounting

Style DD
(NFA Style MT4)



Style DD – Dimensional and Mounting Data

| Bore Ø | Rod No. | MM Rod Ø | E | EE Ports | | | BD | G | J | K | TD Ø +0.000 -0.001 | TL | TM | TY | UM | UW | WF | Min. XI ⁵ | Y | Add Stroke | | |
|--------|----------|----------|-------|-------------------|-----------------------------|---------------------------------|------|------|------|------|--------------------------|------|-------|-------|-------|-------|------|----------------------|-------|------------|-------|---------|
| | | | | NPTF ¹ | SAE Flge. Port ² | SAE Str. Thr. Port ³ | | | | | | | | | | | | | | LG | P | ZB Max. |
| 10.00 | 1 (std.) | 4.500 | 12.63 | 2.00 | 2.00 | 24 | 4.50 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 14.00 | 13.00 | 21.00 | 17.50 | 2.94 | 9.06 | 4.75 | 12.13 | 8.50 | 16.69 |
| | 2 | 7.000 | 12.63 | 2.00 | 2.00 | 24 | 4.50 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 14.00 | 13.00 | 21.00 | 17.50 | 3.50 | 9.63 | 5.31 | 12.13 | 8.50 | 17.25 |
| | 3 | 5.000 | 12.63 | 2.00 | 2.00 | 24 | 4.50 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 14.00 | 13.00 | 21.00 | 17.50 | 3.19 | 9.31 | 5.00 | 12.13 | 8.50 | 16.94 |
| | 4 | 5.500 | 12.63 | 2.00 | 2.00 | 24 | 4.50 | 3.69 | 3.69 | 1.28 | 3.500 | 3.50 | 14.00 | 13.00 | 21.00 | 17.50 | 3.19 | 9.31 | 5.00 | 12.13 | 8.50 | 16.94 |
| 12.00 | 1 (std.) | 5.500 | 14.88 | 2.50 | 2.50 | 24 | 5.50 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 16.50 | 15.50 | 24.50 | 20.75 | 3.19 | 10.63 | 5.38 | 14.50 | 10.13 | 19.44 |
| | 2 | 8.000 | 14.88 | 2.50 | 2.50 | 24 | 5.50 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 16.50 | 15.50 | 24.50 | 20.75 | 4.00 | 11.50 | 6.19 | 14.50 | 10.13 | 20.25 |
| | 3 | 7.000 | 14.88 | 2.50 | 2.50 | 24 | 5.50 | 4.44 | 4.44 | 1.41 | 4.000 | 4.00 | 16.50 | 15.50 | 24.50 | 20.75 | 3.50 | 10.94 | 5.69 | 14.50 | 10.13 | 19.75 |
| 14.00 | 1 (std.) | 7.000 | 17.13 | 2.50 | 2.50 | 24 | 5.50 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 19.50 | 19.25 | 28.50 | 24.75 | 3.50 | 11.44 | 5.88 | 15.63 | 10.88 | 20.88 |
| | 2 | 10.000 | 17.13 | 2.50 | 2.50 | 24 | 5.50 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 19.50 | 19.25 | 28.50 | 24.75 | 4.50 | 12.44 | 6.88 | 15.63 | 10.88 | 21.88 |
| | 3 | 8.000 | 17.13 | 2.50 | 2.50 | 24 | 5.50 | 4.88 | 4.88 | 1.41 | 4.500 | 4.50 | 19.50 | 19.25 | 28.50 | 24.75 | 4.00 | 11.94 | 6.38 | 15.63 | 10.88 | 21.38 |
| 16.00 | 1 (std.) | 8.000 | 19.00 | 3.00 | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.00 | 7.00 | 18.13 | 12.13 | 24.38 | |
| | 3 | 9.000 | 19.00 | 3.00 | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.25 | 7.25 | 18.13 | 12.13 | 24.63 | |
| | 4 | 10.000 | 19.00 | 3.00 | 3.00 | 24 | 5.88 | 5.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.50 | 7.50 | 18.13 | 12.13 | 24.88 | |
| 18.00 | 1 (std.) | 9.000 | 22.00 | 3.00 | 3.00 | 24 | 6.88 | 6.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.25 | 7.25 | 21.13 | 15.13 | 27.63 | |
| | 3 | 10.000 | 22.00 | 3.00 | 3.00 | 24 | 6.88 | 6.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.50 | 7.50 | 21.13 | 15.13 | 27.88 | |
| 20.00 | 1 (std.) | 10.000 | 24.00 | 3.00 | 3.00 | 24 | 7.88 | 7.88 | 1.91 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.50 | 7.50 | 23.63 | 17.63 | 30.38 | |

¹NPTF ports are available at no extra charge.

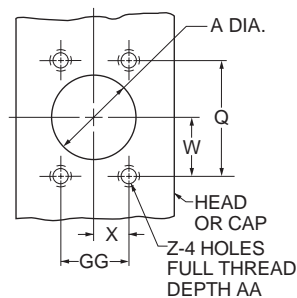
²Optional SAE flange ports may be specified – flange to be supplied by customer. See Optional SAE Flange Port Pattern table for dimensions.

³SAE straight thread ports are standard and are indicated by port number.

⁴Consult Factory

⁵Dimension XI to be specified by customer.

Optional SAE Flange Port Pattern



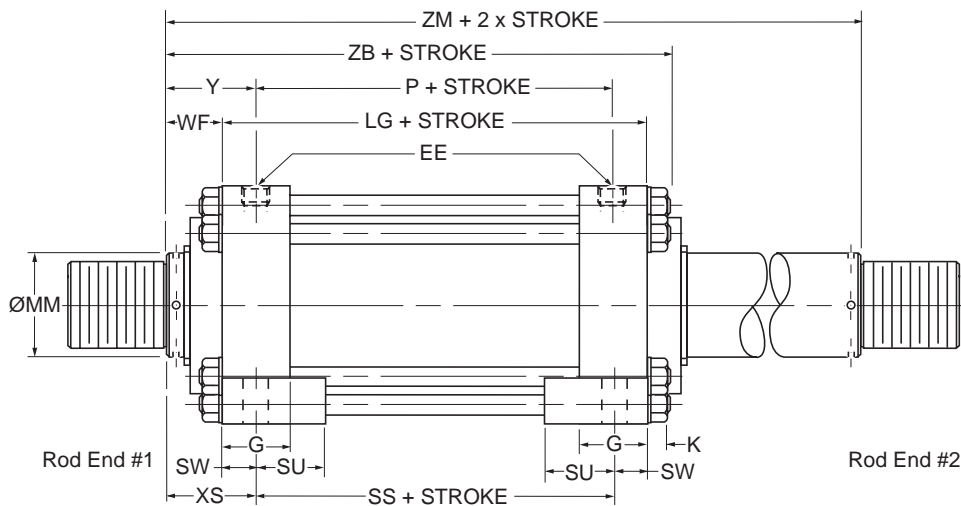
| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. | SAE |
|------------------|------|-------|-------|------|------|--------------|---------|-----|
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 | 32 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 | 40 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 | 48 |

Style DD – Maximum Operating Pressure

| Bore Ø | psi |
|--------|------|
| 10.00 | 2800 |
| 12.00 | 2350 |
| 14.00 | 2200 |



**Double Rod Cylinder
Style K**



| Mounting Styles for Single Rod Models | Mounting Styles for Corresponding Double Rod Models ¹ | Dimension Shown on This Page Supplement Dimensions on Pages Listed Below |
|---------------------------------------|--|--|
| TB | KTB | 53 |
| TD | KTD | 53 |
| JJ | KJJ | 54/55 |
| JB | KJB | 56 |
| C | KC | 59 |
| D | KD | 61 |
| DD ² | KDD | 63 |

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

²Specify XI dimension from rod end #1.

| Bore Ø | Rod Code | Rod Ø | Add 2X Stroke |
|--------|----------|--------|---------------|
| | | | ZM |
| 10.00 | 1 | 4.500 | 18.00 |
| | 2 | 7.000 | 19.12 |
| | 3 | 5.000 | 18.50 |
| | 4 | 5.500 | 18.50 |
| 12.00 | 1 | 5.500 | 20.88 |
| | 2 | 8.000 | 22.50 |
| | 3 | 7.000 | 21.50 |
| 14.00 | 1 | 7.000 | 22.63 |
| | 2 | 10.000 | 24.63 |
| | 3 | 8.000 | 23.63 |
| 16.00 | 1 | 8.000 | 26.13 |
| | 3 | 9.000 | 26.63 |
| | 4 | 10.000 | 27.13 |
| 18.00 | 1 | 9.000 | 29.63 |
| | 3 | 10.000 | 30.13 |
| 20.00 | 1 | 10.000 | 32.63 |

**How to Use Double Rod Cylinder
Dimension Drawings**

To obtain dimensioning information on a double rod cylinder, first select the desired mounting style and refer to the corresponding single rod cylinder model shown on the preceding pages. (See table above.) After you have determined all necessary dimensions from that drawing, turn back to this page and supplement those dimensions with additional ones from the drawing above and table at right. These added dimensions differ from, or are in addition to, those shown on the preceding pages and provide the

additional information needed to completely dimension a double rod cylinder model.

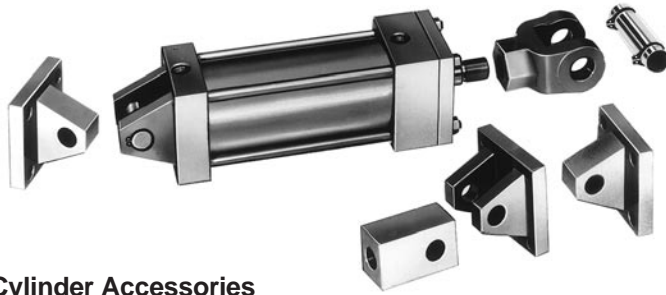
On a double rod cylinder where the two rod ends are different, be sure to clearly state which rod end is to be assembled at which end. Port position 1 is standard. If other than standard, specify pos. 2, 3 or 4 when viewed from rod end #1 only. See port position information in Section E.

Section C

Cylinder Accessories and Replacement Parts

| | |
|--|----|
| 2H & 3H Cylinder Mounting Accessories | 66 |
| 2H Spherical Bearing Mounting Accessories | 70 |
| 2H & 3H Linear Alignment Couplers | 71 |
| Style 55 Split Couplers and Weld Plates | 73 |
| 2H Parts List and Seal Kits | 74 |
| 3H Parts List and Seal Kits for 7.00" & 8.00" Bore | 76 |
| Gland Cartridge Wrenches | 77 |
| 3H Parts List and Seal Kits for 10.00" - 20.00" Bore | 78 |
| 2HD/3HD Parts List and Seal Kits | 80 |

C



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.

**Series 2H & 3H Accessory Part Numbers & Load Capacity
 Chart A**

| Thread Size | Rod Clevis | | Mounting Plate or Eye Bracket | | Pivot Pin | |
|-------------|-------------------------|----------------------|-------------------------------|----------------------|-------------|-----------------------|
| | Part Number | Load Capacity (Lbs.) | Part Number | Load Capacity (Lbs.) | Part Number | Shear Capacity (Lbs.) |
| 5/16-24 | 0512210000 ¹ | 2600 | 0740770000 | 1700 | - | - |
| 7/16-20 | 0509400000 | 4250 | 0691950000 | 4100 | 0683680000 | 8600 |
| 1/2-20 | 0509410000 | 4900 | 0691950000 | 4100 | 0683680000 | 8600 |
| 3/4-16 | 0509420000 | 11200 | 0691960000 | 10500 | 0683690000 | 19300 |
| 3/4-16 | 1332840000 | 11200 | 0691960000 | 10500 | 0683690000 | 19300 |
| 7/8-14 | 0509430000 | 18800 | ² 0853610000 | 20400 | 0683700000 | 34300 |
| 1-14 | 0509440000 | 19500 | ² 0853610000 | 20400 | 0683700000 | 34300 |
| 1-14 | 1332850000 | 19500 | ² 0853610000 | 20400 | 0683700000 | 34300 |
| 1 1/4-12 | 0509450000 | 33500 | 0691980000 | 21200 | 0683710000 | 65000 |
| 1 1/4-12 | 1332860000 | 33500 | 0691980000 | 21200 | 0683710000 | 65000 |
| 1 1/2-12 | 0509460000 | 45600 | ² 0853620000 | 43300 | 0683720000 | 105200 |
| 1 3/4-12 | 0509470000 | 65600 | ² 0853630000 | 70000 | 0683730000 | 137400 |
| 1 7/8-12 | 0509480000 | 65600 | ² 0853630000 | 70000 | 0683730000 | 137400 |
| 2 1/4-12 | 0509490000 | 98200 | ² 0853640000 | 94200 | 0683740000 | 214700 |
| 2 1/2-12 | 0509500000 | 98200 | ² 0853650000 | 121900 | 0683750000 | 309200 |
| 2 3/4-12 | 0509510000 | 98200 | ² 0853650000 | 121900 | 0683750000 | 309200 |
| 3 1/4-12 | 0509520000 | 156700 | 0735380000 | 57400 | 0735450000 | 420900 |
| 3 1/2-12 | 0509530000 | 193200 | 0735390000 | 75000 | 0735470000 | 565800 |
| 4-12 | 0509540000 | 221200 | 0735390000 | 75000 | 0735470000 | 565800 |

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.

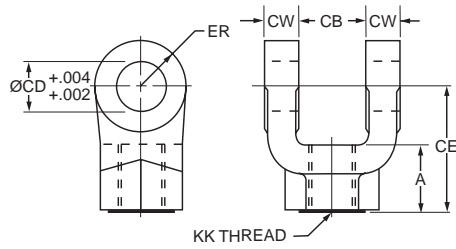
Chart B

| Mtg. Plate Part No. | Series 2H Bore Ø | Series 3H Bore Ø |
|---------------------|------------------|------------------|
| 0691950000 | 1.50 | - |
| 0691960000 | 2.00, 2.50 | - |
| 0853610000 | 3.25 | - |
| 0691980000 | 4.00 | - |
| 0853620000 | 5.00 | - |
| 0853630000 | 6.00 | - |
| 0853640000 | - | 7.00 |
| 0853650000 | - | 8.00 |

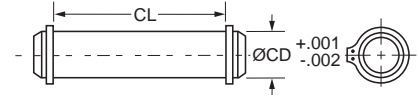
¹ Includes pivot pin.

² Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems – cylinder – dimensions for accessories for cataloged square head industrial cylinders.

Rod Clevis Dimensions



Pivot Pin Dimensions



| Part Number | A | CB | Ø CD | CE | CW | ER | KK |
|-------------------------|-------------------|------|-------|------|------|------|----------|
| 0512210000 ¹ | 0.81 | 0.34 | 0.313 | 2.25 | 0.20 | 0.30 | 5/16-24 |
| 0509400000 | 0.75 | 0.77 | 0.500 | 1.50 | 0.49 | 0.50 | 7/16-20 |
| 0509410000 | 0.75 | 0.77 | 0.500 | 1.50 | 0.49 | 0.50 | 1/2-20 |
| 0509420000 | 1.13 | 1.27 | 0.750 | 2.13 | 0.62 | 0.75 | 3/4-16 |
| 1332840000 | 1.13 | 1.27 | 0.750 | 2.38 | 0.62 | 0.75 | 3/4-16 |
| 0509430000 | 1.63 | 1.52 | 1.000 | 2.94 | 0.74 | 1.00 | 7/8-14 |
| 0509440000 | 1.63 | 1.52 | 1.000 | 2.94 | 0.74 | 1.00 | 1-14 |
| 1332850000 | 1.63 | 1.52 | 1.000 | 3.13 | 0.74 | 1.00 | 1-14 |
| 0509450000 | 1.88 | 2.04 | 1.375 | 3.75 | 0.99 | 1.38 | 1 1/4-12 |
| 1332860000 | 2.00 | 2.04 | 1.375 | 4.13 | 0.99 | 1.38 | 1 1/4-12 |
| 0509460000 | 2.25 | 2.54 | 1.750 | 4.50 | 1.24 | 1.75 | 1 1/2-12 |
| 0509470000 | 3.00 | 2.54 | 2.000 | 5.50 | 1.24 | 2.00 | 1 3/4-12 |
| 0509480000 | 3.00 | 2.54 | 2.000 | 5.50 | 1.24 | 2.00 | 1 7/8-12 |
| 0509490000 | 3.50 | 3.04 | 2.500 | 6.50 | 1.49 | 2.50 | 2 1/4-12 |
| 0509500000 | 3.50 | 3.04 | 3.000 | 6.75 | 1.49 | 2.75 | 2 1/2-12 |
| 0509510000 | 3.50 | 3.04 | 3.000 | 6.75 | 1.49 | 2.75 | 2 3/4-12 |
| 0509520000 | 3.50 ² | 4.04 | 3.500 | 7.75 | 1.98 | 3.50 | 3 1/4-12 |
| 0509530000 | 4.00 ² | 4.54 | 4.000 | 8.81 | 2.23 | 4.00 | 3 1/2-12 |
| 0509540000 | 4.00 ² | 4.54 | 4.000 | 8.81 | 2.23 | 4.00 | 4-12 |

| Part Number | Ø CD | CL |
|-------------------------|-------|------|
| 0683680000 | 0.500 | 1.88 |
| 0683690000 | 0.750 | 2.63 |
| 0683700000 | 1.000 | 3.13 |
| 0683710000 | 1.375 | 4.13 |
| 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 ³ | 4.000 | 9.00 |

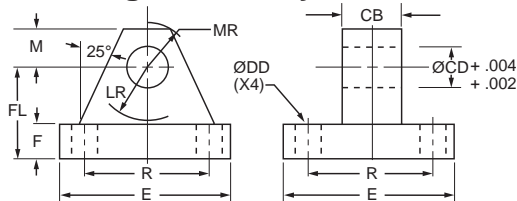
³This size supplied with cotter pins.

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

¹ Includes Pivot Pin

² Consult appropriate cylinder rod end dimensions for compatibility.

Mounting Plate or Eye Bracket Dimensions



When used to mate with the Rod Clevis, select by thread size in table on opposite page.

| Part Number | CB | Ø CD | Ø DD | E | F | FL | LR | M | MR | R |
|-------------------------|------|-------|------|-------|------|------|------|------|------|-------|
| 0740770000 | 0.31 | 0.313 | 0.27 | 2.25 | 0.38 | 1.00 | 0.63 | 0.38 | 0.50 | 1.75 |
| 0691950000 | 0.75 | 0.500 | 0.41 | 2.50 | 0.38 | 1.13 | 0.75 | 0.50 | 0.56 | 1.63 |
| 0691960000 | 1.25 | 0.750 | 0.53 | 3.50 | 0.63 | 1.88 | 1.25 | 0.75 | 0.88 | 2.55 |
| ⁴ 0853610000 | 1.50 | 1.000 | 0.66 | 4.50 | 0.88 | 2.38 | 1.50 | 1.00 | 1.25 | 3.25 |
| 0691980000 | 2.00 | 1.375 | 0.66 | 5.00 | 0.88 | 3.00 | 2.13 | 1.38 | 1.63 | 3.82 |
| ⁴ 0853620000 | 2.50 | 1.750 | 0.91 | 6.50 | 1.13 | 3.38 | 2.25 | 1.75 | 2.13 | 4.95 |
| ⁴ 0853630000 | 2.50 | 2.000 | 1.06 | 7.50 | 1.50 | 4.00 | 2.50 | 2.00 | 2.44 | 5.73 |
| ⁴ 0853640000 | 3.00 | 2.500 | 1.19 | 8.50 | 1.75 | 4.75 | 3.00 | 2.50 | 3.00 | 6.58 |
| ⁴ 0853650000 | 3.00 | 3.000 | 1.31 | 9.50 | 2.00 | 5.25 | 3.25 | 2.75 | 3.25 | 7.50 |
| 0735380000 | 4.00 | 3.500 | 1.81 | 12.63 | 1.69 | 5.69 | 4.00 | 3.50 | 4.13 | 9.62 |
| 0735390000 | 4.50 | 4.000 | 2.06 | 14.88 | 1.94 | 6.44 | 4.50 | 4.00 | 5.25 | 11.45 |

⁴ Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems - cylinder - dimensions for accessories for cataloged square head industrial cylinders.



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 2 be specified on your cylinder order.

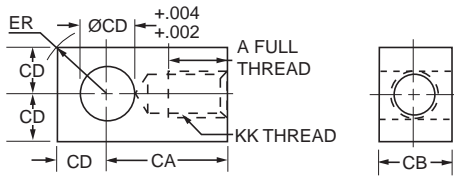
Accessory Load Capacity

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.

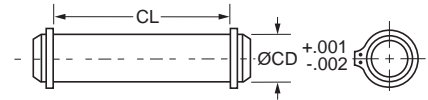
| Thread Size | Knuckle | | Clevis Bracket | | Pivot Pin | |
|-------------|-------------|----------------------|----------------|----------------------|-------------------------|-----------------------|
| | Part Number | Load Capacity (Lbs.) | Part Number | Load Capacity (Lbs.) | Part Number | Shear Capacity (Lbs.) |
| 5/16-24 | 0740750000 | 3300 | 0740760000 | 3600 | 0740780000 | 6600 |
| 7/16-20 | 0690890000 | 5000 | 0692050000 | 7300 | 0683680000 | 8600 |
| 1/2-20 | 0690900000 | 5700 | 0692050000 | 7300 | 0683680000 | 8600 |
| 3/4-16 | 0690910000 | 12100 | 0692060000 | 14000 | 0683690000 | 19300 |
| 7/8-14 | 0690920000 | 13000 | 0692070000 | 19200 | 0683700000 | 34300 |
| 1-14 | 0690930000 | 21700 | 0692070000 | 19200 | 0683700000 | 34300 |
| 1 1/4-12 | 0690940000 | 33500 | 0692080000 | 36900 | 0683710000 | 65000 |
| 1 1/2-12 | 0690950000 | 45000 | 0692090000 | 34000 | 0683720000 | 105200 |
| 1 3/4-12 | 0690960000 | 53500 | 0692100000 | 33000 | 0692150000 | 137400 |
| 1 7/8-12 | 0690970000 | 75000 | 0692100000 | 33000 | 0692150000 | 137400 |
| 2 1/4-12 | 0690980000 | 98700 | 0692110000 | 34900 | 0683740000 | 214700 |
| 2 1/2-12 | 0690990000 | 110000 | 0692120000 | 33800 | 0683750000 | 309200 |
| 2 3/4-12 | 0691000000 | 123300 | 0692130000 | 36900 | 0692160000 | 309200 |
| 3 1/4-12 | 0735360000 | 161300 | 0735420000 | 83500 | 0735450000 | 420900 |
| 3 1/2-12 | 0734370000 | 217300 | 0735420000 | 83500 | 0735450000 | 420900 |
| 4-12 | 0734380000 | 273800 | 0735430000 | 102600 | 0821810000 | 565800 |
| 4 1/2-12 | 0734390000 | 308500 | 0735440000 | 108400 | 0735470000 ¹ | 565800 |

¹This size supplied with cotter pins.

Knuckle Dimensions



Pivot Pin Dimensions



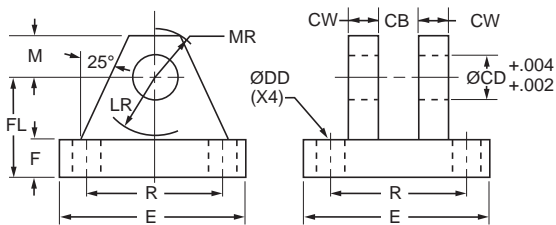
| Part Number | A | CA | CB | CD | ER | KK |
|-------------|------|------|------|-------|------|----------|
| 0740750000 | 0.75 | 1.50 | 0.44 | 0.438 | 0.53 | 5/16-24 |
| 0690890000 | 0.75 | 1.50 | 0.75 | 0.500 | 0.59 | 7/16-20 |
| 0690900000 | 0.75 | 1.50 | 0.75 | 0.500 | 0.59 | 1/2-20 |
| 0690910000 | 1.13 | 2.06 | 1.25 | 0.750 | 0.87 | 3/4-16 |
| 0690920000 | 1.13 | 2.38 | 1.50 | 1.000 | 1.15 | 7/8-14 |
| 0690930000 | 1.63 | 2.81 | 1.50 | 1.000 | 1.15 | 1-14 |
| 0690940000 | 2.00 | 3.44 | 2.00 | 1.375 | 1.55 | 1 1/4-12 |
| 0690950000 | 2.25 | 4.00 | 2.50 | 1.750 | 1.96 | 1 1/2-12 |
| 0690960000 | 2.25 | 4.38 | 2.50 | 2.000 | 2.24 | 1 3/4-12 |
| 0690970000 | 3.00 | 5.00 | 2.50 | 2.000 | 2.24 | 1 7/8-12 |
| 0690980000 | 3.50 | 5.81 | 3.00 | 2.500 | 2.76 | 2 1/4-12 |
| 0690990000 | 3.50 | 6.13 | 3.00 | 3.000 | 3.30 | 2 1/2-12 |
| 0691000000 | 3.63 | 6.50 | 3.50 | 3.000 | 3.30 | 2 3/4-12 |
| 0735360000 | 4.50 | 7.63 | 4.00 | 3.500 | 3.80 | 3 1/4-12 |
| 0734370000 | 5.00 | 7.63 | 4.00 | 3.500 | 3.80 | 3 1/2-12 |
| 0734380000 | 5.50 | 9.13 | 4.50 | 4.000 | 4.43 | 4-12 |
| 0734390000 | 5.50 | 9.13 | 5.00 | 4.000 | 4.43 | 4 1/2-12 |

| 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 | 4.13 |
| 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 | 8.63 |
| 0735470000 ¹ | 4.000 | 9.00 |

¹This size supplied with cotter pins.

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

Clevis Bracket Dimensions



| Part Number | CB | CD Ø | CW | DD Ø | E | F | FL | LR | M | MR | R |
|-------------|------|-------|------|------|-------|------|------|------|------|------|-------|
| 0740760000 | 0.46 | 0.438 | 0.38 | 0.27 | 2.25 | 0.38 | 1.00 | 0.63 | 0.38 | 0.50 | 1.75 |
| 0692050000 | 0.80 | 0.500 | 0.50 | 0.41 | 3.50 | 0.50 | 1.50 | 0.75 | 0.50 | 0.63 | 2.55 |
| 0692060000 | 1.30 | 0.750 | 0.63 | 0.53 | 5.00 | 0.63 | 1.88 | 1.19 | 0.75 | 0.91 | 3.82 |
| 0692070000 | 1.59 | 1.000 | 0.75 | 0.66 | 6.50 | 0.75 | 2.25 | 1.50 | 1.00 | 1.25 | 4.95 |
| 0692080000 | 2.09 | 1.375 | 1.00 | 0.66 | 7.50 | 0.88 | 3.00 | 2.00 | 1.38 | 1.66 | 5.73 |
| 0692090000 | 2.59 | 1.750 | 1.25 | 0.91 | 9.50 | 0.88 | 3.63 | 2.75 | 1.75 | 2.22 | 7.50 |
| 0692100000 | 2.59 | 2.000 | 1.50 | 1.06 | 12.75 | 1.00 | 4.25 | 3.19 | 2.25 | 2.78 | 9.40 |
| 0692110000 | 3.09 | 2.500 | 1.50 | 1.19 | 12.75 | 1.00 | 4.50 | 3.50 | 2.50 | 3.13 | 9.40 |
| 0692120000 | 3.09 | 3.000 | 1.50 | 1.31 | 12.75 | 1.00 | 6.00 | 4.25 | 3.00 | 3.59 | 9.40 |
| 0692130000 | 3.59 | 3.000 | 1.50 | 1.31 | 12.75 | 1.00 | 6.00 | 4.25 | 3.00 | 3.59 | 9.40 |
| 0735420000 | 4.09 | 3.500 | 2.00 | 1.81 | 15.50 | 1.69 | 6.69 | 5.00 | 3.50 | 4.13 | 12.00 |
| 0735430000 | 4.59 | 4.000 | 2.00 | 2.06 | 17.50 | 1.94 | 7.69 | 5.75 | 4.00 | 4.88 | 13.75 |
| 0735440000 | 5.09 | 4.000 | 2.00 | 2.06 | 17.50 | 1.94 | 7.69 | 5.75 | 4.00 | 4.88 | 13.75 |

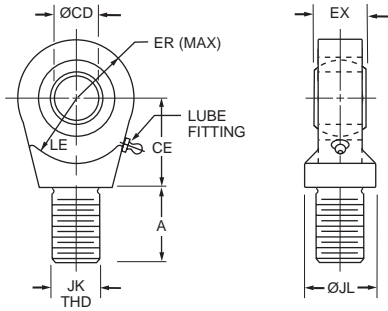
Cylinder accessory dimensions conform to NFPA recommended standard NFPT/T3.6.8 R1-1984, NFPA recommended standard fluid power systems - cylinder - dimensions for accessories for cataloged square head industrial cylinders.



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

respective cylinder include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory refer to the charts below.

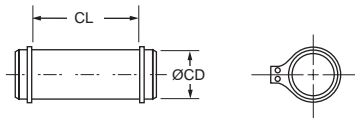
Spherical Rod Eye



| Bore Ø | 1.50 | 2.00 & 2.50 | 3.25 | 4.00 | 5.00 | 6.00 |
|--------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Part No. | 1322900000 | 1322910000 | 1322920000 | 1322930000 | 1322940000 | 1322950000 |
| CD Ø | .5000 ⁻⁰⁰⁰⁵ | .7500 ⁻⁰⁰⁰⁵ | 1.0000 ⁻⁰⁰⁰⁵ | 1.3750 ⁻⁰⁰⁰⁵ | 1.7500 ⁻⁰⁰⁰⁵ | 2.0000 ⁻⁰⁰⁰⁵ |
| A | 0.69 | 1.00 | 1.50 | 2.00 | 2.13 | 2.88 |
| CE | 0.88 | 1.25 | 1.88 | 2.13 | 2.50 | 2.75 |
| EX | 0.44 | 0.66 | 0.88 | 1.19 | 1.53 | 1.75 |
| ER | 0.84 | 1.19 | 1.28 | 1.72 | 2.09 | 2.53 |
| LE | 0.78 | 1.06 | 1.44 | 1.51 | 2.16 | 2.50 |
| JK | 7/16-20 | 3/4-16 | 1-14 | 1 1/4-12 | 1 1/2-12 | 1 7/8-12 |
| JL Ø | 0.88 | 1.31 | 1.50 | 2.00 | 2.25 | 2.75 |
| LOAD CAPACITY LBS. | 2644 | 9441 | 16860 | 28562 | 43005 | 70193 |

Order to fit Piston Rod Thread Size.

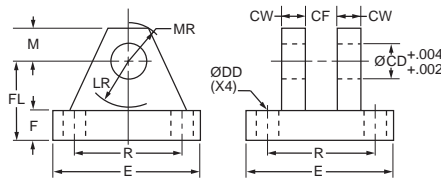
Pivot Pin



| Bore Ø | 1.50 | 2.00 & 2.50 | 3.25 | 4.00 | 5.00 | 6.00 |
|---------------------|------------------------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|
| Part No. | 0839620000 | 0839630000 | 0839640000 | 0839650000 | 0839660000 | 0839670000 |
| CD Ø | .4997 ⁻⁰⁰⁰⁴ | .7497 ⁻⁰⁰⁰⁵ | .9997 ⁻⁰⁰⁰⁵ | 1.3746 ⁻⁰⁰⁰⁶ | 1.7496 ⁻⁰⁰⁰⁶ | 1.9996 ⁻⁰⁰⁰⁷ |
| CL | 1.56 | 2.03 | 2.50 | 3.31 | 4.22 | 4.94 |
| SHEAR CAPACITY LBS. | 8600 | 19300 | 34300 | 65000 | 105200 | 137400 |

Pivot Pins are furnished with (2) Retainer Rings.

Clevis Bracket



| Bore Ø | 1.50 | 2.00 & 2.50 | 3.25 | 4.00 | 5.00 | 6.00 |
|--------------------|------------|-------------|------------|------------|------------|------------|
| Part No. | 0839470000 | 0839480000 | 0839490000 | 0839500000 | 0839510000 | 0839520000 |
| CD Ø | 0.500 | 0.750 | 1.000 | 1.375 | 1.750 | 2.000 |
| CF | 0.45 | 0.67 | 0.89 | 1.20 | 1.55 | 1.77 |
| CW | 0.50 | 0.63 | 0.75 | 1.00 | 1.25 | 1.50 |
| DD Ø | 0.41 | 0.53 | 0.53 | 0.66 | 0.91 | 0.91 |
| E | 3.00 | 3.75 | 5.50 | 6.50 | 8.50 | 10.63 |
| F | 0.50 | 0.63 | 0.75 | 0.88 | 1.25 | 1.50 |
| FL | 1.50 | 2.00 | 2.50 | 3.50 | 4.50 | 5.00 |
| LR | 0.94 | 1.38 | 1.69 | 2.44 | 2.88 | 3.00 |
| M | 0.50 | 0.88 | 1.00 | 1.38 | 1.75 | 2.00 |
| MR | 0.63 | 1.00 | 1.19 | 1.63 | 2.06 | 2.38 |
| R | 2.05 | 2.76 | 4.10 | 4.95 | 6.58 | 7.92 |
| LOAD CAPACITY LBS. | 5770 | 9450 | 14300 | 20322 | 37800 | 50375 |

Order to fit Cap or Rod Eye.

Linear Alignment Couplers



C

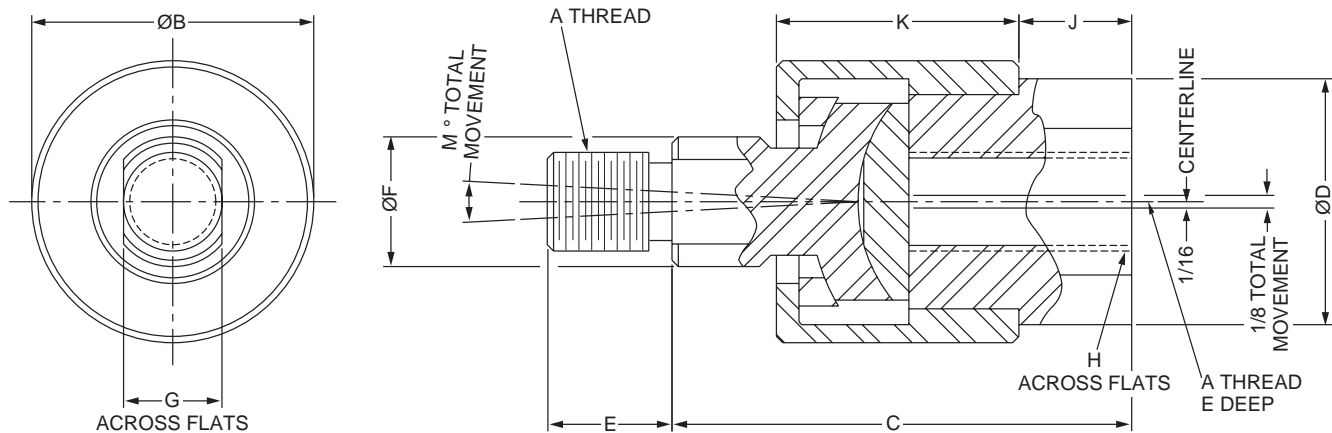
- Simplify Cylinder Installation
- Reduce Assembly Time
- Increase Cylinder Bearing and Seal Life
- Reliable Performance In “Push” *and* “Pull” Applications

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



Part Numbers and Dimensions

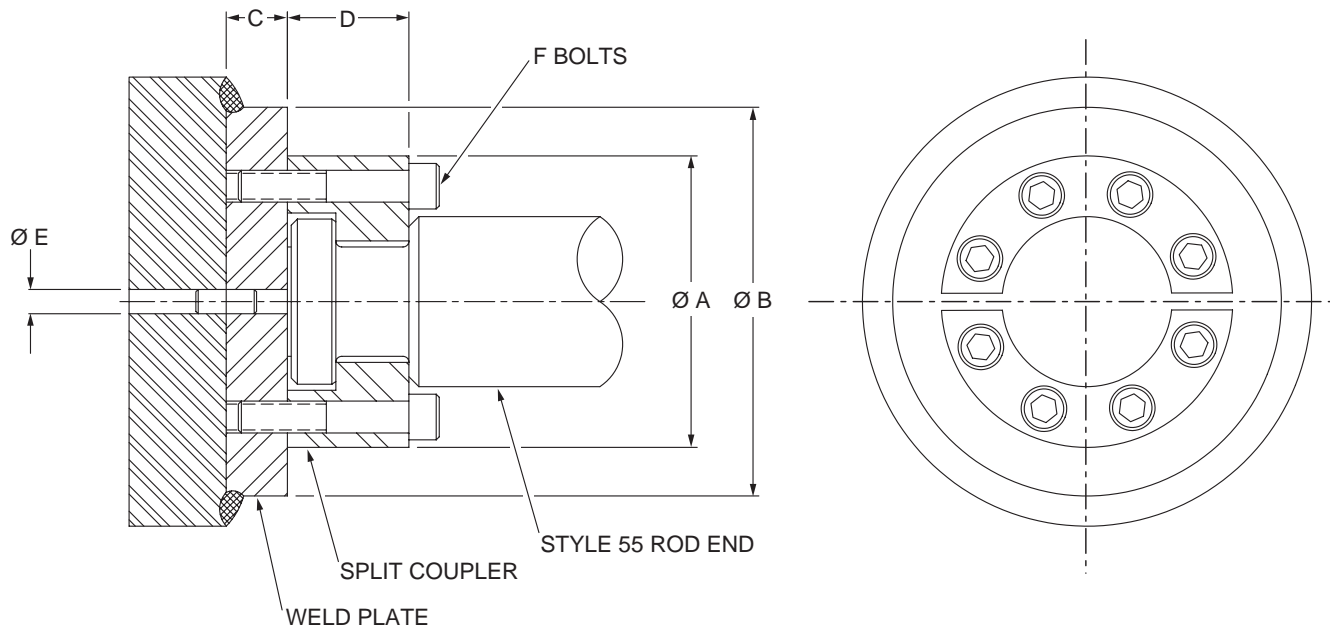
| Part No. | A | B Ø | C | D Ø | E | F Ø | G | H | J | K | M | Max. Pull Load (lbs.) | Max. Approx. Weight (lbs.) |
|------------|----------|--------|-------|--------|------|--------|------|------|------|------|-----|-----------------------|----------------------------|
| 1347570031 | 5/16-24 | 1.13 | 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 | 6° | 30500 | 6.9 |
| 1337390150 | 1 1/2-12 | 4.00 | 4.38 | 2.25 | 2.25 | 1.75 | 1.50 | 1.94 | 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 | 1.94 | 0.88 | 2.75 | 10° | 58350 | 9.8 |
| 1337390188 | 1 7/8-12 | 5.00 | 5.63 | 3.00 | 3.00 | 2.25 | 1.94 | 2.63 | 1.38 | 3.38 | 10° | 67550 | 19.8 |
| 1337390200 | 2-12 | 5.00 | 5.63 | 3.00 | 3.00 | 2.25 | 1.94 | 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



⚠ 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.

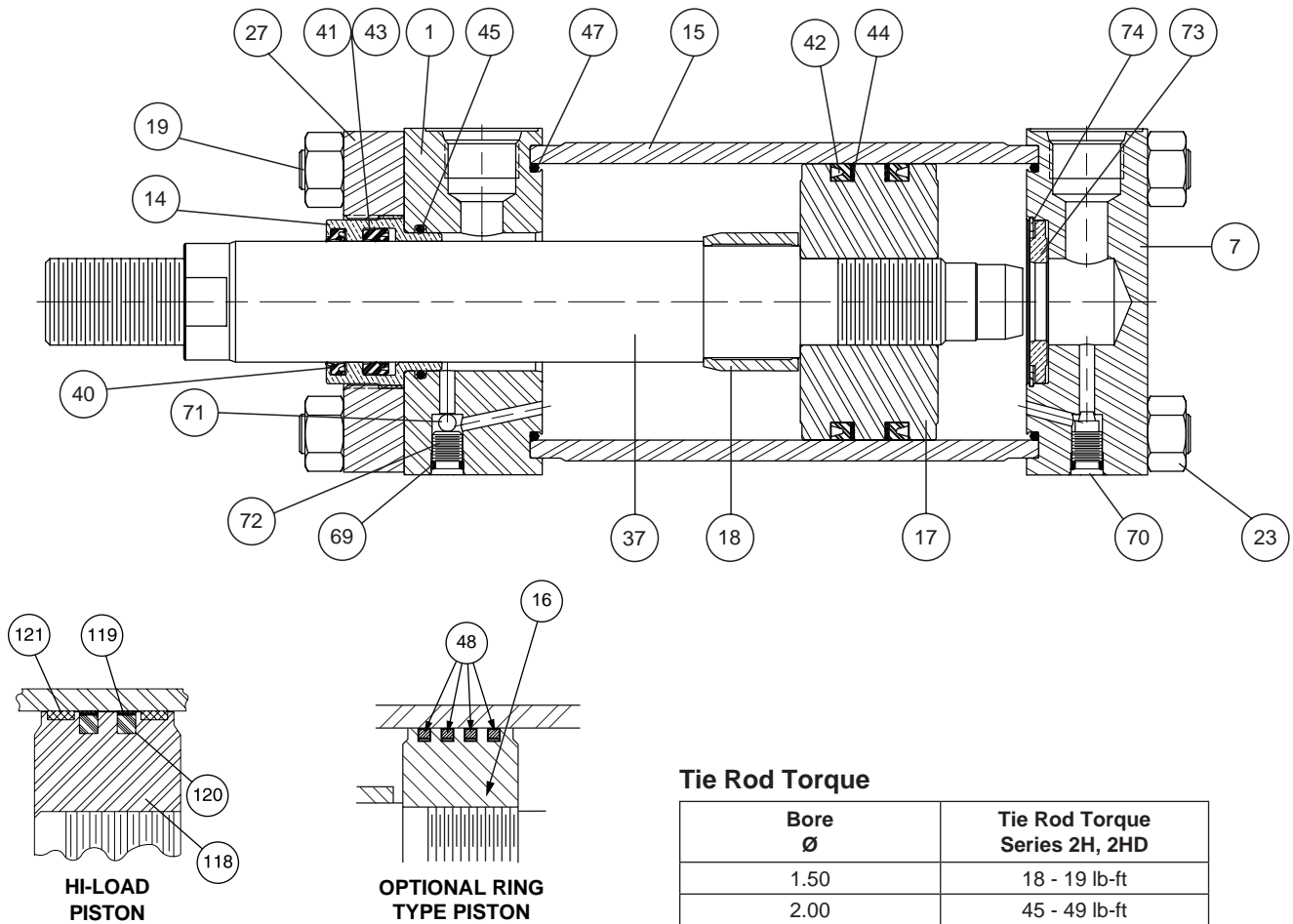
Part Numbers and Dimensions

| Rod Ø | A Ø | B Ø | C | D | E Ø | F | Bolt Size | Bolt Circle | Split Coupler Part No. | Weld Plate Part No. |
|--------|-------|-------|------|------|------|----|-------------------|-------------|------------------------|---------------------|
| 0.625 | 1.50 | 2.00 | .50 | .56 | .250 | 4 | #10-24 x .94 LG | 1.125 | 147234 0062 | 148174 0062 |
| 1.000 | 2.00 | 2.50 | .50 | .88 | .250 | 6 | .250-20 x 1.25 LG | 1.500 | 147234 0100 | 148174 0100 |
| 1.375 | 2.50 | 3.00 | .63 | 1.00 | .250 | 6 | .312-18 x 1.0" LG | 2.000 | 147234 0138 | 148174 0138 |
| 1.750 | 3.00 | 4.00 | .63 | 1.25 | .250 | 8 | .312-18 x 1.75 LG | 2.375 | 147234 0175 | 148174 0175 |
| 2.000 | 3.50 | 4.00 | .75 | 1.63 | .375 | 12 | .375-16 x 2.25 LG | 2.687 | 147234 0200 | 148174 0200 |
| 2.500 | 4.00 | 4.50 | .75 | 1.88 | .375 | 12 | .375-16 x 2.50 LG | 3.187 | 147234 0250 | 148174 0250 |
| 3.000 | 5.00 | 5.50 | 1.00 | 2.38 | .375 | 12 | .500-13 x 3.25 LG | 4.000 | 147234 0300 | 148174 0300 |
| 3.500 | 5.88 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 4.687 | 147234 0350 | 148174 0350 |
| 4.000 | 6.38 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 5.187 | 147234 0400 | 148174 0400 |
| 4.500 | 6.88 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 5.687 | 147234 0450 | 148174 0450 |
| 5.000 | 7.38 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 6.187 | 147234 0500 | 148174 0500 |
| 5.500 | 8.25 | 9.00 | 1.25 | 3.88 | .375 | 12 | .750-10 x 5.00 LG | 6.875 | 147234 0550 | 148174 0550 |
| 7.000 | 10.38 | 11.00 | 1.75 | 4.00 | .500 | 12 | 1.00-8 x 5.50 LG | 8.750 | 147234 0700 | 148174 0700 |
| 8.000 | 11.38 | 12.00 | 2.00 | 4.00 | .500 | 16 | 1.00-8 x 5.50 LG | 9.750 | 147234 0800 | 148174 0800 |
| 8.500 | 12.38 | 13.00 | 2.00 | 4.00 | .500 | 16 | 1.00-8 x 5.50 LG | 10.750 | 147234 0850 | 148174 0850 |
| 9.000 | 13.12 | 14.00 | 2.25 | 4.00 | .500 | 12 | 1.25-7 x 6.00 LG | 11.125 | 147234 0900 | 148174 0900 |
| 10.000 | 14.12 | 15.00 | 2.50 | 4.50 | .500 | 16 | 1.25-7 x 6.50 LG | 12.125 | 147234 1000 | 148174 1000 |

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



1.50" - 6.00" Bore Series 2H



Tie Rod Torque

| Bore Ø | Tie Rod Torque Series 2H, 2HD |
|--------|-------------------------------|
| 1.50 | 18 - 19 lb-ft |
| 2.00 | 45 - 49 lb-ft |
| 2.50 | 45 - 49 lb-ft |
| 3.25 | 120 - 124 lb-ft |
| 4.00 | 131 - 135 lb-ft |
| 5.00 | 312 - 316 lb-ft |
| 6.00 | 528 - 544 lb-ft |

Note: The tie rod torque values are for cylinders rated at 3,000 psi. Consult factory for torque values for cylinders rated above 3,000 psi.

Piston and Rod Assemblies

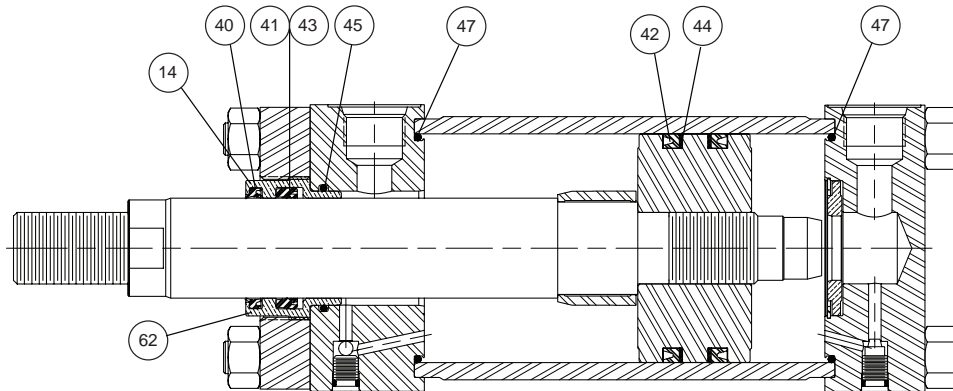
Factory assembled piston and rod assemblies (that include seals for piston type specified) are recommended.

Parts List — 1.50" through 6.00" Bore

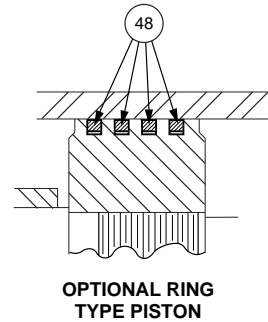
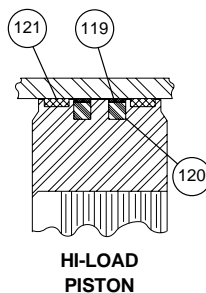
| Symbol | Description |
|--------|-----------------------------------|
| 1 | Head |
| 7 | Cap |
| 14 | Rod Gland |
| 15 | Cylinder tube |
| 16 | Piston, ring type |
| 17 | Piston, lipseal type |
| 18 | Cushion plunger, rod head cushion |
| 19 | Tie rod |
| 23 | Tie rod nut |
| 27 | Retainer |
| 37 | Piston rod, single rod type |
| 40 | Rod Wiper |
| 41 | Rod Seal |
| 42 | Lipseal, piston |
| 43 | Back-up washer, rod seal |

| Symbol | Description |
|--------|---|
| 44 | Back-up washer, piston seal |
| 45 | Gland O-ring |
| 47 | O-ring, cylinder tube to head and cap seal |
| 48 | Piston ring, iron |
| 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 |
| 118 | Piston, Hi-Load type |
| 119 | Outer Ring |
| 120 | Inner Ring |
| 121 | Wear Ring |

1.50" - 6.00" Bore Series 2H



| 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 |
| 48 | Piston ring |
| 62 | Rod Gland Kit ¹ |
| 119 | Outer Ring |
| 120 | Inner Ring |
| 121 | Wear Ring |



¹Gland Cartridge Kit contains: 14, 40, 41, 43 and 45.

Piston Seal Kits and Body Seal Kits Series 2H

| Bore Ø | Class 1 & 2 Service ² | | | |
|-----------|-------------------------------------|----------------------------------|--|--------------------------------|
| | Piston Seal Type ³ | | | Body Seal Kits ⁴ |
| | Piston Lipseal Kits ⁴ | Piston Ring Kits ⁴ | Hi-Load Piston Seal Kits ⁴ | |
| | Series 2H, 3H | Series 2H, 3H | Series 2H, 3H | |
| 1.00 | PK102HLL01 | PR102H0001 | — | CB102HL001 |
| 1.50 | PK152HLL01 | PR152H0001 | PK152HK001 | CB152HL001 |
| 2.00 | PK202HLL01 | PR202H0001 | PK202HK001 | CB202HL001 |
| 2.50 | PK252HLL01 | PR252H0001 | PK252HK001 | CB252HL001 |
| 3.25 | PK322HLL01 | PR322H0001 | PK322HK001 | CB322HL001 |
| 4.00 | PK402HLL01 | PR402H0001 | PK402HK001 | CB402HL001 |
| 5.00 | PK502HLL01 | PR502H0001 | PK502HK001 | CB502HL001 |
| 6.00 | PK602HLL01 | PR602H0001 | PK602HK001 | CB602HL001 |

² Rod gland cartridge kit & rod 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.

³ Contents and Part Numbers of Seal Kits for Pistons & Bodies

Piston Lipseal Kits – (includes cylinder body end seals) contains two each of items 47, 42, & 44.

Piston Ring Kits – (includes cylinder body end seals) contains qty. 4 of item 48 and qty. 2 of 47.

Hi Load Piston Seal Kits – (includes cylinder body end seals) contains qty. 2 of 119, 120, 121 and 47. Piston seal kit & body seal kit part numbers shown identify class 1 & 2 seals. To order class 5 or 6 seals substitute 5 or 6 as required for the last digit of the kit number.

⁴ Piston seal kit & body seal kit part numbers shown identify class 1 & 2 seals. To order class 5 or 6 seals substitute 5 or 6 as required for the last digit of the kit number.

Retainer Bolt Torque for Cylinders with Round Gland Retainers

Torque values are for bolts installed with lubrication.

| Bolt 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 |

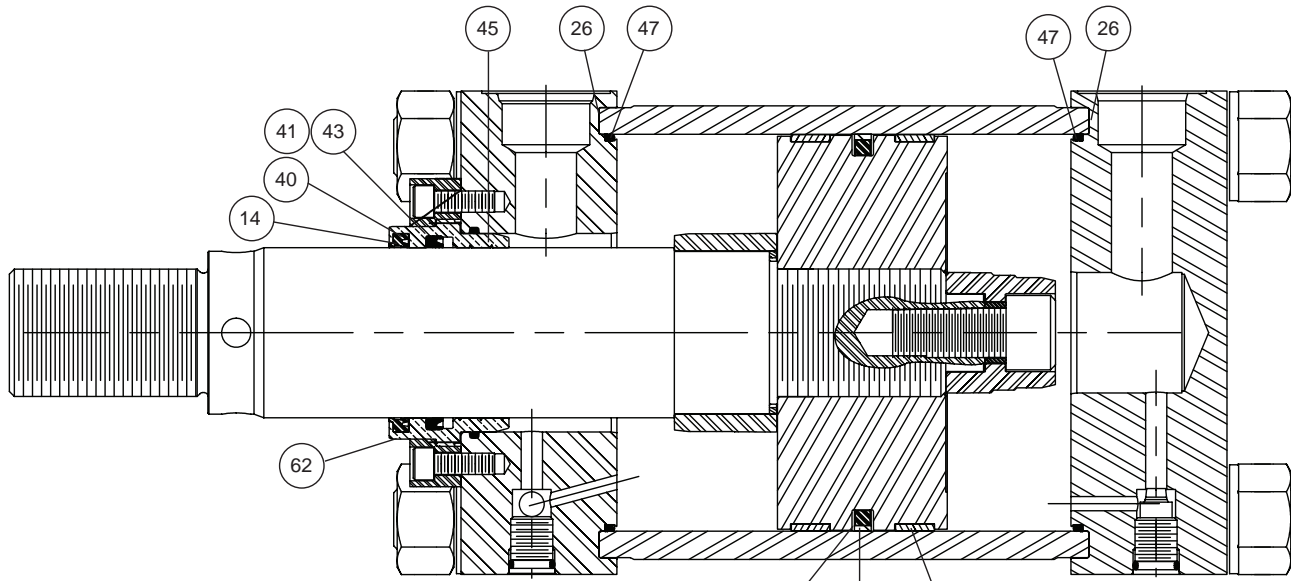
Service Kit Numbers – Gland Cartridge Kits and Rod Seal Kits – Series 2H

| Rod Ø | Seal Type | | | |
|----------|---|-------------------------------|---|-------------------------------|
| | Class 1 Service (Polyurethane & Nitrile) | | Class 2 Service ² (Nitrile) | |
| | Gland Cartridge Kits ⁵ | Rod Seal Kits ⁵ | Gland Cartridge Kits ⁵ | Rod Seal Kits ⁵ |
| 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 |

⁵ Gland Cartridge Kits contain items 14, 40, 41, 45 (43 class 2, 5 & 6 only). Rod Seal Kits contain items 40, 41, 45 (43 class 2, 5 & 6 only).



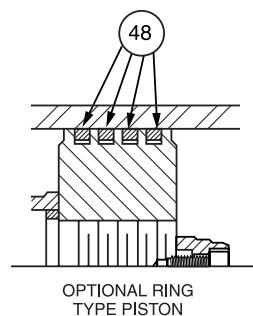
7.00" & 8.00" Bore Series 3H



Parts Identification

| Sym. No. | Description | Sym. No. | Description |
|----------|--------------------------|----------|----------------------------|
| 14 | Rod Gland | 47 | End Seal O-Ring |
| 40 | Rod Wiper | 48 | Piston Ring |
| 41 | Rod Seal | 62 | Rod Gland Kit ¹ |
| 43 | Rod Seal Back Up Washer | 119 | Outer Ring |
| 26 | End Seal Back Up Washer | 120 | Inner Ring |
| 45 | Rod Gland to Head O-Ring | 121 | Wear Ring |

¹Rod Gland Kit contains 14, 40, 41, 43 and 45.



Class 1 Hydraulic Service Only²

| Rod. Ø | Gland Cartridge Kits (Sym. #62) | Rod Seal Kits |
|--------|---------------------------------|---------------------------------|
| | Class 1 (Std.) | Class 1 (Std.) |
| | Buna-N (Nitrile) & Polyurethane | Buna-N (Nitrile) & Polyurethane |
| 3.000 | RG2HLTS301 | RK2HLTS301 |
| 3.500 | RG2HLTS351 | RK2HLTS351 |
| 4.000 | RG2HLTS401 | RK2HLTS401 |
| 4.500 | RG2HLTS451 | RK2HLTS451 |
| 5.000 | RG2HLTS501 | RK2HLTS501 |
| 5.500 | RG2HLTS551 | RK2HLTS551 |

²For other classes of service, refer to Bulletin 1110-M3.

| Bore Ø | Cylinder Body Seal Kit | Piston Seal Kits ³ | | Tie Rod Torque 7.00 & 8.00 |
|--------|-------------------------------|--|--|-------------------------------|
| | CB | PR | Hi-Load | |
| | Includes 2 ea. Symbol 47 & 26 | Includes 2 ea. Sym. 47 & 26; 4 ea. Sym. 48 | Includes 2 ea. Sym. 26, 47 & 121; 1 ea. Sym. 119 & 120 | |
| 7.00 | CB703H0001 | PR703H0001 | PK703HK001 | 800-816 lb-ft |
| 8.00 | CB803H0001 | PR803H0001 | PK803HK001 | 1168-1184 lb-ft |

³CB, PR & hi-load piston seal kit part numbers shown identify class 1, 2 & 6 service only. To order Class 5 seals substitute 5 for the last digit of kit number.

Retainer Bolt Torque for Cylinders with Round Gland Retainers

Torque values are for bolts installed with lubrication.

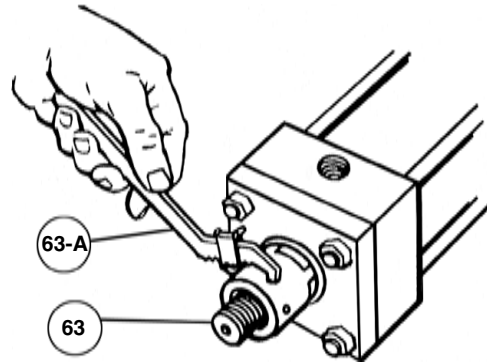
| Bolt Size | Torque |
|-----------|---------------|
| #10 | 56 - 58 lb-in |
| 1/4 | 11 - 12 lb-ft |
| 5/16 | 23 - 24 lb-ft |
| 3/8 | 41 - 43 lb-ft |
| 7/16 | 65 - 68 lb-ft |

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.

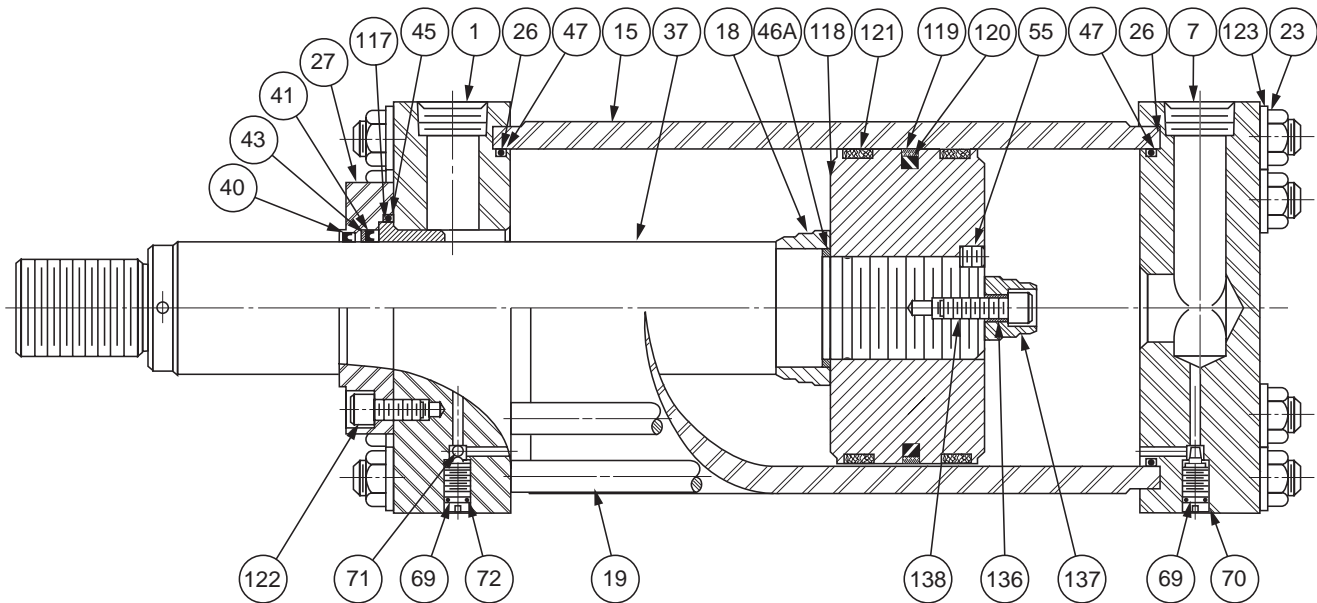
See chart below.



| Rod Diameter | Gland Wrench (Symbol 63) | Spanner Wrench (Symbol 63-A) |
|--------------|--------------------------|------------------------------|
| 5/8" | 0695900000 | 0116760000 |
| 1" | 0695910000 | |
| 1 3/8" | 0695920000 | 0117030000 |
| 1 3/4" | 0695930000 | 0116770000 |
| 2" | 0695940000 | |
| 2 1/2" | 0695950000 | 0116770000 |
| 3" | 0695960000 | |
| 3 1/2" | 0695970000 | |
| 4" | 0695980000 | 0116780000 |
| 4 1/2" | 0837770000 | |
| 5" | 0695990000 | |
| 5 1/2" | 0696000000 | |



10.00" - 20.00" Bore Series 3H

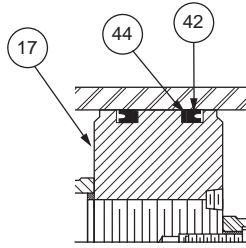


| Sym. No. | |
|----------|--------------------------------|
| 1 | Head |
| 7 | Cap |
| 16 | Piston Tube – Ring Type Piston |
| 17 | Lipseal Piston |
| 18 | Cushion Sleeve |
| 19 | Tie Rod |
| 23 | Tie Rod Nut – Non-Locking |
| 26 | Back-Up Washer, Cylinder Tube |
| 27 | Retainer |
| 37 | Piston Rod |
| 40 | Wiperseal |
| 41 | Rod Seal (Polypak) |
| 42 | Lipseal Back-Up Washer |
| 43 | Back-Up Washer, Polypak |
| 44 | Piston Lipseal |
| 45 | O-Ring, Gland to Head |
| 46A | Cushion Sealing Ring |

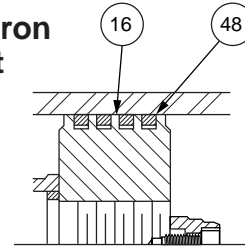
| Sym. No. | |
|----------|-------------------------------------|
| 47 | O-Ring Cylinder Tube |
| 48 | Piston Ring |
| 55 | Piston Lock Pin |
| 69 | O-Ring, Cushion Adj. & Check Screws |
| 70 | Cushion Adjusting Needle Screw |
| 71 | Check Valve Ball |
| 72 | Check Valve Screw |
| 117 | Rod Bearing (Gland) |
| 118 | Piston – Hi-Load |
| 119 | Outer Piston Ring |
| 120 | Inner Piston Ring |
| 121 | Wear Ring |
| 122 | Retainer Bolt |
| 123 | Washer, Tie Rod Nut |
| 136 | Spacer, Cushion |
| 137 | Cushion Spear, Detachable |
| 138 | Bolt, Cushion Spear |

10.00" - 20.00" Bore Series 3H

Optional Piston Lipseal Kit



Optional Cast Iron Piston Ring Kit



3H Large Bore Seal Kits

| Bore Ø | Rod Dia. | Rod Seal Kits | | Rod Seal Kits Including Bearing | |
|--------|---------------------|--------------------------------|--------------------|--------------------------------------|--------------------|
| | | Contains Symbol 40, 41, 43, 45 | | Contains Symbol 40, 41, 43, 45 & 117 | |
| | | Group 1 Kit No. | Group 5 Kit No. | Group 1 Kit No. | Group 5 Kit No. |
| 10.00 | 4.500 | RK3H000451 | RK3H000455 | RG3H000451 | RG3H000455 |
| | 7.000 | RK3H000701 | RK3H000705 | RG3H000701 | RG3H000705 |
| | 5.000 | RK3H000501 | RK3H000505 | RG3H000501 | RG3H000505 |
| | 5.500 | RK3H000551 | RK3H000555 | RG3H000551 | RG3H000555 |
| 12.00 | 5.500 | RK3H000551 | RK3H000555 | RG3H000551 | RG3H000555 |
| | 8.000 | RK3H000801 | RK3H000805 | RG3H000801 | RG3H000805 |
| | 7.000 | RK3H000701 | RK3H000705 | RG3H000701 | RG3H000705 |
| 14.00 | 7.000 | RK3H000701 | RK3H000705 | RG3H000701 | RG3H000705 |
| | 10.000 ¹ | RK3H001001 | RK3H001005 | RG3H001001 | RG3H001005 |
| | 8.000 ¹ | RK3H000801 | RK3H000805 | RG3H000801 | RG3H000805 |

| Bore Ø | Tie Rod Torque |
|----------|-------------------|
| 10.00 | 700 - 716 lb-ft |
| 12.00 | 1320 - 1336 lb-ft |
| 14.00 | 1000 - 1016 lb-ft |
| 16/18/20 | 2900 - 3000 lb-ft |

Retainer Bolt Torque for Cylinders with Round Gland Retainers

Torque values are for bolts installed with lubrication.

| Bolt Size | Torque |
|-----------|-----------------|
| 1/2 | 100 - 105 lb-ft |
| 5/8 | 185 - 194 lb-ft |
| 3/4 | 330 - 346 lb-ft |

¹For 16.00", 18.00" and 20.00" Bore 3H Cylinders with 8.000" and 10.000" rods use the seal kits listed above for 14.00" Bore 3H with 8.000" and 10.000" rods.

3H Piston Ring & Piston Lipseal Kits

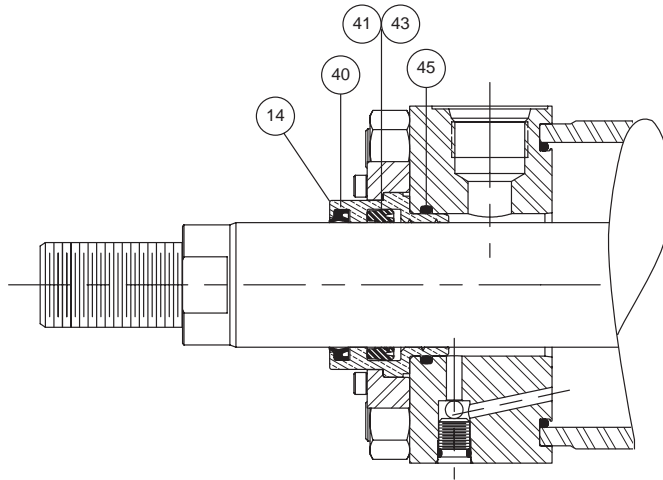
| Bore Ø | Piston Ring Kit | | Piston Lip Seal Kit | |
|--------|--|-----------------|--|-----------------|
| | Contains 2 ea. Symbol # 26 & 47, & 4 ea. Symbol # 48 | | Contains Symbol # 40, 41, 43, 45 & 117 | |
| | Service Class 1 | Service Class 5 | Service Class 1 | Service Class 5 |
| 10.00 | PR9023H001 | PR9023H005 | PK9023H001 | PK9023H005 |
| 12.00 | PR9223H001 | PR9223H005 | PK9223H001 | PK9223H005 |
| 14.00 | PR9423H001 | PR9423H005 | PK9423H001 | PK9423H005 |

3H Hi Load Piston Seal Kits

| Bore Ø | Hi Load Piston Seal Kit | | Cylinder Body End Seal Kit | |
|--------|-------------------------|-----------------|---------------------------------|-----------------|
| | | | Contains 2 ea. Symbol # 26 & 47 | |
| | Service Class 1 | Service Class 5 | Service Class 1 | Service Class 5 |
| 10.00 | PK903HK001 | PK903HK005 | CB9023H001 | CB9023H0005 |
| 12.00 | PK923HK001 | PK923HK005 | CB9223H001 | CB9223H0005 |
| 14.00 | PK943HK001 | PK943HK005 | CB9423H001 | CB9423H0005 |
| 16.00 | PK963HK001 | PK963HK005 | CB9623H001 | CB9623H0005 |
| 18.00 | PK983HK001 | PK983HK005 | CB9823H001 | CB9823H0005 |
| 20.00 | PK9A3HK001 | PK9A3HK005 | CB9A23H001 | CB9A23H0005 |



1.50" - 6.00" Bore Series 2HD
7.00" & 8.00" Bore Series 3HD



| Symbol Number | Description |
|---------------|-------------------------|
| 14 | Rod Gland |
| 40 | Rod Wiperseal |
| 41 | Rod Seal |
| 43 | Rod Seal Back-up Washer |
| 45 | Gland to Head O-Ring |

Rod Gland and Rod Seal Kits for 2HD & 3HD Option Cylinders

| Rod Ø | Class 1 Polyurethane & Buna-N | | Class 5 Fluorocarbon | | Retainer Bolt Torque (Torque values are for bolts installed with lubrication.) |
|-------|---|--|---|--|---|
| | Rod Gland Kits (Contains: 1 Each Sym. #14, 40, 41, & 45) | Rod Seal Kits (Contains: 1 Each Sym. #40, 41, & 45) | Rod Gland Kits (Contains: 1 Each Sym. #14, 40, 41, 43 ¹ , 45) | Rod Seal Kits (Contains: 1 Each Sym. #40, 41, 43 ¹ , & 45) | |
| 0.625 | RG2HDL0061 | RK2HDL0061 | RG2HDL0065 | RK2HDL0065 | 56 - 58 lb-in |
| 1.000 | RG2HDL0101 | RK2HDL0101 | RG2HDL0105 | RK2HDL0105 | 56 - 58 lb-in |
| 1.375 | RG2HDL0131 | RK2HDL0131 | RG2HDL0135 | RK2HDL0135 | 56 - 58 lb-in |
| 1.750 | RG2HDL0171 | RK2HDL0171 | RG2HDL0175 | RK2HDL0175 | 56 - 58 lb-in |
| 2.000 | RG2HDL0201 | RK2HDL0201 | RG2HDL0205 | RK2HDL0205 | 11 - 12 lb-ft |
| 2.500 | RG2HDL0251 | RK2HDL0251 | RG2HDL0255 | RK2HDL0255 | 11 - 12 lb-ft |
| 3.000 | RG2HDL0301 | RK2HDL0301 | RG2HDL0305 | RK2HDL0305 | 41 - 43 lb-ft |
| 3.500 | RG2HDL0351 | RK2HDL0351 | RG2HDL0355 | RK2HDL0355 | 41 - 43 lb-ft |
| 4.000 | RG2HDL0401 | RK2HDL0401 | RG2HDL0405 | RK2HDL0405 | 41 - 43 lb-ft |
| 4.500 | RG2HDL0451 | RK2HDL0451 | RG2HDL0455 | RK2HDL0455 | 41 - 43 lb-ft |
| 5.000 | RG2HDL0501 | RK2HDL0501 | RG2HDL0505 | RK2HDL0505 | 41 - 43 lb-ft |
| 5.500 | RG2HDL0551 | RK2HDL0551 | RG2HDL0555 | RK2HDL0555 | 41 - 43 lb-ft |

Parker Crown Wiper™ Rod Gland and Rod Seal Kits for 2HD & 3HD Option Cylinders

| Rod Ø | Class 1 Polyurethane & Buna-N | | Class 5 Fluorocarbon | | Retainer Bolt Torque (Torque values are for bolts installed with lubrication.) |
|-------|---|--|---|--|---|
| | Rod Gland Kits (Contains: 1 Each Sym. #14, 40, 41, & 45) | Rod Seal Kits (Contains: 1 Each Sym. #40, 41, & 45) | Rod Gland Kits (Contains: 1 Each Sym. #14, 40, 41, 43 ¹ , & 45) | Rod Seal Kits (Contains: 1 Each Sym. #40, 41, 43 ¹ , & 45) | |
| 0.625 | RGCW2HD061 | RKCW2HD061 | RGCW2HD065 | RKCW2HD065 | 56 - 58 lb-in |
| 1.000 | RGCW2HD101 | RKCW2HD101 | RGCW2HD105 | RKCW2HD105 | 56 - 58 lb-in |
| 1.375 | RGCW2HD131 | RKCW2HD131 | RGCW2HD135 | RKCW2HD135 | 56 - 58 lb-in |
| 1.750 | RGCW2HD171 | RKCW2HD171 | RGCW2HD175 | RKCW2HD175 | 56 - 58 lb-in |
| 2.000 | RGCW2HD201 | RKCW2HD201 | RGCW2HD205 | RKCW2HD205 | 11 - 12 lb-ft |
| 2.500 | RGCW2HD251 | RKCW2HD251 | RGCW2HD255 | RKCW2HD255 | 11 - 12 lb-ft |
| 3.000 | RGCW2HD301 | RKCW2HD301 | RGCW2HD305 | RKCW2HD305 | 41 - 43 lb-ft |
| 3.500 | RGCW2HD351 | RKCW2HD351 | RGCW2HD355 | RKCW2HD355 | 41 - 43 lb-ft |
| 4.000 | RGCW2HD401 | RKCW2HD401 | RGCW2HD405 | RKCW2HD405 | 41 - 43 lb-ft |
| 4.500 | RGCW2HD451 | RKCW2HD451 | RGCW2HD455 | RKCW2HD455 | 41 - 43 lb-ft |
| 5.000 | RGCW2HD501 | RKCW2HD501 | RGCW2HD505 | RKCW2HD505 | 41 - 43 lb-ft |
| 5.500 | RGCW2HD551 | RKCW2HD551 | RGCW2HD555 | RKCW2HD555 | 41 - 43 lb-ft |

¹ Item 43 not required for 0.625" and 1.000" rod diameter.

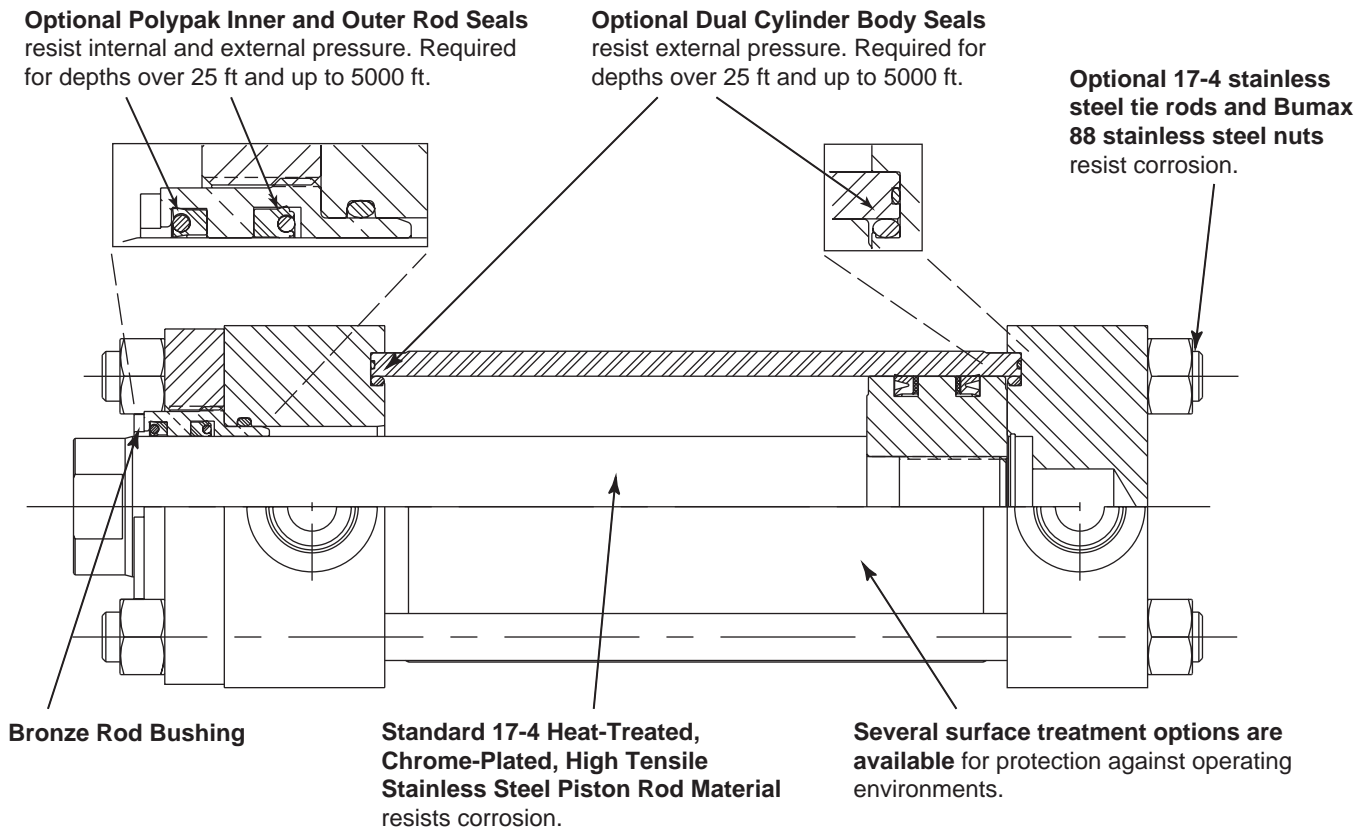
Section D

Custom Modifications

| | |
|-----------------------------------|----|
| 2H & 3H Water Submersible Options | 82 |
| Hi Load Piston | 84 |
| Low Friction Seals | 86 |
| Metallic Rod Wiper | 88 |
| Parker Crown Wiper™ | 88 |
| Rod End Boots | 88 |
| Gland Drain | 88 |
| Air Bleed Ports | 88 |
| Tie Rod Supports | 89 |
| Stroke Adjusters | 89 |
| Thrust Key Mountings | 89 |
| Metric Piston Rod Thread | 89 |
| End of Stroke Proximity Switches | 90 |

D

Water Submersible Option for Series 2H and 3H Hydraulic Cylinders



Specifications:

- Submersion Depth: up to 5000 ft
- Heavy Duty Service – ANSI (NFPA) T3.6.7R2 – 1996 Specifications and Mounting Dimension Standards
- Nominal Pressure – 3000 psi
- Operating Temperature – -10°F to +165°F
- 17-4 PH chrome plated stainless steel piston rod
- Stainless steel name tag affixed with stainless steel wire around tie rod

Cylinder Seal Construction:

- Up to 25 ft – Standard rod seal and body seals
- Over 25 ft to 5000 ft
 - Subsea rod seal package that includes a Polypak oil seal and an outward facing Polypak wiper to seal against water intrusion.
 - Subsea body seal package with ID oil seal and body-end o-ring to seal against water intrusion.

Standard Options for Water Submersible Cylinders:

Material

- 17-4 PH stainless steel tie rods and Bumax 88 stainless steel tie rod nuts
- Chrome plated body ID

Surface Treatments for Corrosion Protection

- Electroless nickel plated exterior (head, cap, body and retainer)
- Inorganic zinc primer (zinc primer only – without bond coating)
- Inorganic zinc primer with epoxy undercoat and anacrylic topcoat
- Epoxy undercoat and topcoat

Custom Options available for Special Order:

- End-of-Stroke Switches
- All stainless steel construction

Water Submersible Option for Series 2H and 3H Hydraulic Cylinders

How to order:

1. Specify the complete Parker Cylinder Model Number.
2. Put an “S” in the model number to indicate a special cylinder.
3. Include the 3 digit Submersible Code.
4. For custom options, such as switches, provide a complete description or drawing of your requirements.

Submersible Code

When selecting the submersible option, an S must be placed in the Model Number. Select Submersible Code values for the required Submersion Depth, Cylinder Body, and Corrosion Protection. See the example Model Number below:

| Feature | Code | Specification | For |
|----------------------|-------|--|---|
| Submersion Depth | 1 | Conventional rod gland and body seal design | Depths to 25 ft |
| | 2 | Submersible rod gland & dual cylinder body seals | Depths to 5000 ft |
| | 3 | Other | Specify depth / requirements |
| Cylinder Body | P | Plain ID | |
| | C | Chrome plated ID | |
| Corrosion Protection | 1 | Inorganic zinc primer | Splash & short term immersion service where equipment is top coated by the customer |
| | 2 | Inorganic zinc primer with stainless steel tie rods, nuts, & fasteners | |
| | 3 | Electroless nickel plated exterior with stainless steel tie rods, nuts, & fasteners | |
| | 4 | Inorganic zinc primer, epoxy undercoat, & anacrylic topcoat. | Splash & short term immersion service |
| | 5 | Inorganic zinc primer, epoxy undercoat, & anacrylic topcoat with stainless steel tie rods, nuts, & fasteners | |
| | 6 | Epoxy base & top coat. | Long term immersion service |
| | 7 | Epoxy base & top coat. with stainless steel tie rods, nuts, & fasteners | |
| 9 | Other | Specify requirements | |

Example:

4.00 BB 2HK T S 14 X 24.00

S=Submersible Code: 2P1

(describes a 4" x 24" cylinder for submersion up to 5000 ft, with a plain cylinder body ID and Inorganic Zinc Primer corrosion protection.)

Water Submersible Codes and Features Supplied

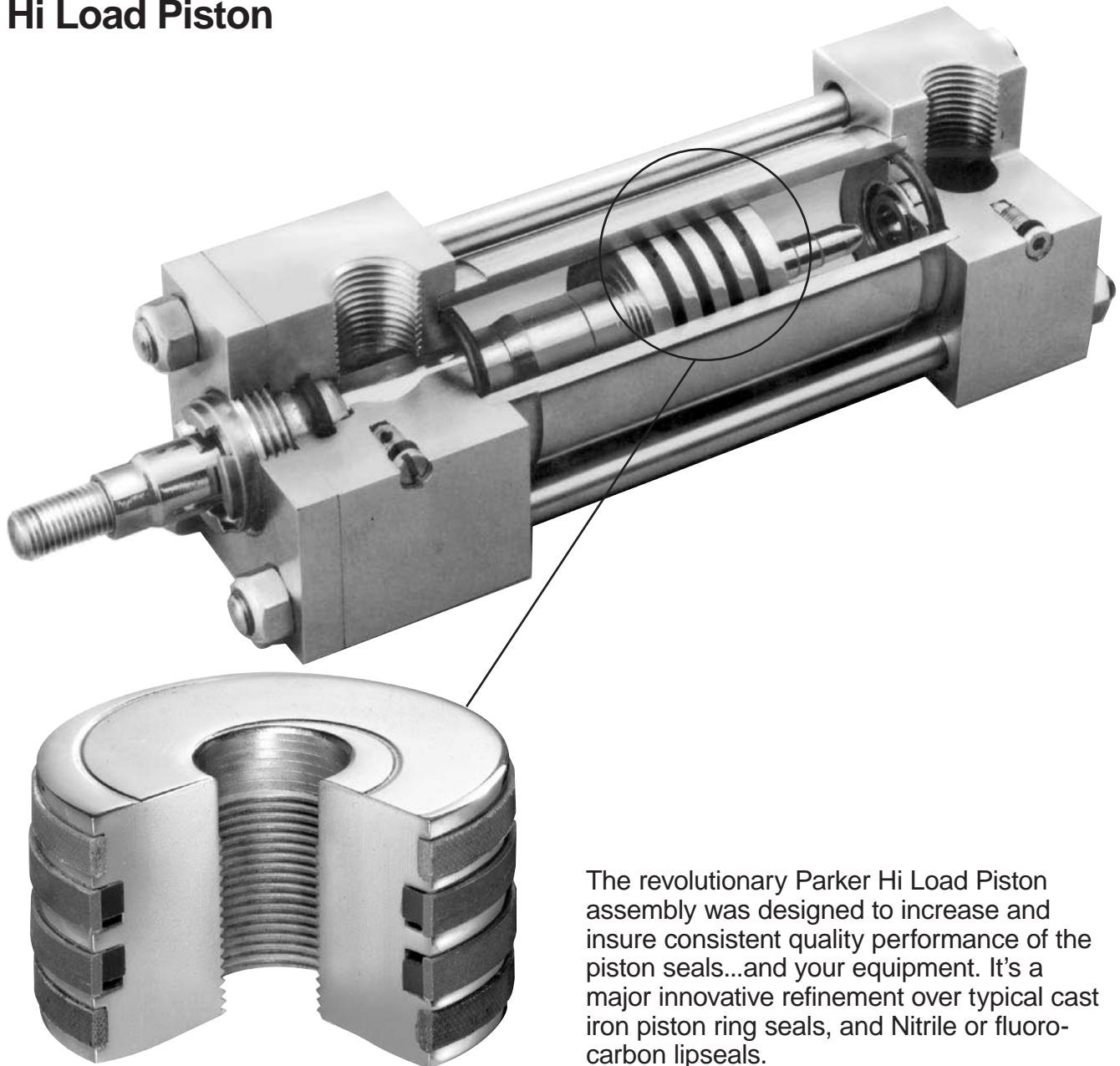
Depths to 5000 ft¹

| Submersible Cylinder Feature | Water Submersible Code ¹ | | | | | | | | | | | | | |
|-------------------------------------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 2P1 | 2P2 | 2P3 | 2P4 | 2P5 | 2P6 | 2P7 | 2C1 | 2C2 | 2C3 | 2C4 | 2C5 | 2C6 | 2C7 |
| 17-4 PH piston rod | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Stainless steel tag | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Submersible rod gland | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Dual cylinder body seals | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Chrome plated cylinder ID | | | | | | | | X | X | X | X | X | X | X |
| SS tie rods, nuts, & fasteners | | X | X | | X | | X | | X | X | | X | | X |
| Electroless nickel plated exterior | | | X | | | | | | | X | | | | |
| Inorganic zinc primer | X | X | | | | | | X | X | | | | | |
| Inorganic zinc primer with topcoats | | | | X | X | | | | | | X | X | | |
| Epoxy base & topcoat | | | | | | X | X | | | | | | X | X |

¹ Corresponding submersible codes for depths to 25 ft begin with 1 (e.g. 1P1, 1P2, etc.) and include all of the features marked for 5000 ft depth **except** Submersible Rod Gland and Dual Cylinder Body Seals.



The Exclusive Parker Hi Load Piston



- Virtually eliminates leakage
- Hi Load capacity
- High contamination tolerance
- Long life
- Low friction
- Standard on Series 3H cylinders

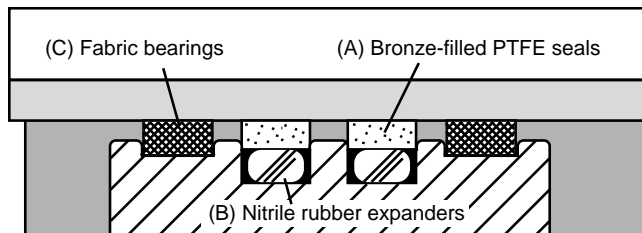
The revolutionary Parker Hi Load Piston assembly was designed to increase and insure consistent quality performance of the piston seals...and your equipment. It's a major innovative refinement over typical cast iron piston ring seals, and Nitrile or fluoro-carbon lipseals.

The Hi Load piston assembly overcomes the inherent problems commonly associated with these conventional types of seals, such as scoring of the cylinder bore due to contamination, and it virtually eliminates leakage flow. It can also reduce or eliminate the need for stop tubing. It has much greater side load carrying capacity, and most importantly, even at pressures up to 3,000 psi, it has a longer wearing life than any seal we have tested to date.

The Exclusive Parker Hi Load Piston

The effective difference... Parker's bronze-filled PTFE ring design.

The Hi Load piston assembly is comprised of two square-cut bronze-filled PTFE piston rings (A) with Nitrile rubber expanders underneath (B) and two non-metallic wear rings (C) which uniquely work together, incorporating the best qualities of both elements to achieve dramatic efficiency.



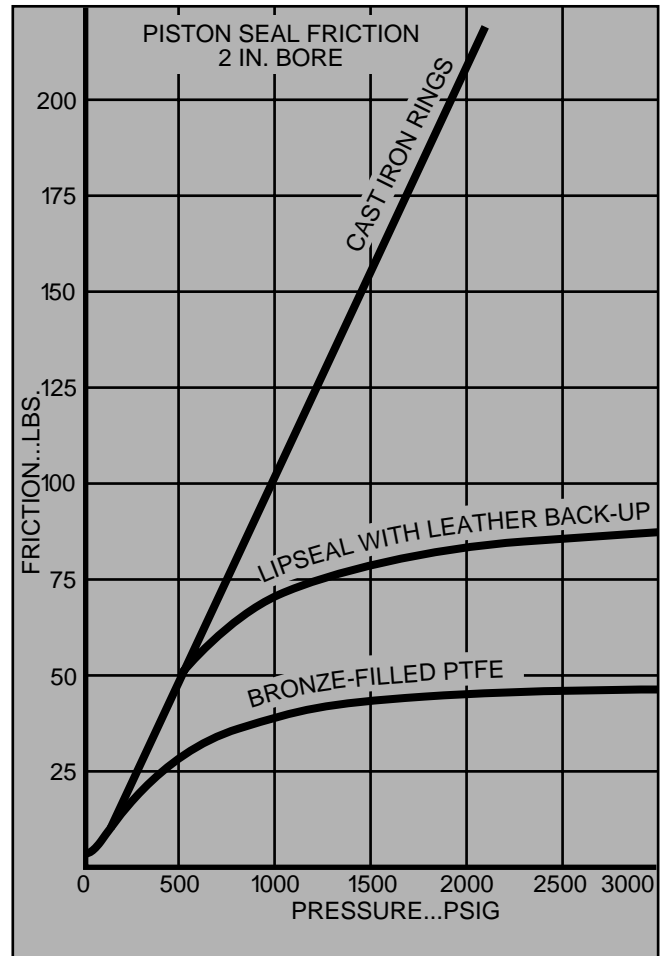
Reduced scoring. Low friction. The non-metallic wear rings eliminate all metal-to-metal contact between the piston and cylinder body. Some scoring may occur even with the use of compatible materials such as cast iron or bronze for the piston and steel for the cylinder body. The combination of the high imbeddability factor and the wiping action of the wear rings prevent contamination from getting between the piston bearing and sealing surfaces, therefore, scoring is greatly reduced. This also contributes to the extended life of the bronze-filled PTFE rings. Other benefits of the Hi Load piston are excellent lubricity and minimum wear when using water-based fluids, soluble oil and water and biodegradable fluids.

Extensive controlled contamination tests in our laboratory have shown the Hi Load piston to operate more than **4 times longer** than lip seals when high degrees of contamination are present.

Note: Because the Hi Load piston prevents metal-to-metal contact with the cylinder bore, steel pistons may be used which are stronger than other types.

Higher side load carrying capacity. Under severe side load conditions such as long stroke or pivot mounted cylinders the characteristics of non-metallic wear rings provides increased side load carrying capability, which is another distinctive benefit. Non-metallic bearings can also absorb shock, and with increased side load can give and thus conform more to piston and cylinder body. The action of deformation increases the area of contact, which in turn keeps the contact stresses from increasing and permits the Hi Load piston to have a higher side load carrying capacity. This can often reduce or eliminate the need for stop tubing.

Comparative Piston Seal Friction



Virtually zero leakage. The Hi Load piston assembly means virtually zero leakage with hydraulic and/or water base fluids because of the continuous bronze-filled PTFE rings with a homogenous inner ring of Nitrile rubber to apply seal preloading. The Nitrile expanders provide enough initial radial force to eliminate low pressure leakage. At higher pressure (above 2,000 psi) the seals are pressurized underneath, and are therefore dynamically self-sealing just as cast iron rings are.

The bronze-filled PTFE resists extrusion in the clearance between the piston much better than Nitrile, and, as a result, provides at least double the life, increasing life spans as pressure goes up.

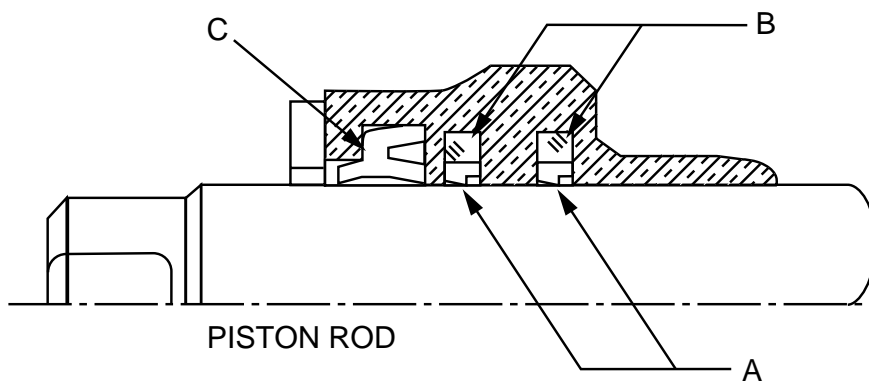
When ordering the Hi Load piston option for Series 2H cylinders, please specify K in the piston seal field of the model code. The Hi Load piston is standard on all Series 3H cylinders.

Parker Series 2H/3H Hydraulic Cylinders with Low Friction Seal Option

High Performance Cylinders for Your Demanding Applications

- Smooth-running operation – reduces “slip-stick” or “chatter”
- Ideally suited for use in servo applications
- Bronze-filled PTFE material for low friction, rapid break-in and long service life
- Innovative seal geometry for maximum sealing efficiency

Low Friction Rod Gland



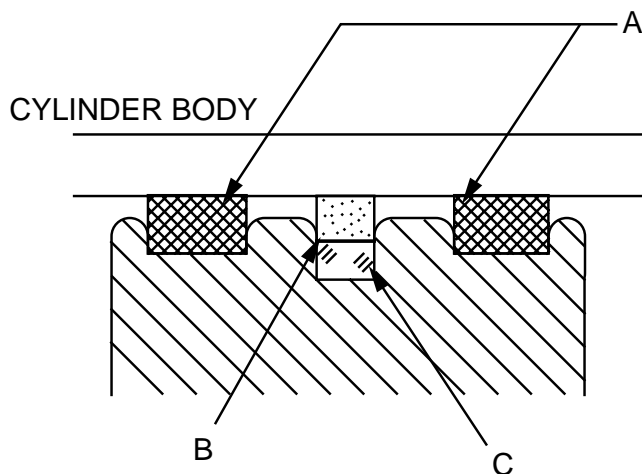
A - Dual step-seal rod seals insure positive sealing and smooth operation up to 3,000 psi.

B - Square ring elastomer expander for pressure compensation and low pressure effectiveness.

C - Dual lip wiper keeps contaminants out.

D - Available in 1.000", 1.375", 1.750", 2.000", 2.500", 3.000", 3.500", 4.000", 4.500", 5.000", 5.500" diameter piston rods (1.50" - 8.00" Bore).

Low Friction Piston



A - Dual bronze-filled PTFE piston bearings for high load capacity, low friction and no metal-to-metal contact.

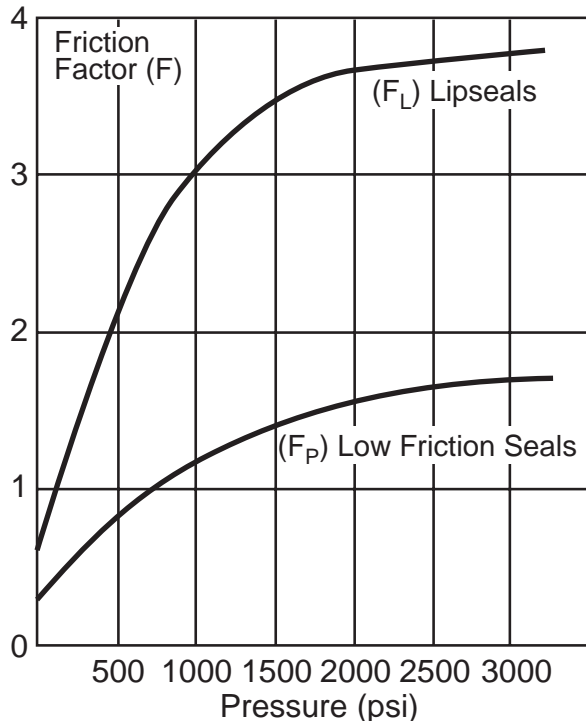
B - Bronze filled PTFE piston seal insures maximum sealing efficiency.

C - Square-ring elastomer expander for pressure compensation

D - Available in 2.00" - 8.00" bore diameters

Seal Friction:

Seal friction under a given set of working conditions is not easily calculated due to the multiplicity of variables involved. The following graphs are offered as a guide for use in performance calculations, but for critical application measurements should be made under simulated or actual working conditions.



Calculation of Running Friction:

The seal friction attributable to the cylinder is calculated as the sum of the friction due to the individual sealing elements = (wiper seal friction + rod seal friction + piston seal friction), using the following formulae:

| Option: | Formula: |
|-----------------------------------|-----------------------------|
| Lipseal Rod + Piston | $12d + 12 F_L d + 24 F_L D$ |
| Lipseal Rod w/Low Friction Piston | $12d + 12 F_L d + 12 F_p D$ |
| Low Friction Rod + Piston | $12d + 30 F_p d + 6 F_p D$ |

Where: d = rod dia. (in.) D = bore dia. (in.)
 F_L = friction factor for lipseals (F_L)
 F_p = friction factor for PTFE (F_p)

Breakaway Friction:

Breakaway friction may be calculated by applying the following correction factors:

Correction factors:
 Lipseals: $F_L \times 1.5$
 Low Friction: $F_p \times 1.0$

Sample Calculation:

2HX Cylinder with 3.25 dia. bore + 1.75 dia. piston rod with low friction seals at 1500 psi.

Running Friction Calculation:

$$\text{Friction (lbs. force)} \approx 12d + 30F_p d + 6F_p D$$

$$\text{Friction (lbs. force)} \approx 12 (1.75) + 30 (1.3 \times 1.75) + 6 (1.3 \times 3.25)$$

$$\text{Friction (lbs. force)} \approx 115$$

Breakaway Friction Calculation:

$$F_p \times 1.0 \approx F_p$$

Based on zero pressure:

$$\text{Friction (lbs. force)} \approx 12d + 30F_p d + 6F_p D$$

$$\text{Friction (lbs. force)} \approx 12 (1.75) + 30 (.3 \times 1.75) + 6 (.3 \times 3.25)$$

$$\text{Friction (lbs. force)} \approx 43$$

Specifications for Low Friction Options:

- Operating Pressure: 0 - 3000 psi
- Operating Temperature: -10°F to +160°F.
For higher temperatures, consult factory.
- Fluid Media: Petroleum based hydraulic oils.
For other fluids, consult factory.

How to Order Low Friction Option for Series 2H/3H Cylinders

When ordering Series 2H or 3H cylinders, place an "F" in the piston field for low friction seals.

Consult factory for availability of gland drain or other options.



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

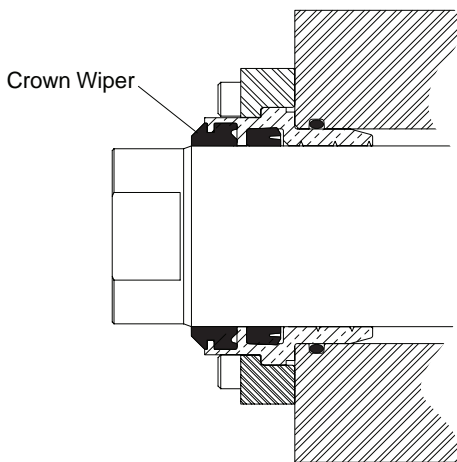
Metallic Rod Wiper

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.

Parker Crown Wiper™ for Series 2HD and 7" & 8" bore 3HD

For environments that contain fine abrasive particulate specify the Crown Wiper option. The Crown Wiper is a proven superior alternative to piston rod end boots or metallic wipers that can ingest particulate. It has a sharp leading edge to effectively clean the piston rod and a beveled shape to prevent contaminant intrusion by channeling it away from the gland. It also acts as a secondary seal to wipe clean any oil film adhering to the rod on the extend stroke.

Standard Crown Wiper material for Seal Class 1 and 2 service is durable polyurethane. Optional FKM material is available for Class 5 service. The Crown Wiper requires a unique gland but does not change cylinder mounting dimensions



Crown Wiper Rod Gland Kits are available to retrofit existing 2HD & 3HD cylinders. See 2HD/3HD Parts List and Seal Kits page.

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.

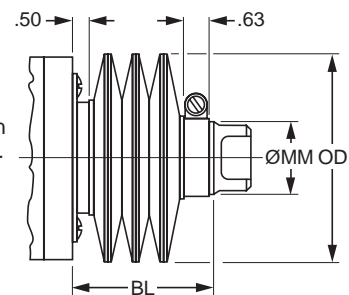
| | | | | | | | | | | | | |
|-----------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LF | .13 | .13 | .13 | .13 | .13 | .13 | .13 | .10 | .10 | .10 | .10 | .10 |
| OD | 2.25 | 2.25 | 2.63 | 3.00 | 3.38 | 3.75 | 4.38 | 5.13 | 5.63 | 6.25 | 7.00 | 7.50 |
| 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

$$BL = \text{Stroke} \times LF + 1.13"$$

$$BL + \text{Std. W} + A = \text{length of piston rod to extend beyond the retainer.}$$

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



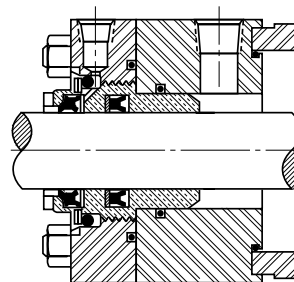
Gland Drain

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.

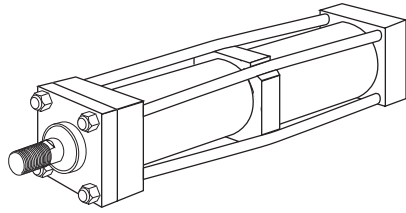
On 1.50" bore size Series 2H cylinders, the drain port is located in the head adjacent to the port and on code 2 rod, the retainer thickness increases to .63". On 2.00" thru 8.00" bore sizes the drain port is located in the retainer as shown.



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.



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 | 2 | 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 14.00" bore sizes — no supports required.

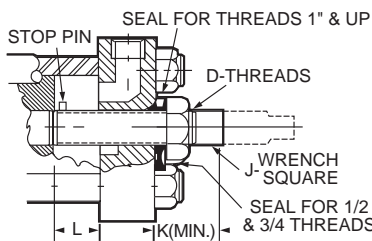
Stroke Adjusters

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 economical¹.

| Bore Ø Series 2H & 3H | D | J | K | L (Max.) |
|-----------------------|------------|------|------|----------|
| 1.50 | 1/2 - 20 | 0.31 | 0.94 | 5 |
| 2.00 | 3/4 - 16 | 0.44 | 1.25 | 8 |
| 2.50, 3.25 | 1 - 14 | 0.63 | 1.69 | 9 |
| 4.00 | 1 1/2 - 12 | 0.94 | 2.13 | 18 |
| 5.00 | 2 - 12 | 0.94 | 2.69 | 20 |
| 6.00 | 2 1/2 - 12 | 1.69 | 3.13 | 20 |
| 7.00 | 3 - 12 | 2.00 | 3.25 | 20 |
| 8.00 | 3 1/2 - 12 | 2.38 | 3.50 | 20 |

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.

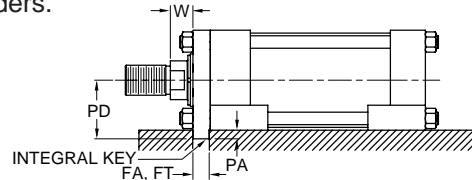


¹ Infrequent is defined by positioning the retract stroke in a couple of attempts at original machine set up. The frequent stroke adjuster is recommended for adjustments required after the original equipment has been adjusted by the original machine manufacturer.

Thrust Key Mountings (2H, 3H, 2HD, 3HD)

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.

Note: Please consult factory when replacing HD Series cylinders.



| Bore Ø | FA (Series 2HD/3HD) | FT (Series 2H/3H) | PA | PD Mtg. Styles CP & FP |
|--------|---------------------|--------------------|------|------------------------|
| 1.50 | .361 -0.001 +0.000 | .312 -0.002 +0.000 | 0.19 | 1.44 |
| 2.00 | .611 -0.001 +0.000 | .562 -0.002 +0.000 | 0.31 | 1.81 |
| 2.50 | .611 -0.001 +0.000 | .562 -0.002 +0.000 | 0.31 | 2.06 |
| 3.25 | .736 -0.001 +0.000 | .687 -0.003 +0.000 | 0.38 | 2.63 |
| 4.00 | .861 -0.001 +0.000 | .812 -0.003 +0.000 | 0.44 | 2.94 |
| 5.00 | .861 -0.001 +0.000 | .812 -0.003 +0.000 | 0.44 | 3.69 |
| 6.00 | .986 -0.001 +0.000 | .937 -0.003 +0.000 | 0.50 | 4.25 |
| 7.00 | .986 -0.001 +0.000 | .937 -0.003 +0.000 | 0.50 | 4.75 |
| 8.00 | .986 -0.001 +0.000 | .937 -0.003 +0.000 | 0.50 | 5.25 |

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 |
| 7.000 | M125x4 | - | 7.00 |
| 8.000 | M140x4 | - | 8.00 |
| 9.000 | M160x4 | - | 9.00 |
| 10.000 | M180x4 | - | 10.00 |



Cylinder End-of-Stroke Proximity Switches

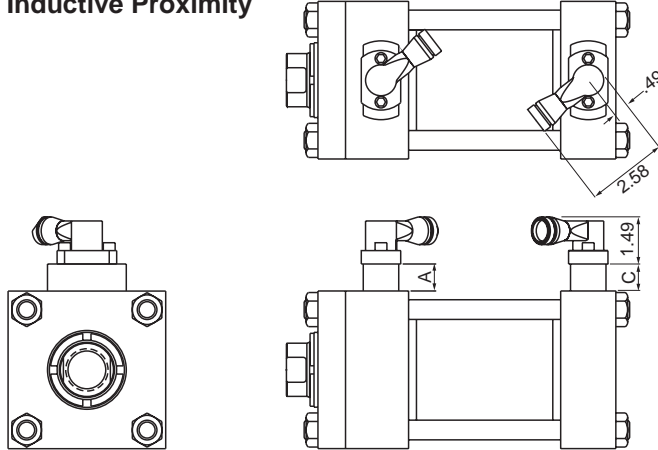


“EPS” Style Inductive Sensors
For General Industrial AC and DC Applications

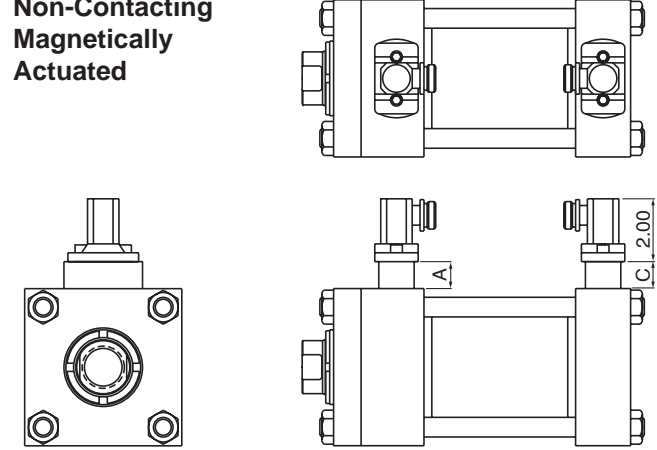
“CLS” Style Magnetic Sensors
Including Extreme Temperature Applications

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

**EPS 7 & 6 Sensors
Inductive Proximity**



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



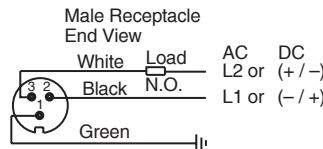
**Spacer Height
EPS & CLS Sensors**

| A max. | C max. |
|--------|--------|
| .86 | 1.75 |

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

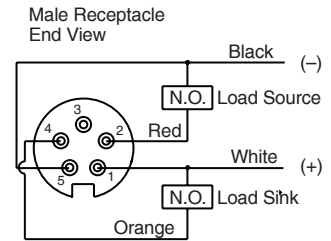
Connector Pin Numbering

3-Pin Mini



EPS-7

5-Pin Mini



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.

Parker 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.

Parker 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. In most cases, the use of two or more EPS-6 or 7 sensors in parallel will require the use of a bypass (shunt) resistor.

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.



| Specifications | | | | |
|-----------------------------------|---|---|---|---|
| Style: | EPS-7 | EPS-6 | CLS-1 | CLS-4 |
| Code Designator: | H | D | F | B |
| Description: | 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. |
| Supply Voltage: | 20 to 250 VAC/DC | 10 to 30 VDC | 24 to 240 VAC/DC | 24 to 240 VAC/DC |
| Load Current, min: | 8 mA | N/A | NA | NA |
| Load Current, max: | 300 mA | 200 mA | 4 AMPS @ 120 VAC 3 AMPS @ 24VDC | 4 AMPS @ 120 VAC 3 AMPS @ 24 VDC |
| Leakage Current: | 1.7 mA, max. | 10 micro amps max | – | – |
| Voltage Drop: | 7 V, max. | 2 VDC max. | N/A | NA |
| Operating Temperature: | -14° to +158° F | -14° to +158°F | -40°F to +221°F | -40°F to +400°F |
| Sensor Type: | Inductive proximity | Inductive proximity | non-contacting magnetically actuated | non-contacting magnetically actuated |
| Part Number: | 148897 ¹ | 148896 ¹ | 148275 ¹ | 149109 ¹ |
| Part Number Suffix ¹ : | ¹4-digit suffix indicates probe length: 0125=1.25", 0206=2.06", 0288=2.875", 0456=4.562" | | | |
| Connection: | 3 pin mini | 5 pin mini | 3 pin mini | 144" PTFE Coated Flying Leads with 1/2" conduit hub |
| Enclosure Rating: | IEC IP67 | IEC IP67 | NEMA 1, 2, 3, 4, 4x, 5, 6, 6P, 11, 12, 12K, 13 | NEMA 1, 2, 3, 4, 4x, 5 |
| LED indication: | Yes | Yes | Yes | No |
| Short Circuit Protection: | Yes | Yes | No | No |
| Weld Field Immunity: | Yes | Yes | Yes | Yes |
| Output: | 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 |
| Approvals/Marks: | CE, UL, CSA | CE, UL, CSA | UL or CSA ² | UL or CSA ² |
| Make/Break Location: | 0.13" from end of stroke, typical. Tolerance is +0/-0.13" | | | |
| Wiring Instructions: | Pin 1: AC Ground (Green) Pin 2: Output (Black) Pin 3: AC Line (White) | Pin 1) +10 to 30 VDC (White) Pin 2) Sourcing Output (Red) Pin 3) Grounded (not connected or required) Pin 4) Sinking Output (Orange) Pin 5) DC Common (Black) | Pin 1: Common (Green) Pin 2: Normally Closed (Black) Pin 3: Normally Open (White) | Common: (Black) Normally Open: (Blue) Normally Closed: (Red) |
| Cable: 6' | 0853550006 | 0859170006 | 0853550006 | – |
| Cable: 12' | 0853550012 | 0859170012 | 0853550012 | – |
| Cable: 6', Right Angle | 0875470006 | – | 0875470006 | – |

²CSA available upon request – contact factory.

How to Specify EPS Proximity Switches

Parker EPS proximity switches may be ordered on Series 2H & 3H 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 = H13CGG-XXXX denotes a switch on the head end only, EPS-7

Example = XXXX-B42BGG denotes a switch on the cap end only, CLS-4

Head End

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

Cap End

| 4 | 2 | B | GG |
|--------------------------------|----------------------------------|--|---|
| Port Location See Figure 1. | Switch Location See Figure 1. | Switch Orientation See Figure 2 for EPS-7 and Eps-6 only. | Actuation Point GG = End of Stroke FF = Stroke to Go; 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.

¹CLS-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

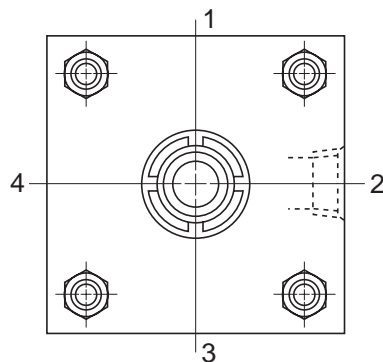
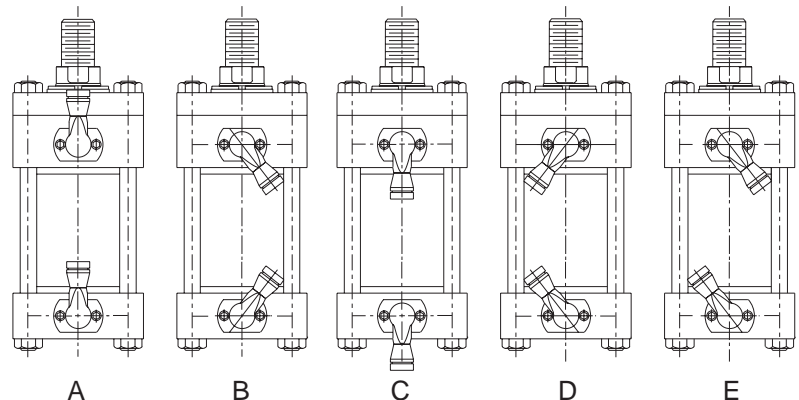


Figure 2



Notes

Section E

Engineering Data

| | |
|--|-----|
| Theoretical Push and Pull Forces | 96 |
| Cylinder Weights | 98 |
| Operating Fluids and Seals / Temperature Range | 99 |
| Pressure Ratings | 100 |
| Ports | 101 |
| Stroke Data, Stop Tube and Mounting Classes | 103 |
| Piston Rod Selection Chart | 104 |
| Cushioning | 106 |
| Manufacturing Locations | 117 |
| Cylinder Safety Guide | 118 |
| Offer of Sale | 120 |

E

Theoretical Push Forces for Hydraulic Cylinders — Push Force

| Cylinder Bore Ø | Piston Area (Sq. In.) | Cylinder Push Stroke Force in Pounds at Various Pressures | | | | | | |
|--------------------|--------------------------|---|-------|--------|--------|--------|--------|--------|
| | | 100 | 250 | 500 | 1000 | 1500 | 2000 | 3000 |
| 1.50 | 1.77 | 177 | 443 | 885 | 1770 | 2651 | 3540 | 5310 |
| 2.00 | 3.14 | 314 | 785 | 1570 | 3140 | 4712 | 6280 | 9420 |
| 2.50 | 4.91 | 491 | 1228 | 2455 | 4910 | 7363 | 9820 | 14730 |
| 3.25 | 8.30 | 830 | 2075 | 4150 | 8300 | 12444 | 16600 | 24900 |
| 4.00 | 12.57 | 1257 | 3143 | 6285 | 12570 | 18850 | 25140 | 37710 |
| 5.00 | 19.64 | 1964 | 4910 | 9820 | 19640 | 29453 | 39280 | 58920 |
| 6.00 | 28.27 | 2827 | 7068 | 14135 | 28270 | 42412 | 56540 | 84810 |
| 7.00 | 38.49 | 3849 | 9623 | 19245 | 38490 | 57727 | 76980 | 115470 |
| 8.00 | 50.27 | 5027 | 12568 | 25135 | 50270 | 75398 | 100540 | 150810 |
| 10.00 | 78.54 | 7854 | 19635 | 39270 | 78540 | 117810 | 157080 | 235620 |
| 12.00 | 113.10 | 11310 | 28275 | 56550 | 113100 | 169650 | 226200 | 339300 |
| 14.00 | 153.94 | 15394 | 38485 | 76970 | 153940 | 230910 | 307880 | 461820 |
| 16.00 | 201.06 | 20106 | 50265 | 100530 | 201060 | 301590 | 402120 | 603180 |
| 18.00 | 254.47 | 25447 | 63620 | 127230 | 254470 | 381700 | 508940 | 763410 |
| 20.00 | 314.16 | 31416 | 78540 | 157080 | 314160 | 471240 | 628320 | 942480 |

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

| Cylinder Bore Ø | Piston Rod Ø | Piston Rod Area (Sq. In.) | Cylinder Pull Force in Pounds at Various Pressures (psi) | | | | | | |
|-----------------|--------------|---------------------------|--|-------|--------|--------|--------|--------|--------|
| | | | 100 | 250 | 500 | 1000 | 1500 | 2000 | 3000 |
| 1.50 | 0.625 | 0.307 | 146 | 365 | 730 | 1460 | 2190 | 2920 | 4380 |
| | 1.000 | 0.785 | 98 | 245 | 491 | 982 | 1473 | 1964 | 2946 |
| 2.00 | 1.000 | 0.785 | 236 | 589 | 1178 | 2355 | 3533 | 4710 | 7065 |
| | 1.375 | 1.48 | 166 | 414 | 828 | 1655 | 2483 | 3310 | 4965 |
| 2.50 | 1.000 | 0.785 | 413 | 1031 | 2063 | 4125 | 6188 | 8250 | 12375 |
| | 1.375 | 1.48 | 343 | 856 | 1713 | 3425 | 5138 | 6850 | 10275 |
| | 1.750 | 2.41 | 250 | 625 | 1250 | 2500 | 3750 | 5000 | 7500 |
| 3.25 | 1.375 | 1.48 | 682 | 1704 | 3408 | 6815 | 10223 | 13630 | 20445 |
| | 1.750 | 2.41 | 589 | 1473 | 2945 | 5890 | 8835 | 11780 | 17670 |
| | 2.000 | 3.14 | 516 | 1290 | 2580 | 5160 | 7740 | 10320 | 15480 |
| 4.00 | 1.750 | 2.41 | 1016 | 2540 | 5080 | 10160 | 15240 | 20320 | 30480 |
| | 2.000 | 3.14 | 943 | 2358 | 4715 | 9430 | 14145 | 18860 | 28290 |
| | 2.500 | 4.91 | 766 | 1915 | 3830 | 7660 | 11490 | 15320 | 22980 |
| 5.00 | 2.000 | 3.14 | 1650 | 4125 | 8250 | 16500 | 24750 | 33000 | 49500 |
| | 2.500 | 4.91 | 1473 | 3683 | 7365 | 14730 | 22095 | 29460 | 44190 |
| | 3.000 | 7.07 | 1257 | 3143 | 6285 | 12570 | 18855 | 25140 | 37710 |
| | 3.500 | 9.62 | 1002 | 2505 | 5010 | 10020 | 15030 | 20040 | 30060 |
| 6.00 | 2.500 | 4.91 | 2336 | 5840 | 11680 | 23360 | 35040 | 46720 | 70080 |
| | 3.000 | 7.07 | 2120 | 5300 | 10600 | 21200 | 31800 | 42400 | 63600 |
| | 3.500 | 9.62 | 1865 | 4663 | 9325 | 18650 | 27975 | 37300 | 55950 |
| | 4.000 | 12.57 | 1570 | 3925 | 7850 | 15700 | 23550 | 31400 | 47100 |
| 7.00 | 3.000 | 7.07 | 3142 | 7855 | 15710 | 31420 | 47130 | 62840 | 94260 |
| | 3.500 | 9.62 | 2887 | 7218 | 14435 | 28870 | 43305 | 57740 | 86610 |
| | 4.000 | 12.57 | 2592 | 6480 | 12960 | 25920 | 38880 | 51840 | 77760 |
| | 4.500 | 15.90 | 2259 | 5648 | 11295 | 22590 | 33885 | 45180 | 67770 |
| | 5.000 | 19.63 | 1886 | 4715 | 9430 | 18860 | 28290 | 37720 | 56580 |
| 8.00 | 3.500 | 9.62 | 4065 | 10163 | 20325 | 40650 | 60975 | 81300 | 121950 |
| | 4.000 | 12.57 | 3770 | 9425 | 18850 | 37700 | 56550 | 75400 | 113100 |
| | 4.500 | 15.90 | 3437 | 8593 | 17185 | 34370 | 51555 | 68740 | 103110 |
| | 5.000 | 19.63 | 3064 | 7660 | 15320 | 30640 | 45960 | 61280 | 91920 |
| | 5.500 | 23.76 | 2651 | 6628 | 13255 | 26510 | 39765 | 53020 | 79530 |
| 10.00 | 4.500 | 15.90 | 6264 | 15660 | 31320 | 62640 | 93960 | 125280 | 187920 |
| | 5.000 | 19.63 | 5891 | 14728 | 29455 | 58910 | 88365 | 117820 | 176730 |
| | 5.500 | 23.76 | 5478 | 13695 | 27390 | 54780 | 82170 | 109560 | 164340 |
| | 7.000 | 38.48 | 4006 | 10015 | 20030 | 40060 | 60090 | 80120 | 120180 |
| 12.00 | 5.500 | 23.76 | 8934 | 22335 | 44670 | 89340 | 134010 | 178680 | 268020 |
| | 7.000 | 38.48 | 7462 | 18655 | 37310 | 74620 | 111930 | 149240 | 223860 |
| | 8.000 | 50.26 | 6284 | 15710 | 31420 | 62840 | 94260 | 125680 | 188520 |
| 14.00 | 7.000 | 38.48 | 11546 | 28865 | 57730 | 115460 | 173190 | 230920 | 346380 |
| | 8.000 | 50.26 | 10368 | 25920 | 51840 | 103680 | 155520 | 207360 | 311040 |
| | 10.000 | 78.54 | 7540 | 18850 | 37700 | 75400 | 113100 | 150800 | 226200 |
| 16.00 | 8.000 | 50.26 | 15080 | 37700 | 75400 | 150800 | 226200 | 301600 | 452400 |
| | 9.000 | 63.62 | 13744 | 34360 | 68720 | 137440 | 206160 | 274880 | 412320 |
| | 10.000 | 78.54 | 12252 | 30630 | 61260 | 122520 | 183780 | 245040 | 367560 |
| 18.00 | 9.000 | 63.62 | 19085 | 47713 | 95425 | 190850 | 286275 | 381700 | 572550 |
| | 10.000 | 78.54 | 17593 | 43983 | 87965 | 175930 | 263895 | 351860 | 527790 |
| 20.00 | 10.000 | 78.54 | 23562 | 58905 | 117810 | 235620 | 353430 | 471240 | 706860 |



The weights shown below are for standard Series 2H and 3H 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 C. 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.

Table A Cylinder Weights, in pounds, for Series 2H, 3H (7.00" & 8.00") hydraulic cylinders

| Bore Ø | Rod Ø | Rod Code | Single Rod Cylinders Basic Wt. Zero Stroke | | Add Per Inch of Stroke | Double Rod Cylinders Basic Wt. Zero Stroke | | Add Per Inch of Stroke |
|--------|-------|----------|---|---------------------------------------|---------------------------|---|---------------------------------|---------------------------|
| | | | F, H, HB, J, JB T, TB, TC, TD | BB, C, CB, D, DB DD, DE, G, HH, JJ | | KF, KJ, KJB KT, KTB, KTD | DE, KC, KCB, KD KDD, KE, KJJ | |
| 1.50 | 0.625 | 1 | 7.8 | 9.0 | 0.5 | 9.7 | 10.8 | 0.6 |
| | 1.000 | 2 | 8.4 | 9.3 | 0.6 | 9.1 | 10.7 | 0.8 |
| 2.00 | 1.000 | 1 | 11.6 | 13.2 | 0.8 | 14.6 | 16.8 | 1.0 |
| | 1.375 | 2 | 13.5 | 17.1 | 1.0 | 19.4 | 20.6 | 1.4 |
| 2.50 | 1.000 | 1 | 17.0 | 19.5 | 1.1 | 21.0 | 24.5 | 1.3 |
| | 1.750 | 2 | 22.5 | 25.5 | 1.5 | 27.0 | 30.0 | 2.2 |
| 3.25 | 1.375 | 1 | 32.0 | 41.0 | 1.8 | 43.0 | 52.0 | 2.2 |
| | 2.000 | 2 | 37.0 | 46.0 | 2.2 | 48.0 | 57.0 | 3.1 |
| 4.00 | 1.750 | 1 | 48.0 | 53.0 | 2.5 | 59.0 | 63.0 | 3.2 |
| | 2.500 | 2 | 52.0 | 58.0 | 3.2 | 92.0 | 97.0 | 4.6 |
| 5.00 | 2.000 | 1 | 76.0 | 82.0 | 3.4 | 96.0 | 102.0 | 4.8 |
| | 3.500 | 2 | 88.0 | 86.0 | 5.2 | 117.0 | 123.0 | 7.9 |
| 6.00 | 2.500 | 1 | 125.0 | 133.0 | 5.2 | 153.0 | 159.0 | 6.6 |
| | 4.000 | 2 | 133.0 | 140.0 | 7.3 | 182.0 | 190.0 | 10.9 |
| 7.00 | 3.000 | 1 | 233.0 | 242.0 | 6.7 | 320.0 | 339.0 | 8.7 |
| | 5.000 | 2 | 240.0 | 253.0 | 10.3 | 341.0 | 360.0 | 15.9 |
| 8.00 | 3.500 | 1 | 262.0 | 276.0 | 9.0 | 323.0 | 331.0 | 11.7 |
| | 5.500 | 2 | 300.0 | 309.0 | 13.0 | 390.0 | 411.0 | 19.7 |

Table B Cylinder Weights, in pounds, for Series 3H large bore hydraulic cylinders

| Bore Ø | Rod Ø | Rod Code | Single Rod Cylinders Basic Wt. Zero Stroke | | | | | Add Per Inch of Stroke | Double Rod Cylinders | |
|--------|--------|----------|---|---------------|--------|-------|--|---------------------------|---------------------------|--|
| | | | D, DB | DD, JJ, HH | JB, HB | BB, C | Basic Wt. Zero Stroke Add to All Mtg. Styles | | Add Per Inch of Stroke | |
| 10.00 | 4.500 | 1 | 562 | 646 | 684 | 607 | 15 | 43 | 20 | |
| | 5.000 | 3 | 574 | 656 | 695 | 619 | 16 | 50 | 21 | |
| | 5.500 | 4 | 583 | 667 | 705 | 628 | 17 | 64 | 24 | |
| | 7.000 | 2 | 620 | 704 | 742 | 665 | 21 | 101 | 32 | |
| 12.00 | 5.500 | 1 | 924 | 1057 | 1136 | 1000 | 22 | 64 | 29 | |
| | 7.000 | 3 | 961 | 1094 | 1173 | 1036 | 26 | 101 | 37 | |
| | 8.000 | 2 | 1022 | 1155 | 1234 | 1097 | 29 | 162 | 43 | |
| 14.00 | 7.000 | 1 | 1335 | 1520 | 1582 | 1485 | 28 | 101 | 39 | |
| | 8.000 | 3 | 1396 | 1581 | 1643 | 1546 | 31 | 162 | 45 | |
| | 10.000 | 2 | 1496 | 1681 | 1743 | 1646 | 39 | 262 | 61 | |

| Bore Ø | Rod Ø | Rod Code | Single Rod Cylinders Basic Wt. Zero Stroke | | | | Add Per Inch of Stroke | Double Rod Cylinders | |
|--------|--------|----------|---|--------|------|--|---------------------------|---------------------------|--|
| | | | JJ, HH | JB, HB | BB | Basic Wt. Zero Stroke Add to All Mtg. Styles | | Add Per Inch of Stroke | |
| 16.00 | 8.000 | 1 | 2073 | 2257 | 2226 | 35 | 149 | 49 | |
| | 9.000 | 3 | 2122 | 2305 | 2275 | 39 | 198 | 57 | |
| | 10.000 | 4 | 2181 | 2364 | 2334 | 43 | 257 | 65 | |
| 18.00 | 9.000 | 1 | 3165 | 3256 | 3330 | 45 | 198 | 63 | |
| | 10.000 | 3 | 3224 | 3315 | 3390 | 50 | 257 | 72 | |
| 20.00 | 10.000 | 1 | 4231 | 4406 | 4551 | 57 | 257 | 79 | |

Table C Extra weight for longer than standard rod extensions can be calculated from table below.

| 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 | 2.500 | 1.40 | 5.000 | 5.56 |
| 1.000 | 0.22 | 3.000 | 2.00 | 5.500 | 6.72 |
| 1.375 | 0.42 | 3.500 | 2.72 | 7.000 | 10.89 |
| 1.750 | 0.68 | 4.000 | 3.56 | 8.000 | 14.22 |
| 2.000 | 0.89 | 4.500 | 4.51 | 10.000 | 22.23 |



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, PTFE or filled PTFE

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 (HWCF) 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 PTFE back-up washer when required. O-rings will have nitrile back-up washers when required.

Ethylene Propylene (EPR) 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 EPR seals are Skydrol 500 and 700. EPR are Ethylene Propylene. Lipseals will have a PTFE back-up washer when required. O-rings will have EPR back-up washers when required.

Note: EPR seals are not compatible with mineral base hydraulic oil or greases. Even limited exposure to these fluids will cause severe swelling. PTFE 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 PTFE 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 (+120°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 PTFE back-up washers when required. O-rings will have fluorocarbon back-up when required.

HWCF Seals (class 6)

Class 6 seals are intended for High Water Content Fluids (HWCF) such as Houghton, Hydrolubric 120B and Sonsol 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 PTFE 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 lip seal 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. Body and gland o-ring seals will be fluorocarbon. Fluid resistance is comparable to Class 5. Cylinders incorporating Class 8 Seals will not have studded piston rods.

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 (+74°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.

Hi-Load Seals

Hi-load seals consist of one or two filled PTFE dynamic piston seals with an elastomer expander underneath. Hi-load piston arrangement normally consists of a wear ring on each end of the piston with the seals in the middle. These types of seals are virtually leak free seals under static conditions and can tolerate high pressure. The wear rings on the piston can also tolerate high side loads. The dynamic portion of the seal is bronze filled PTFE and compatible with all conditions and fluids listed on this page. However, carbon filled PTFE will provide better seal life when used with class 6 fluids. A nitrile expander will be provided unless Class 3 or 5 seals are specified. In those cases the expander will be of EPR or fluorocarbon respectively. **Note:** It may be necessary to cycle the piston seals 40 or 50 times before achieving leakage free performance.

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.

Low Friction Hydraulic Seals

Low Friction hydraulic seals are available as an option for both piston and rod seals for Series 2H and 3H cylinders. They are sometimes used when a cylinder is controlled by servo or proportional valve. The seal assembly itself is a two piece assembly consisting of a filled PTFE dynamic seal with an elastomer expander. A piston seal assembly consists of one seal assembly in the middle of the piston with a filled PTFE wear ring on each side of the piston. The piston rod seal assembly consists of two seal assemblies and an elastomer wiper seal. The filled PTFE seals are compatible with the fluids listed on this page and provide virtually leak free sealing. The expanders and rod wiper will be fluorocarbon unless EPR or fluorocarbon seals are specified. In those cases the expanders and wiper will be EPR and fluorocarbon respectively. When specifying low friction seals specify if piston, piston rod seals or both are required. **Note:** It may be necessary to cycle these seals 40 or 50 times before achieving leakage free performance.

Cast Iron Piston Rings

Cast iron rings are the standard piston seals for Series 2H cylinders. They offer the widest operating conditions by tolerating high operating pressures, wide temperature range and are compatible with most fluids. The only drawback of cast iron rings is that they allow a small amount of leakage. The leakage for a 4" bore cylinder, operating at 2000 psi, with mineral base hydraulic fluid will be less than 10in³/min. Leakage will increase as pressure, bore size and viscosity of the operating hydraulic fluid increases. For these reasons cast iron rings are not recommended when using water or (HWCF) fluids.

Water Service

Series 2H 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 2H and 3H 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 No. | Typical Fluids | Temperature Range |
|--|--|--|
| 1 (Standard) (Nitrile Polyurethane) | Air, Nitrogen Hydraulic Oil, Mil-H-5606 Oil | -10°F (-23°C) to +165°F (+74°C) |
| 2 Optional Water Base Fluid Seal | Water, Water-Glycol, HWCF — See Class 6 below. Water-in-Oil Emulsion Houghto-Safe, 271, 620, 5040. Mobil Pyrogard D, Shell Irus 905. Ucon Hydrolube J-4 | -10°F (-23°C) to +165°F (+74°C) |
| 3 Special (EPR) (at extra cost) | Some Phosphate Ester Fluids Skydrol 500, 7000 | -10°F (-23°C) to +130°F (+54°C) |
| Note: (EPR) 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) (Fluorocarbon Seals) | High Temperature Houghto-Safe 1010, 1055, 1120 Fyrquel 150, 220, 300, 550 Mobil Pyrogard 42,43,53,55 | See paragraph on Fluorocarbon seals for recommended temperature 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 Sonsol Lubrizol, for other HWCF — consult factory. | +40°F (+4°C) to +120°F (+49°C) |
| 8 Optional (at extra cost) Energized PTFE | See Class 5 Seals | -15°F (-26°C) to +400°F (+204°C) |

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

Standard operating fluid — clean, filtered hydraulic oil. Pressure ratings for heavy-duty hydraulic cylinders are shown in the table.

Series 2H and 3H hydraulic cylinders are recommended for pressures to 3000 psi for heavy-duty service with hydraulic oil. The 4:1 design factor ratings shown are based on tensile strength of material and are for standard rod diameter only. The rating is conservative for continuous severe applications. Design factors at other pressures can be calculated from this rating. In addition, mounting styles, stroke, etc., should be considered because of the limiting effect they may have on these ratings.

**Series 2H & 3H Hydraulic Cylinders
Maximum Pressure Ratings**

| Bore Ø | Rod Ø | 4:1 ¹ Design Factor (Tensile) (psi) | Heavy-Duty Service (psi) |
|-----------|----------|--|--------------------------------|
| 1.50 | 0.625 | 2530 | 3000 |
| 2.00 | 1.000 | 2950 | 3000 |
| 2.50 | 1.000 | 2340 | 3000 |
| 3.25 | 1.375 | 2250 | 3000 |
| 4.00 | 1.750 | 2130 | 3000 |
| 5.00 | 2.000 | 2170 | 3000 |
| 6.00 | 2.500 | 2270 | 3000 |
| 7.00 | 3.000 | 2030 | 3000 |
| 8.00 | 3.500 | 2040 | 3000 |
| 10.00 | 4.500 | 2720 | 3000 |
| 12.00 | 5.500 | 2580 | 3000 |
| 14.00 | 7.000 | 2320 | 3000 |
| 16.00 | 8.000 | 2750 | 3000 |
| 18.00 | 9.000 | 2900 | 3000 |
| 20.00 | 10.000 | 2640 | 3000 |

¹ Applies to all mountings except Styles J, JB, H, D, DB, DD.



Ports

Ports

Series 2H and 3H cylinders can be supplied with SAE 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

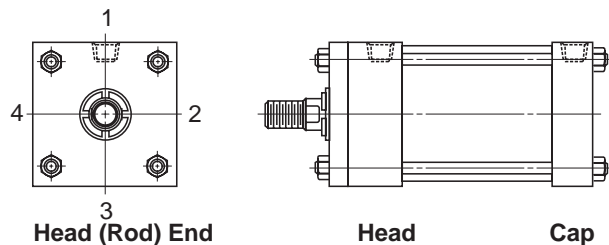


Table A

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

Straight Thread Ports

The SAE straight thread O-ring port is recommended for hydraulic applications. Parker will furnish this port configuration at positions shown in Table A. This port can also be provided at positions other than those shown in Table A at an extra charge. SAE port size numbers are listed next to the NPTF pipe thread counterparts for each bore size in the respective product catalogs. Size number, tube O.D., and port thread size for SAE ports are listed in Table B.

Table B

SAE Straight Thread O-Ring Ports

| Size No. | Tube O.D. (In.) | Thread Size | Size No. | Tube O.D. (In.) | Thread Size |
|----------|-----------------|-------------|----------|-----------------|-------------|
| 2 | 0.13 | 5/16 - 24 | 12 | 0.75 | 1 1/16 - 12 |
| 3 | 0.19 | 3/8 - 24 | — | — | — |
| 4 | 0.25 | 7/16 - 20 | 16 | 1.00 | 1 5/16 - 12 |
| 5 | 0.31 | 1/2 - 20 | 20 | 1.25 | 1 5/8 - 12 |
| 6 | 0.38 | 9/16 - 18 | 24 | 1.50 | 1 7/8 - 12 |
| 8 | 0.50 | 3/4 - 16 | 32 | 2.00 | 2 1/2 - 12 |
| 10 | 0.63 | 7/8 - 14 | — | — | — |

Note: For the pressure ratings of individual connectors, contact your connector supplier. Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at the cylinder piston rod end. The rod end pressure is approximately equal to:

$$\frac{\text{Effective Cap End Piston Area}}{\text{Effective Rod End Piston Area}} \times \text{Operating Pressure}$$

International Ports

Other port configurations to meet international requirements are available at extra cost. Parker Series 2H and 3H cylinders can be supplied, on request, with British standard taper port (BSPT). Such port has a taper of 1 in 16 measured on the diameter (1/16" per inch). The thread form is Whitworth System, and size and number of threads per inch are as follows:

Table C

British Standard Pipe Threads

| Nominal Pipe Size | No. Threads Per Inch | Pipe O.D. |
|-------------------|----------------------|-----------|
| 1/8 | 28 | 0.383 |
| 1/4 | 19 | 0.518 |
| 3/8 | 19 | 0.656 |
| 1/2 | 14 | 0.825 |
| 3/4 | 14 | 1.041 |
| 1 | 11 | 1.309 |
| 1 1/4 | 11 | 1.650 |
| 1 1/2 | 11 | 1.882 |
| 2 | 11 | 2.347 |

British standard parallel internal threads are designated as BSPP and have the same thread form and number of threads per inch as the BSPT type and can be supplied, on request, at extra cost. Unless otherwise specified, the BSPP or BSPT port size supplied will be the same nominal pipe size as the NPTF port for a given bore size cylinder.

Metric ports can also be supplied to order at extra cost. See table below for standard port size for each bore.

Table D – Standard Port Sizes

| Bore Ø | T SAE | U NPTF | P SAE Code 61 Flange | Y ISO 6149 | B BSPT R BSPP | G Metric |
|--------|-------|--------|----------------------|------------|---------------|-----------|
| 1.50 | 10 | 1/2 | N/A | M22 x 1.5 | 1/2 | M22 x 1.5 |
| 2.00 | 10 | 1/2 | N/A | M22 x 1.5 | 1/2 | M22 x 1.5 |
| 2.50 | 10 | 1/2 | 1/2 ¹ | M22 x 1.5 | 1/2 | M22 x 1.5 |
| 3.25 | 12 | 3/4 | 3/4 | M27 x 2 | 3/4 | M27 x 2 |
| 4.00 | 12 | 3/4 | 3/4 | M27 x 2 | 3/4 | M27 x 2 |
| 5.00 | 12 | 3/4 | 3/4 | M27 x 2 | 3/4 | M27 x 2 |
| 6.00 | 16 | 1 | 1 | M33 x 2 | 1 | M33 x 2 |

| Bore Ø | T SAE | U NPTF | P SAE Code 61 Flange | Y ISO 6149 | B BSPT R BSPP | G Metric |
|-------------|-------|--------|----------------------|------------|---------------|----------|
| 7.00 | 20 | 1 1/4 | 1 1/4 | M42 x 2 | 1 1/4 | M42 x 2 |
| 8.00 | 24 | 1 1/2 | 1 1/2 | M48 x 2 | 1 1/2 | M48 x 2 |
| 10.00 | 24 | 2 | 2 | M48 x 2 | 2 | M48 x 2 |
| 12.00 | 24 | 2 1/2 | 2 1/2 | M48 x 2 | 2 1/2 | M48 x 2 |
| 14.00 | 24 | 2 1/2 | 2 1/2 | M48 x 2 | 2 1/2 | M48 x 2 |
| 16.00-20.00 | 24 | — | 3 | — | — | — |

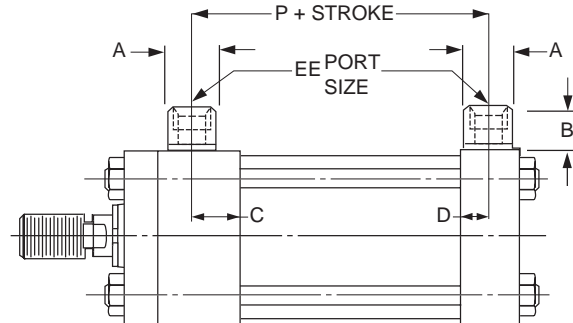
¹Available with 1.000 inch rod diameter only.



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 2H and 3H 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.

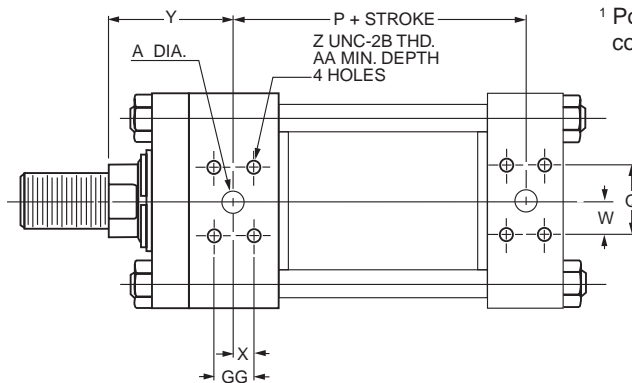


Oversize NPTF Port Boss Dimensions

| Bore Ø | EE (NPTF) | A (Dia.) | B | C | D | P |
|--------|-----------|----------|------|------|------|------|
| 1.50 | 3/4 | 1.38 | 1.00 | 0.75 | 0.78 | 2.91 |
| 2.00 | 3/4 | 1.38 | 1.00 | 0.75 | 0.78 | 2.91 |
| 2.50 | 3/4 | 1.38 | 1.00 | 0.75 | 0.78 | 3.03 |
| 3.25 | 1 | 1.75 | 1.19 | 0.91 | 0.88 | 3.53 |
| 4.00 | 1 | 1.75 | 1.19 | 0.91 | 0.88 | 3.78 |
| 5.00 | 1 | 1.75 | 1.19 | 0.91 | 0.88 | 4.28 |
| 6.00 | 1 1/4 | 2.25 | 1.31 | 1.13 | 1.13 | 5.13 |
| 7.00 | 1 1/2 | 2.50 | 1.56 | 1.38 | 1.38 | 5.75 |
| 8.00 | 2 | 3.00 | 1.69 | 1.50 | 1.50 | 6.50 |

Oversize SAE Straight Thread Port Boss Dimensions

| Bore Ø | EE (SAE) | A (Dia.) | B | C | D | P |
|--------|-----------------|----------|------|------|------|------|
| 1.50 | 12 ¹ | - | - | - | - | 2.88 |
| 2.00 | 12 ¹ | - | - | - | - | 2.88 |
| 2.50 | 12 ¹ | - | - | - | - | 3.00 |
| 3.25 | 16 | 1.75 | 1.19 | 0.91 | 0.91 | 3.44 |
| 4.00 | 16 | 1.75 | 1.19 | 0.91 | 0.91 | 3.69 |
| 5.00 | 16 | 1.75 | 1.19 | 0.91 | 0.91 | 4.19 |
| 6.00 | 20 ¹ | - | - | - | - | 5.19 |
| 7.00 | 24 ¹ | - | - | - | - | 5.50 |
| 8.00 | N/A | - | - | - | - | 6.25 |



¹ Port tapped directly into head with code 1 rod in these bores

Flange Ports (Code 61, 3000 psi) SAE 4 Bolt Flange Ports

| Bore Ø | SAE Dash No. | Y | A | P | Q | W | X |
|-------------------|--------------|------|------|------|------|------|-----|
| 2.50 ² | 8 | 2.39 | .50 | 2.97 | 1.50 | .75 | .34 |
| 3.25 ² | 12 | 2.80 | .75 | 3.47 | 1.87 | .94 | .44 |
| | | 3.17 | | | | | |
| 4.00 ² | 12 | 3.05 | .75 | 3.72 | 1.87 | .94 | .44 |
| | | 3.42 | | | | | |
| | | 3.17 | | | | | |
| 5.00 ² | 12 | 3.17 | .75 | 4.22 | 1.87 | .94 | .44 |
| | | 3.42 | | | | | |
| | | 3.42 | | | | | |
| 6.00 | 16 | 3.52 | 1.00 | 4.85 | 2.06 | 1.03 | .52 |
| 7.00 | 20 | 3.70 | 1.25 | 5.47 | 2.31 | 1.16 | .59 |
| 8.00 | 24 | 3.84 | 1.50 | 6.19 | 2.75 | 1.37 | .70 |

| Bore Ø | SAE Dash No. | Z | AA | GG |
|-------------------|--------------|-----------|------|------|
| 2.50 ² | 8 | 5/16 - 18 | .81 | .69 |
| 3.25 ² | 12 | 3/8 - 16 | .75 | .87 |
| 4.00 ² | 12 | 3/8 - 16 | .75 | .87 |
| 5.00 ² | 12 | 3/8 - 16 | .75 | .87 |
| 6.00 | 16 | 3/8 - 16 | .87 | 1.03 |
| 7.00 | 20 | 7/16 - 14 | 1.00 | 1.19 |
| 8.00 | 24 | 1/2 - 13 | 1.06 | 1.41 |

² 2.50", 3.25", 4.00" & 5.00" bores cap-flange port not available on Style HB
Style H not available at position 2 or 4. Port flange overhangs cap on Style HH.
³ 2.50" bore head flange port available with 1.000" rod only.



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.

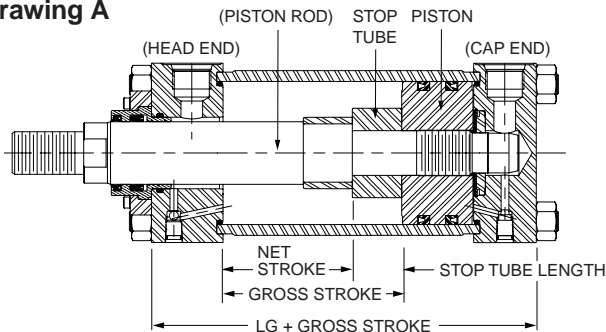
Stroke Tolerances

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 desired result.

Stop Tubing

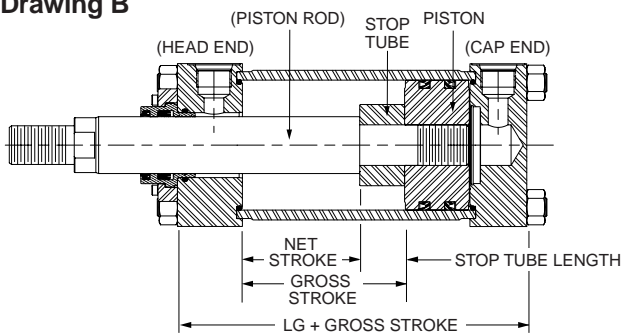
Stop tube is recommended to lengthen the distance between the rod bearing and piston to reduce bearing loads when the cylinder is fully extended. This is especially true of horizontally mounted and long stroke cylinders. Long stroke cylinders achieve additional stability through the use of a stop tube.

Drawing A



When specifying cylinders with long stroke and 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.

Drawing B



This design is supplied on all non-cushion cylinders.

Mounting Classes

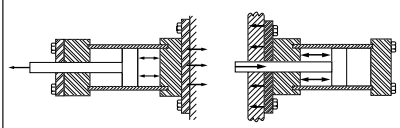
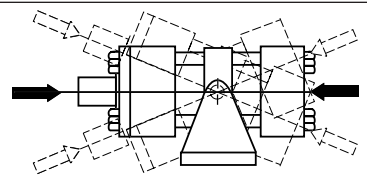
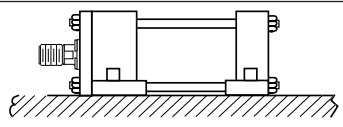
Standard mountings for fluid power cylinders fall into three basic groups. The groups can be summarized as follows:

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 Group 3.

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

How to Use the Chart

The selection of a piston rod for thrust (push) conditions requires the following steps:

1. Determine the type of cylinder mounting style and rod end connection to be used. Then consult the chart below and find the “stroke factor” that corresponds to the conditions used.

2. Using this stroke factor, determine the “basic length” from the equation:

$$\frac{\text{Basic Length}}{\text{Stroke}} = \text{Stroke Factor}$$

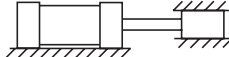
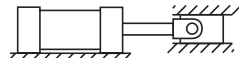
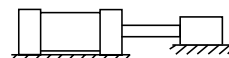

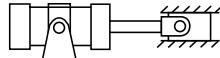

The graph is prepared for standard rod extensions beyond the face of the rod gland retainers. For rod extensions greater than standard, add the increase to the stroke in arriving at the “basic length.”

3. Find the load imposed for the thrust application by multiplying the full bore area of the cylinder by the system pressure.
4. Enter the graph along the values of “basic length” and “thrust” as found above and note the point of intersection:
 - A) The correct piston rod size is read from the diagonally curved line labeled “Rod Diameter” next above the point of intersection.
 - B) The required length of stop tube is read from the right of the graph by following the shaded band in which the point of intersection lies.

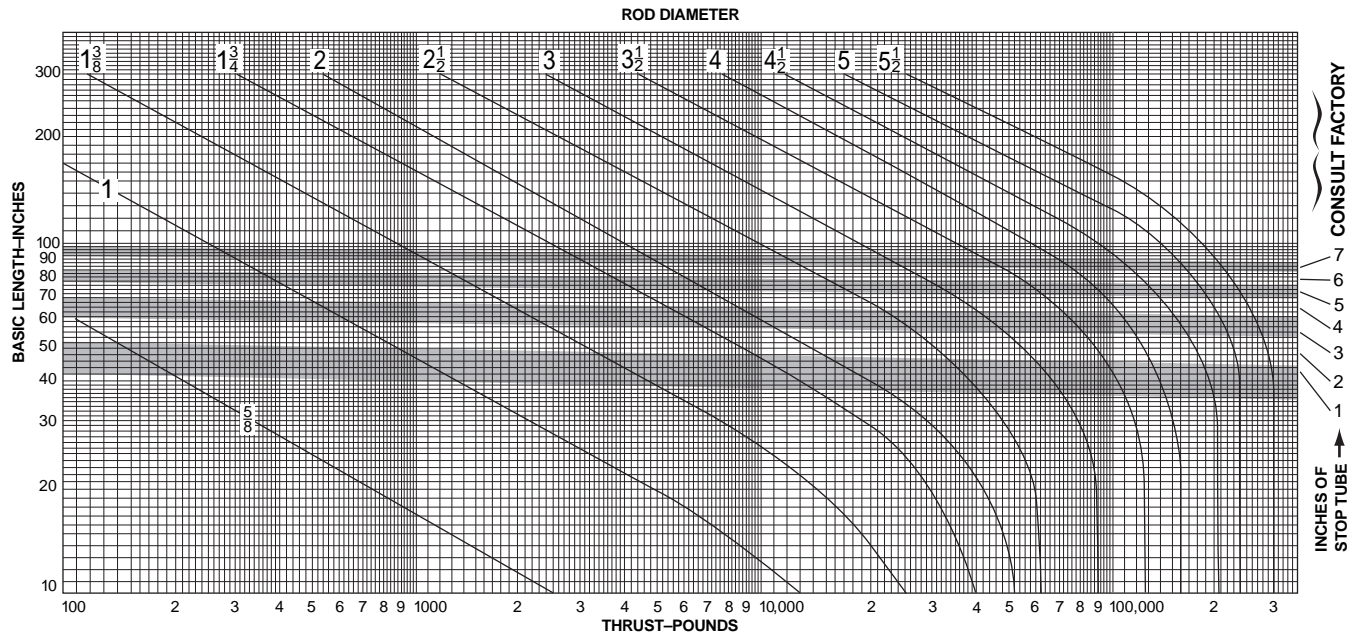
- C) If required length of stop tube is in the region labeled “consult factory,” submit the following information for an individual analysis:
 - 1) Cylinder mounting style.
 - 2) Rod end connection and method of guiding load.
 - 3) Bore, required stroke, length of rod extension if greater than standard, and series of cylinder used.
 - 4) Mounting position of cylinder. (Note: If at an angle or vertical, specify direction of piston rod.)
 - 5) Operating pressure of cylinder if limited to less than standard pressure for cylinder selected.

Warning ⚠

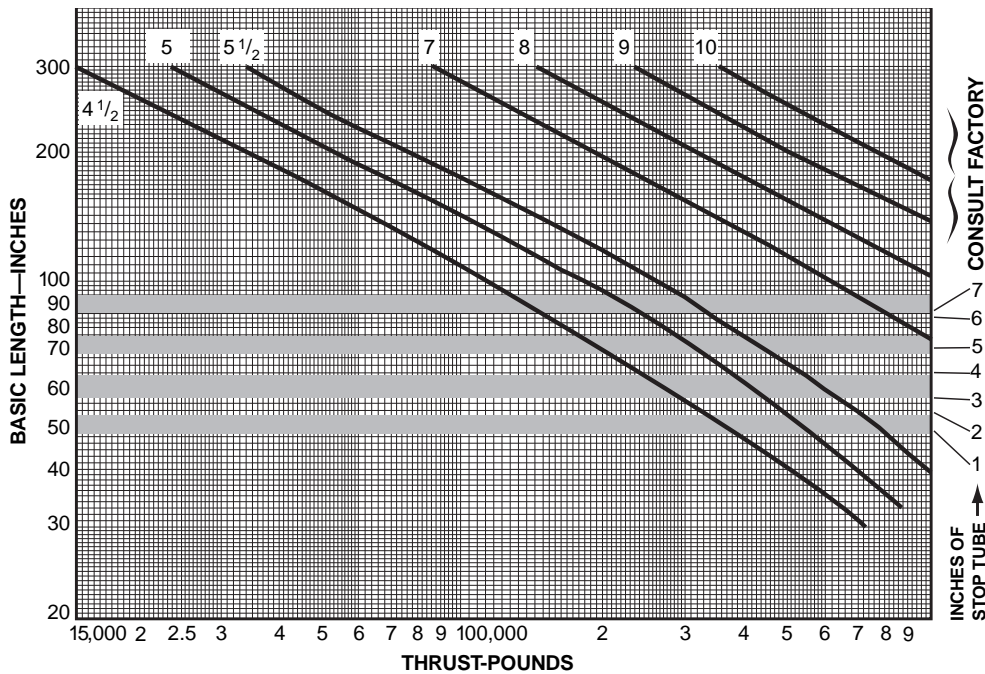
Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod end to fail. If these types of additional loads are expected to be imposed on the piston rods, their magnitude should be made known to our Engineering Department so they may be properly addressed. Additionally, cylinder users should always make sure that the piston rod is securely attached to the machine member.

| Recommended Mounting Styles for Maximum Stroke and Thrust Loads | Rod End Connection | Case | Stroke Factor |
|---|----------------------------------|---|---------------|
| Groups 1 or 3 Long stroke cylinders for thrust loads should be mounted using a heavy-duty mounting style at one end, firmly fixed and aligned to take the principal force. Additional mounting should be specified at the opposite end, which should be used for alignment and support. An intermediate support may also be desirable for long stroke cylinders mounted horizontally. See “Tie Rod Supports — Rigidity of Envelope” for a guide. Machine mounting pads can be adjustable for support mountings to achieve proper alignment. | Fixed and Rigidly Guided | I  | .50 |
| | Pivoted and Rigidly Guided | II  | .70 |
| | Supported but not Rigidly Guided | III  | 2.00 |
| Group 2 Style D — Trunnion on Head | Pivoted and Rigidly Guided | IV  | 1.00 |
| Style DD, DE — Intermediate Trunnion | Pivoted and Rigidly Guided | V  | 1.50 |
| Style DB — Trunnion on Cap or Style BB — Clevis on Cap | Pivoted and Rigidly Guided | VI  | 2.00 |

Piston Rod — Stroke Selection Chart — 1.50" through 8.00" Bore



Piston Rod — Stroke Selection Chart — 10.00" through 20.00" Bore

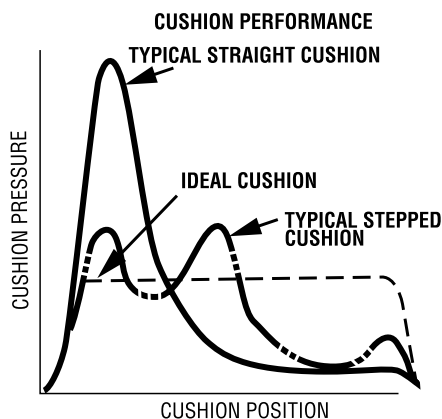


An Introduction to Cushioning

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, 2H/3H 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, and

cushion performance for each of the rod sizes available is illustrated graphically in the charts on the following pages.

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, 2H/3H cylinder incorporates 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 on the next page. Cushions are adjustable via recessed needle valves.

Cushion Calculation

The charts on the cushion energy absorption capacity data page show the energy absorption capacity for each bore/rod combination at the head (annulus) and the cap (full bore) ends of cylinder. The charts are valid for piston velocities within a range of 0.33 to 1 ft/s. For velocities between 1ft/s and 1.64 ft/s the energy values derived from the charts should be reduced by 25%. For velocities less than 0.33 ft/s where large masses are involved, and for velocities greater than 1.60 ft/s, a special cushion profile may be required. Please consult the factory for details.

The cushion capacity of the head end is less than the cap, and reduces to zero at high drive pressures due to the pressure intensification effect across the piston.

The energy absorption capacity of the cushion decreases with drive pressure.

Formula

Cushioning calculations are based on the formula $E = (1/2)mv^2$ for horizontal applications. For inclined or vertically downward or upward applications, this is modified to:

$$E = (1/2)mv^2 + mg(L/12) \times \sin(a)$$

(for inclined or vertically downward direction of mass)

$$E = (1/2)mv^2 - mg(L/12) \times \sin(a)$$

(for inclined vertically upward direction of mass)

where:

E = energy absorbed in ft-lb

g = acceleration due to gravity = 32.2 ft/s²

v = velocity in ft/s

L = length of cushion in inches (see cushion length chart on the next page).

m = mass of load in slug (including piston, rod and rod end accessories).

a = angle to the horizontal in degrees

p = pressure in psi

Example:

The following example shows how to calculate the energy developed by masses moving in a straight line. For non-linear motion, other calculations are required; please consult the factory. The example assumes that the bore and rod diameter are already appropriate for the application. The effects of friction on the cylinder and load have been ignored.

Selected bore/rod 6.00" bore x 2.50" rod (No. 1 rod)

Cushion at the cap end.

Pressure = 2,500 psi

Mass = 685 slugs = weight in lb / (32.2 ft/s²)

Velocity = 1.3 ft/s

Cushion length = 1.313 inch

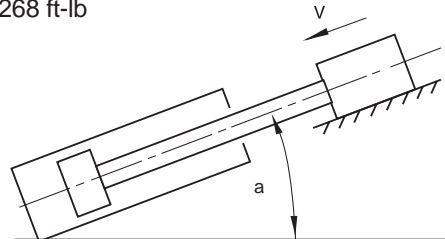
a = 45°

Sin (a) = 0.70

$$E = (1/2)mv^2 + mgl/12 \times \sin(a)$$

$$= (1/2) \times 685 \times 1.3^2 + 685 \times 32.2 \times 1.313/12 \times 0.70$$

$$= 2,268 \text{ ft-lb}$$



Note: In the above example velocity is greater than 1 ft/s. Therefore, a de-rating factor of 0.75 must be applied to the calculated value of E. Applying this correction factor will increase the energy value to 3024 ft-lb (2268/0.75 = 3024 ft-lb). A review of the graph for the cap end cushion of a 6 inch bore x 2.50" rod cylinder operating at 2500 psi indicates that it can absorb approximately 3200 ft-lb maximum of energy. Since 3024 ft-lb is less than the maximum allowable of 3200 ft-lb, the cylinder can be applied as indicated. If the calculated energy exceeds the value shown on the curve, select a larger bore cylinder and/or reduce the operating pressure and recalculate the energy. Compare the newly calculated energy value to the appropriate curve to ensure it does not exceed the maximum allowable energy.

Cushion Length Chart (Series 2H/3H Cylinders)

| Bore Ø | Rod Ø | Effective Cushion Length | |
|-----------|----------|--------------------------|-------|
| | | Head | Cap |
| 1.50 | 0.625 | 0.924 | 1.000 |
| | 1.000 | 0.927 | 1.000 |
| 2.00 | 1.000 | 0.927 | 0.938 |
| | 1.375 | 0.925 | 0.938 |
| 2.50 | 1.000 | 0.927 | 0.938 |
| | 1.750 | 0.928 | 0.938 |
| | 1.375 | 0.925 | 0.938 |
| 3.25 | 1.375 | 1.175 | 1.125 |
| | 2.000 | 0.862 | 1.125 |
| | 1.750 | 1.178 | 1.125 |
| 4.00 | 1.750 | 1.178 | 1.063 |
| | 2.500 | 0.869 | 1.063 |
| | 2.000 | 0.862 | 1.063 |
| 5.00 | 2.000 | 0.862 | 0.938 |
| | 3.500 | 0.869 | 0.938 |
| | 2.500 | 0.869 | 0.938 |
| | 3.000 | 0.869 | 0.938 |
| 6.00 | 2.500 | 1.119 | 1.313 |
| | 4.000 | 1.119 | 1.313 |
| | 3.000 | 1.119 | 1.313 |
| | 3.500 | 0.869 | 1.313 |
| 7.00 | 3.000 | 1.619 | 1.750 |
| | 5.000 | 1.496 | 1.750 |
| | 3.500 | 1.619 | 1.750 |
| | 4.000 | 1.119 | 1.750 |
| | 4.500 | 1.496 | 1.750 |
| 8.00 | 3.500 | 1.869 | 1.813 |
| | 5.500 | 1.745 | 1.813 |
| | 4.000 | 1.119 | 1.813 |
| | 4.500 | 1.496 | 1.813 |
| | 5.000 | 1.496 | 1.813 |



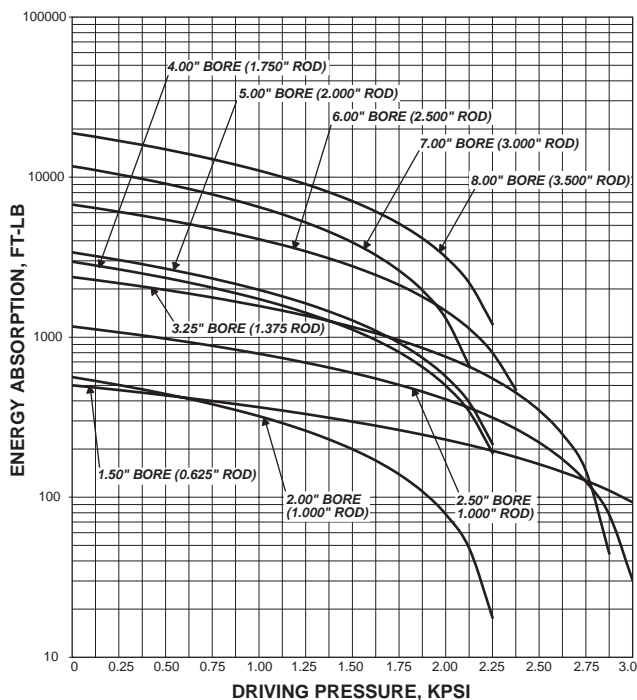
Cushion Energy Absorption Capacity Data

The cushion energy absorption data shown below is based on the maximum fatigue-free pressure developed in the tube. For application with a life cycle of less than 10⁶ cycles, greater

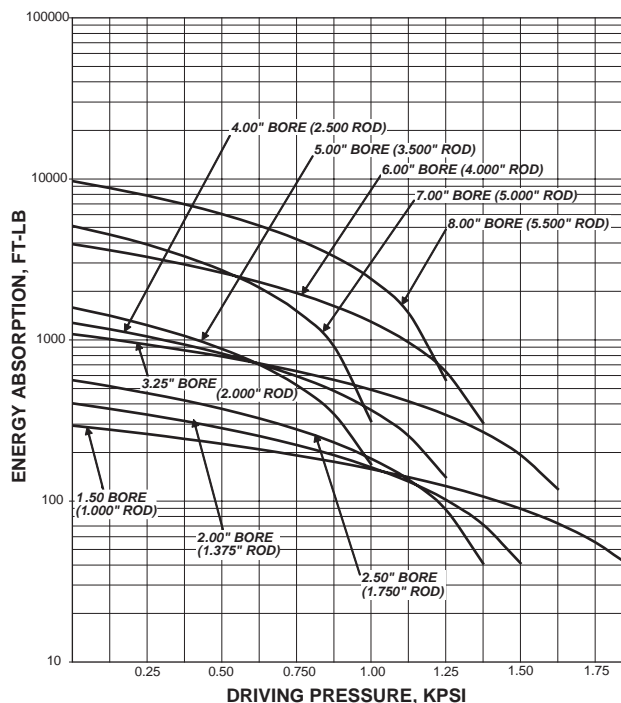
energy absorption figures can be applied. Please consult the factory if further information is required.

Head End

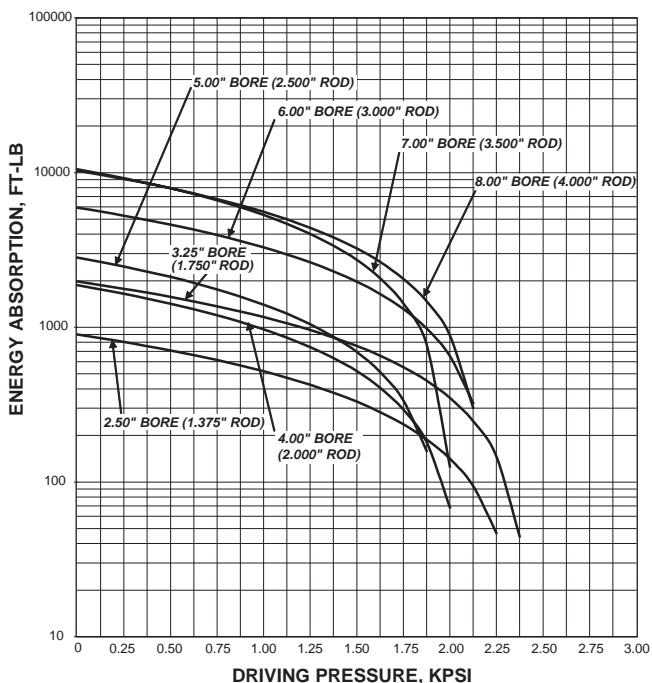
STANDARD ROD DIA.



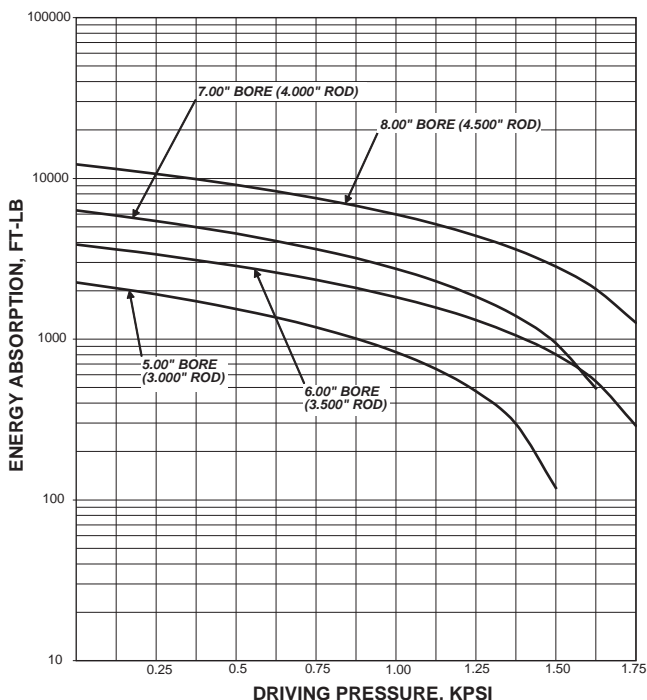
MAXIMUM ROD DIA.



FIRST OVERSIZE ROD DIA.



SECOND OVERSIZE ROD DIA.

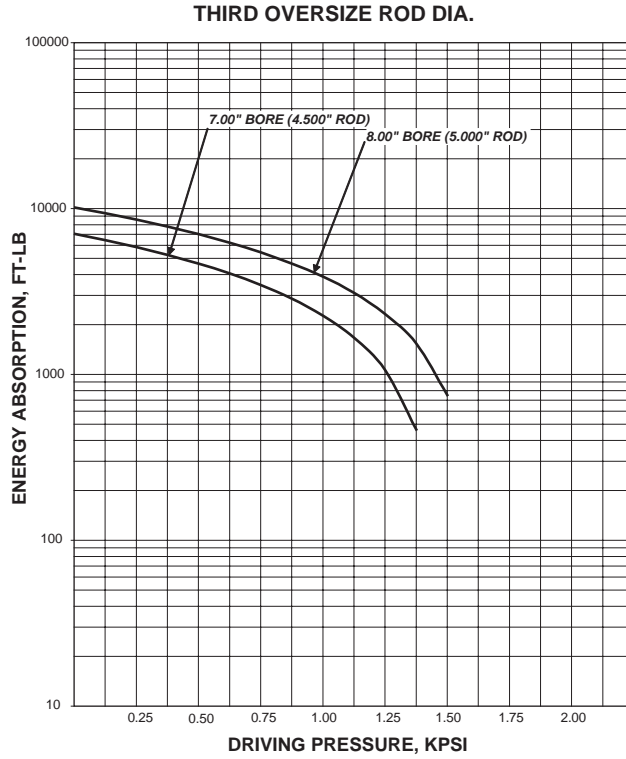


Cushion Energy Absorption Capacity Data

The cushion energy absorption data shown below is based on the maximum fatigue-free pressure developed in the tube. For application with a life cycle of less than 10^6 cycles, greater

energy absorption figures can be applied. Please consult the factory if further information is required.

Head End

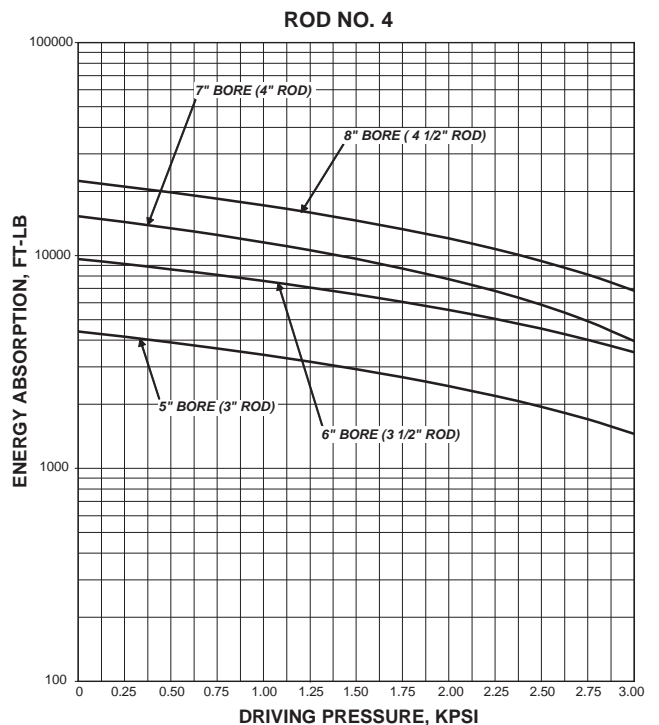
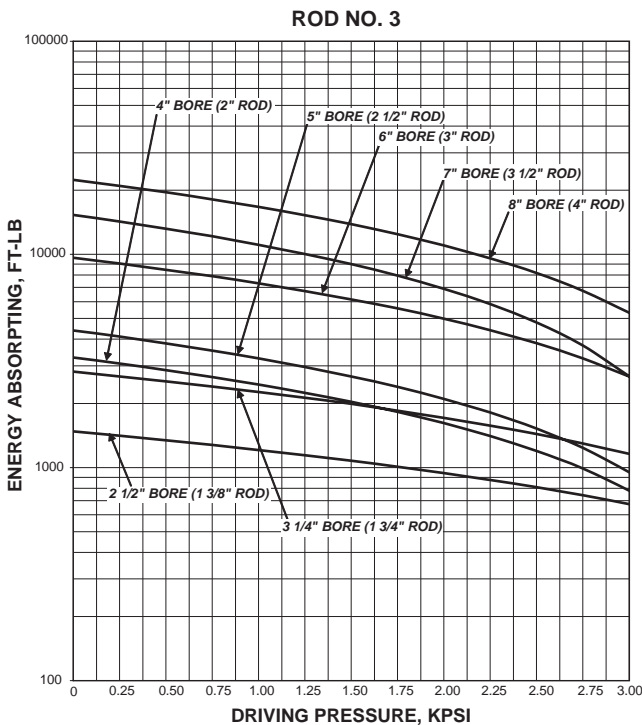
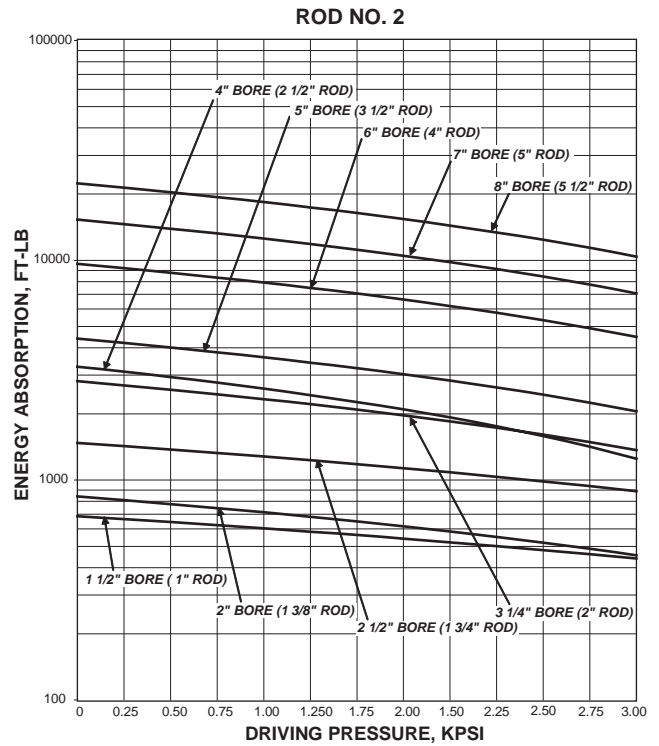
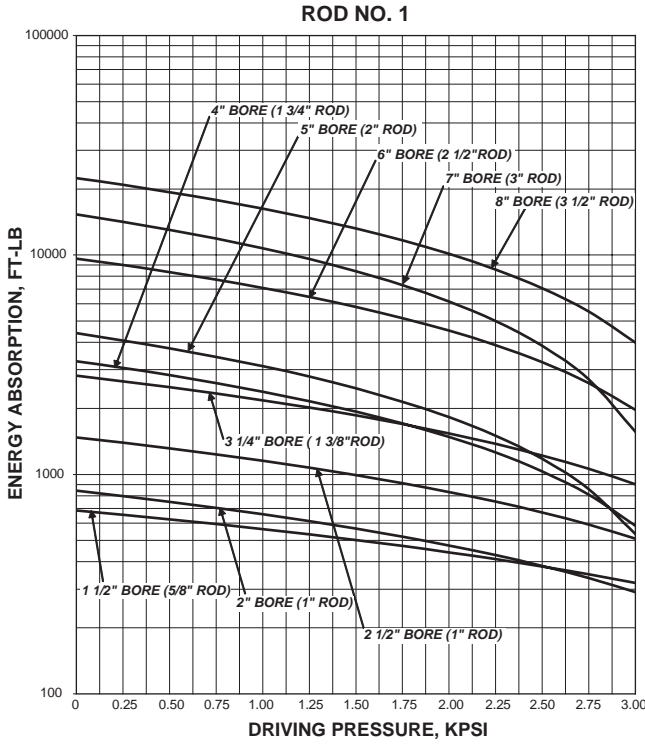


Cushion Energy Absorption Capacity Data

The cushion energy absorption data shown below is based on the maximum fatigue-free pressure developed in the tube. For application with a life cycle of less than 10^6 cycles, greater

energy absorption figures can be applied. Please consult the factory if further information is required.

Cap End

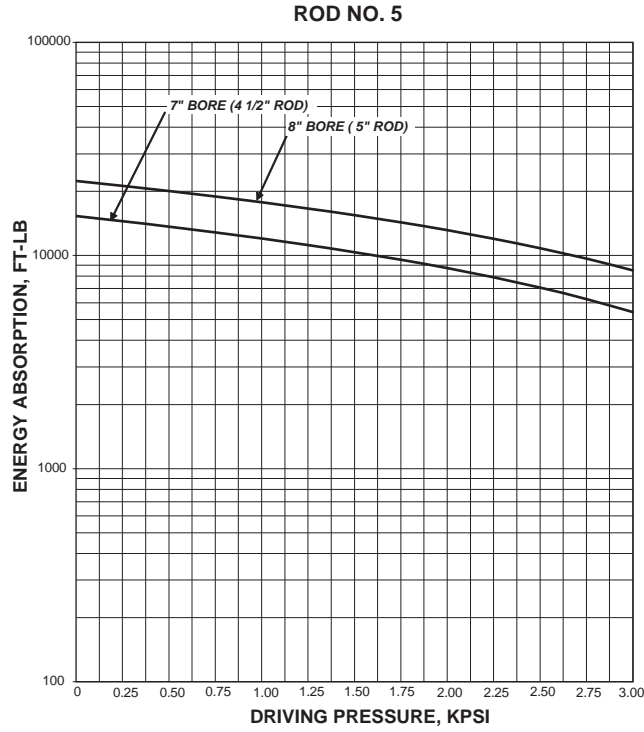


Cushion Energy Absorption Capacity Data

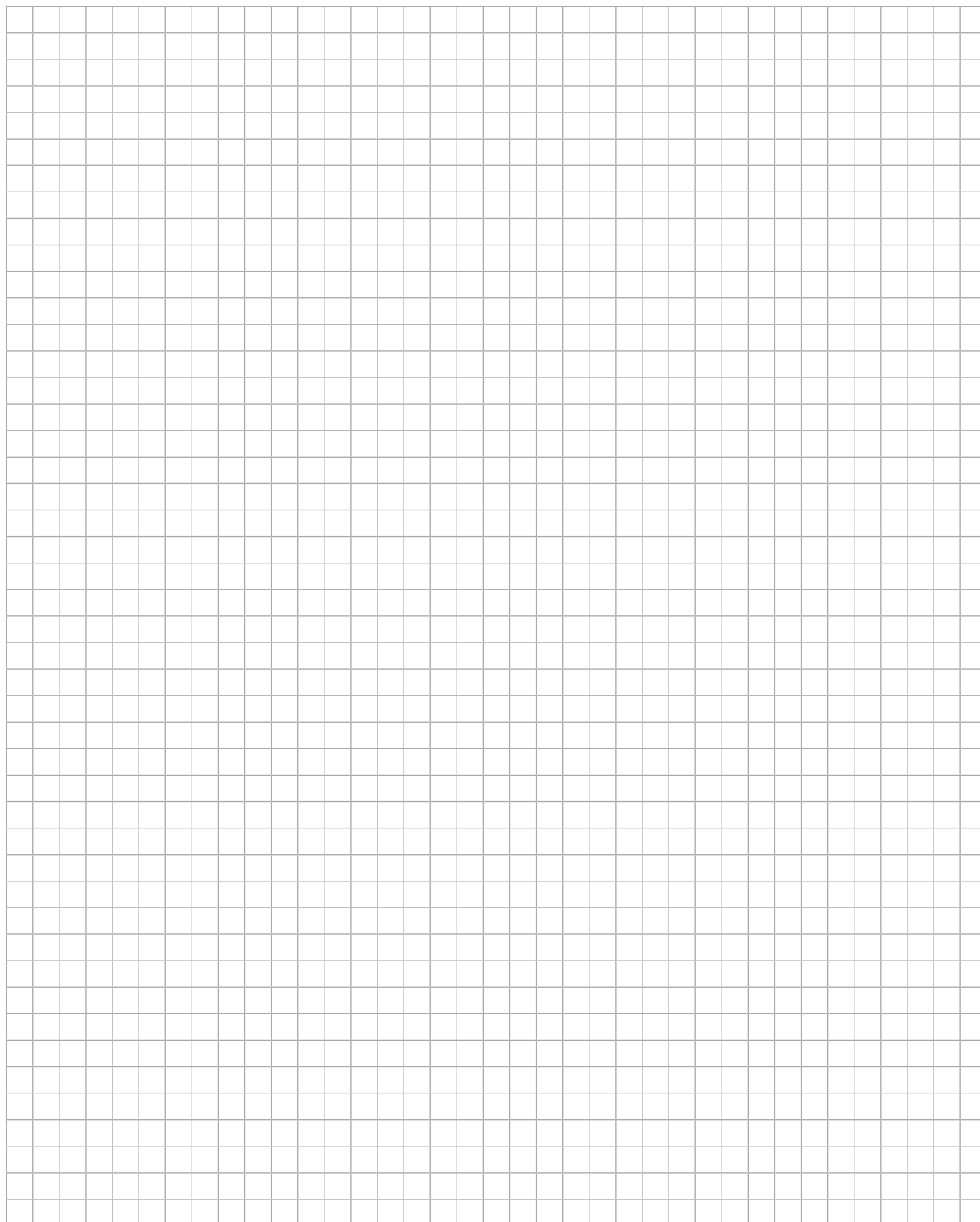
The cushion energy absorption data shown below is based on the maximum fatigue-free pressure developed in the tube. For application with a life cycle of less than 10⁶ cycles, greater

energy absorption figures can be applied. Please consult the factory if further information is required.

Cap End



Notes

A large grid of graph paper for taking notes, consisting of approximately 30 columns and 40 rows of small squares.

Manufacturing Locations

Regional Plants

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

E

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, 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.

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 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 Industrial 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, Hydraulics Group, 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 or work described will be referred to as "Products".

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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 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which 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 any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

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. Contingencies. Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. 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.

9. 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, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer placing an order for the items which are 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.

10. 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.

11. 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. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. 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.

13. 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.

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

15. 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 the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. 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.

17. Termination. This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. 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. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. 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.

20. Taxes. Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. Equal Opportunity Clause. For the performance of government contracts and where dollar value of the Products exceed \$10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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AEROSPACE

Key Markets

- Aircraft engines
- Business & general aviation
- Commercial transports
- Land-based weapons systems
- Military aircraft
- Missiles & launch vehicles
- Regional transports
- Unmanned aerial vehicles

Key Products

- Flight control systems & components
- Fluid conveyance systems
- Fluid metering delivery & atomization devices
- Fuel systems & components
- Hydraulic systems & components
- Inert nitrogen generating systems
- Pneumatic systems & components
- Wheels & brakes



CLIMATE CONTROL

Key Markets

- Agriculture
- Air conditioning
- Food, beverage & dairy
- Life sciences & medical
- Precision cooling
- Processing
- Transportation

Key Products

- CO₂ controls
- Electronic controllers
- Filter driers
- Hand shut-off valves
- Hose & fittings
- Pressure regulating valves
- Refrigerant distributors
- Safety relief valves
- Solenoid valves
- Thermostatic expansion valves



ELECTROMECHANICAL

Key Markets

- Aerospace
- Factory automation
- Food & beverage
- Life science & medical
- Machine tools
- Packaging machinery
- Paper machinery
- Plastics machinery & converting
- Primary metals
- Semiconductor & electronics
- Textile
- Wire & cable

Key Products

- AC/DC drives & systems
- Electric actuators
- Controllers
- Gantry robots
- Gearheads
- Human machine interfaces
- Industrial PCs
- Inverters
- Linear motors, slides and stages
- Precision stages
- Stepper motors
- Servo motors, drives & controls
- Structural extrusions



FILTRATION

Key Markets

- Food & beverage
- Industrial machinery
- Life sciences
- Marine
- Mobile equipment
- Oil & gas
- Power generation
- Process
- Transportation

Key Products

- Analytical gas generators
- Compressed air & gas filters
- Condition monitoring
- Engine air, fuel & oil filtration & systems
- Hydraulic, lubrication & coolant filters
- Process, chemical, water & microfiltration filters
- Nitrogen, hydrogen & zero air generators



FLUID & GAS HANDLING

Key Markets

- Aerospace
- Agriculture
- Bulk chemical handling
- Construction machinery
- Food & beverage
- Fuel & gas delivery
- Industrial machinery
- Mobile
- Oil & gas
- Transportation
- Welding

Key Products

- Brass fittings & valves
- Diagnostic equipment
- Fluid conveyance systems
- Industrial hose
- PTFE & PFA hose, tubing & plastic fittings
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects



HYDRAULICS

Key Markets

- Aerospace
- Aerial lift
- Agriculture
- Construction machinery
- Forestry
- Industrial machinery
- Mining
- Oil & gas
- Power generation & energy
- Truck hydraulics

Key Products

- Diagnostic equipment
- Hydraulic cylinders & accumulators
- Hydraulic motors & pumps
- Hydraulic systems
- Hydraulic valves & controls
- Power take-offs
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects



PNEUMATICS

Key Markets

- Aerospace
- Conveyor & material handling
- Factory automation
- Food & beverage
- Life science & medical
- Machine tools
- Packaging machinery
- Transportation & automotive

Key Products

- Air preparation
- Compact cylinders
- Field bus valve systems
- Grippers
- Guided cylinders
- Manifolds
- Miniature fluidics
- Pneumatic accessories
- Pneumatic actuators & grippers
- Pneumatic valves and controls
- Rodless cylinders
- Rotary actuators
- Tie rod cylinders
- Vacuum generators, cups & sensors



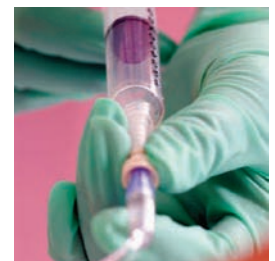
PROCESS CONTROL

Key Markets

- Chemical & refining
- Food, beverage & dairy
- Medical & dental
- Microelectronics
- Oil & gas
- Power generation

Key Products

- Analytical sample conditioning products & systems
- Fluoropolymer chemical delivery fittings, valves & pumps
- High purity gas delivery fittings, valves & regulators
- Instrumentation fittings, valves & regulators
- Medium pressure fittings & valves
- Process control manifolds



SEALING & SHIELDING

Key Markets

- Aerospace
- Chemical processing
- Consumer
- Energy, oil & gas
- Fluid power
- General industrial
- Information technology
- Life sciences
- Military
- Semiconductor
- Telecommunications
- Transportation

Key Products

- Dynamic seals
- Elastomeric o-rings
- EMI shielding
- Extruded & precision-cut, fabricated elastomeric seals
- Homogeneous & inserted elastomeric shapes
- High temperature metal seals
- Metal & plastic retained composite seals
- Thermal management



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