# Series MH
# Heavy Duty Mill
# Hydraulic Cylinder

*Catalog HY08-1117-1/NA*
*May, 2008*

- **Meets All NFPA Mounting Dimensions**
- **Heavy Duty Service – Mill Type Construction**
- **Nominal Pressure – 2000 PSI**
- **Standard Bore Sizes – 1-1/2" through 14"**
- **Piston Rod Diameters – 5/8" through 10"**

# The heavy-duty mill hydraulic cylinder with features only Parker can promise – and deliver!

Series MH cylinders keep on performing like you expect from Parker — millions of trouble-free cycles. Everything you need for reliable 2,000 psi performance:

- Chrome-plated, induction hardened piston rods.
- Heads retained with ASTM A-574 socket head cap screws.
- Floating cushions with float-check action and positive metal-to-metal seal.
- And every cylinder is individually tested before it leaves our plant.

## Certified Dimensions

Parker Cylinders guarantees that all cylinders ordered from this catalog will be built to dimensions shown. All dimensions are certified to be correct, and thus it is not necessary to request certified drawings.



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Des Plaines, IL USA
Milton, Ontario Canada

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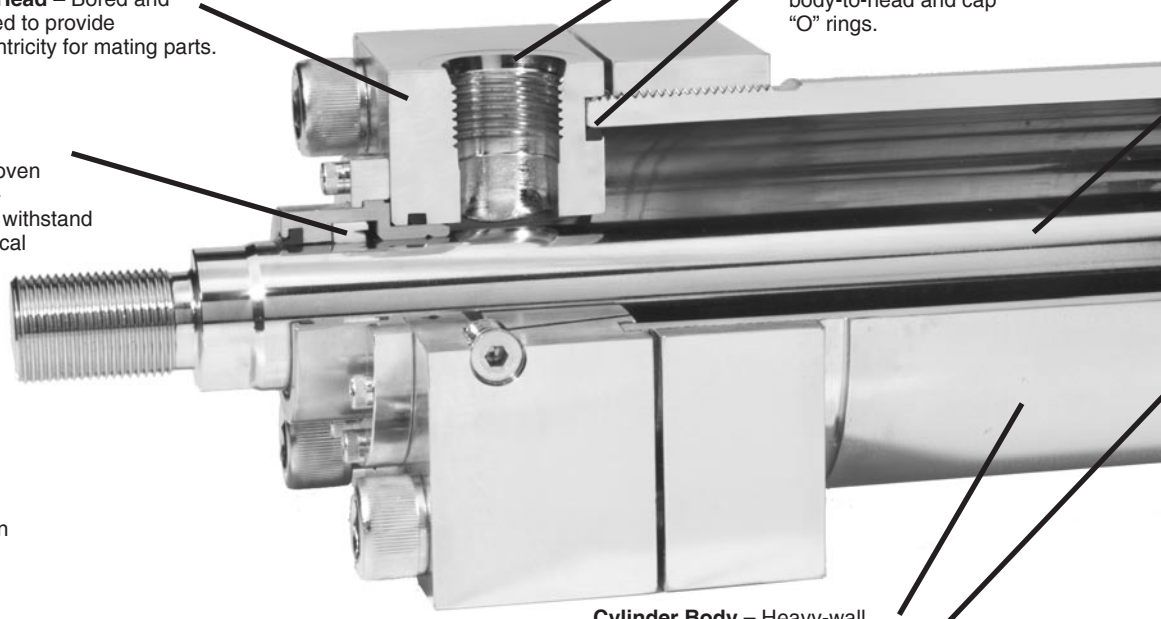
# The inside story on why Series MH is your best choice in heavy duty mill hydraulic cylinders



**Ports –** S.A.E. "O" ring ports are standard.

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

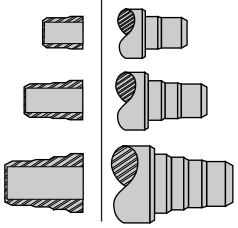
**Steel Head –** Bored and grooved to provide concentricity for mating parts.

**Primary Seal –** Unique enhanced polyurethane tri-lip rod seal is a proven leakproof design – completely self-compensating and self-relieving to withstand variations and conform to mechanical deflection that may occur.

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

**Stepped Cushions**

Sleeve Design | Spear Design



**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.

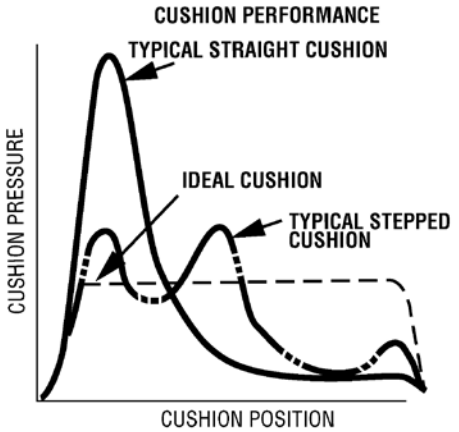
## Stepped floating cushions combine the best features of known cushion technology.

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. 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. Extensive research has found that both designs have their limitations.

As a result, we have taken a new approach in cushioning of industrial mill 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 areas 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 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 cushions are adjustable.

The Series MH 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.

(1) When a cushion is specified at the head end:

a. A self-centering stepped sleeve is furnished on the piston rod assembly.



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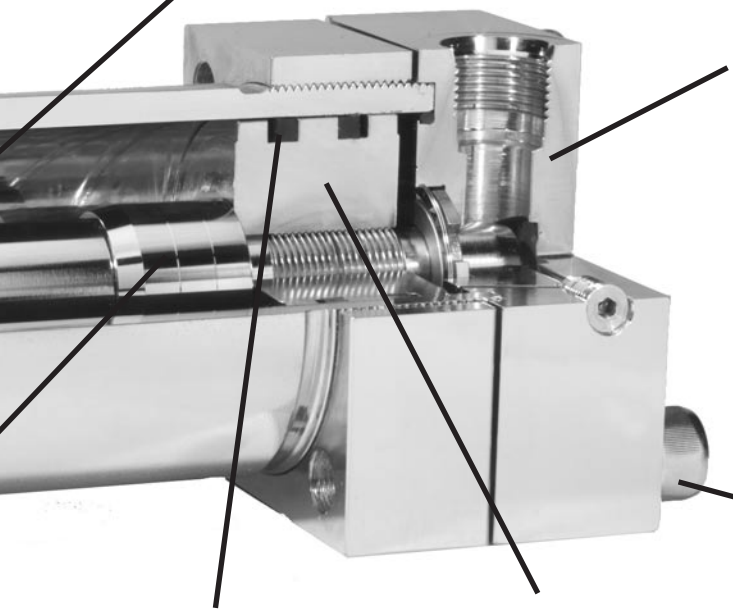
**Piston Rod –** Medium carbon steel, induction case-hardened to 54 $R_c$, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 90,000 to 100,000 psi minimum yield material in 5/8" through 4" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum material, depending on rod diameter. The piston thread equals the catalog style #1 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.



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

## Optional Ports

**Ports –** N.P.T.F. ports are optional at no extra charge. Oversize N.P.T.F. and S.A.E. ports are available at extra charge.

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

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

**Socket Head Cap Screws** Made from high alloy steel for added strength.

**Piston Seals –** Enhanced polyurethane PolyPak® seals are furnished as standard.

**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.

**Bolted Standard Rod Gland –** The rod gland is a unitized design that is piloted into the rod head and carries the unique enhanced polyurethane tri-lip rod seal. An extra-long inboard bearing surface insures lubrication from within the cylinder. A spiral groove on the bearing area helps eliminate drag pressure that can cause damage to the rod seal and provides positive lubrication for less wear.

**Parker Low Friction Rod Gland –** Parker's low friction rod gland provides the same unitized design as the standard rod gland with low friction seals. The filled PTFE seals in tandem with the wiperseal offer a virtual zero leak seal system with very low slip-stick and smooth operation up to 2000 psi. The spiral groove is also utilized from the standard rod gland.

**Cast Iron Piston Ring –** Optional at no extra charge.

**Low Friction Piston –** Optional at extra charge. Includes wear rings and 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. A filled PTFE seal designed for extrusion-free, low friction service and longer cylinder life than the standard piston.

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, JB and E.

c. On 5" bore and larger cylinders a springless check valve is provided that is also flush with the side of the head and is mounted opposite to the needle valve except on mounting style E, D and JJ, where it is mounted adjacent to the needle valve. It may be identified by the fact that it is slotted.

d. On 1½" - 4" bore cylinders, a slotted sleeve design is used in place of the check valve.

e. 1½" - 2" bore cylinders use a cartridge style needle valve. (See Figure A)

(2) When a cushion is specified at the cap end:

a. A cushion stepped spear is provided on the piston rod.

b. A "float check" self-centering bushing is provided on 1½" - 6" bore which incorporates a large flow check valve for fast "out-stroke" action. A springless ball check valve is provided from 7" - 14" bore cylinders.

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 E, D and HH. In these styles it is located on side number 3.

## Cushion Length

| Cyl. Bore In. | Rod Dia. In. | Cushion Length – Inch | |
|---|---|---|---|
| | | Head* | Cap |
| 1½ | 5/8 | 1 1/8 | 1 3/16 |
| | 1 | 1 1/8 | 1 3/16 |
| 2 | 1 | 1 1/8 | 1 1/8 |
| | 1 3/8 | 1 1/8 | 1 1/8 |
| 2½ | 1 | 1 1/8 | 1 1/8 |
| | 1 3/4 | 1 1/8 | 1 1/8 |
| 3¼ | 1 3/8 | 1 3/8 | 1 5/16 |
| | 2 | 1 1/16 | 1 5/16 |
| 4 | 1 3/4 | 1 3/8 | 1 1/4 |
| | 2½ | 1 1/16 | 1 1/4 |
| 5 | 2 | 1 1/16 | 1 1/8 |
| | 3½ | 1 1/16 | 1 1/8 |

| Cyl. Bore In. | Rod Dia. In. | Cushion Length – Inch | |
|---|---|---|---|
| | | Head* | Cap |
| 6 | 2½ | 1 5/16 | 1½ |
| | 4 | 1 5/16 | 1½ |
| 7 | 3 | 1 13/16 | 1 15/16 |
| | 5 | 1 11/16 | 1 15/16 |
| 8 | 3½ | 2 1/16 | 2 |
| | 5½ | 1 15/16 | 2 |

*Head end cushions for rod diameters not listed have cushion lengths with the limits shown.

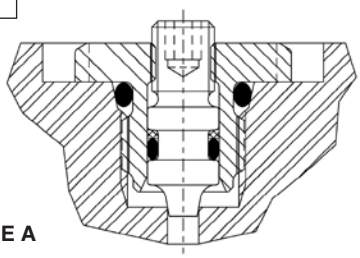


**FIGURE A**



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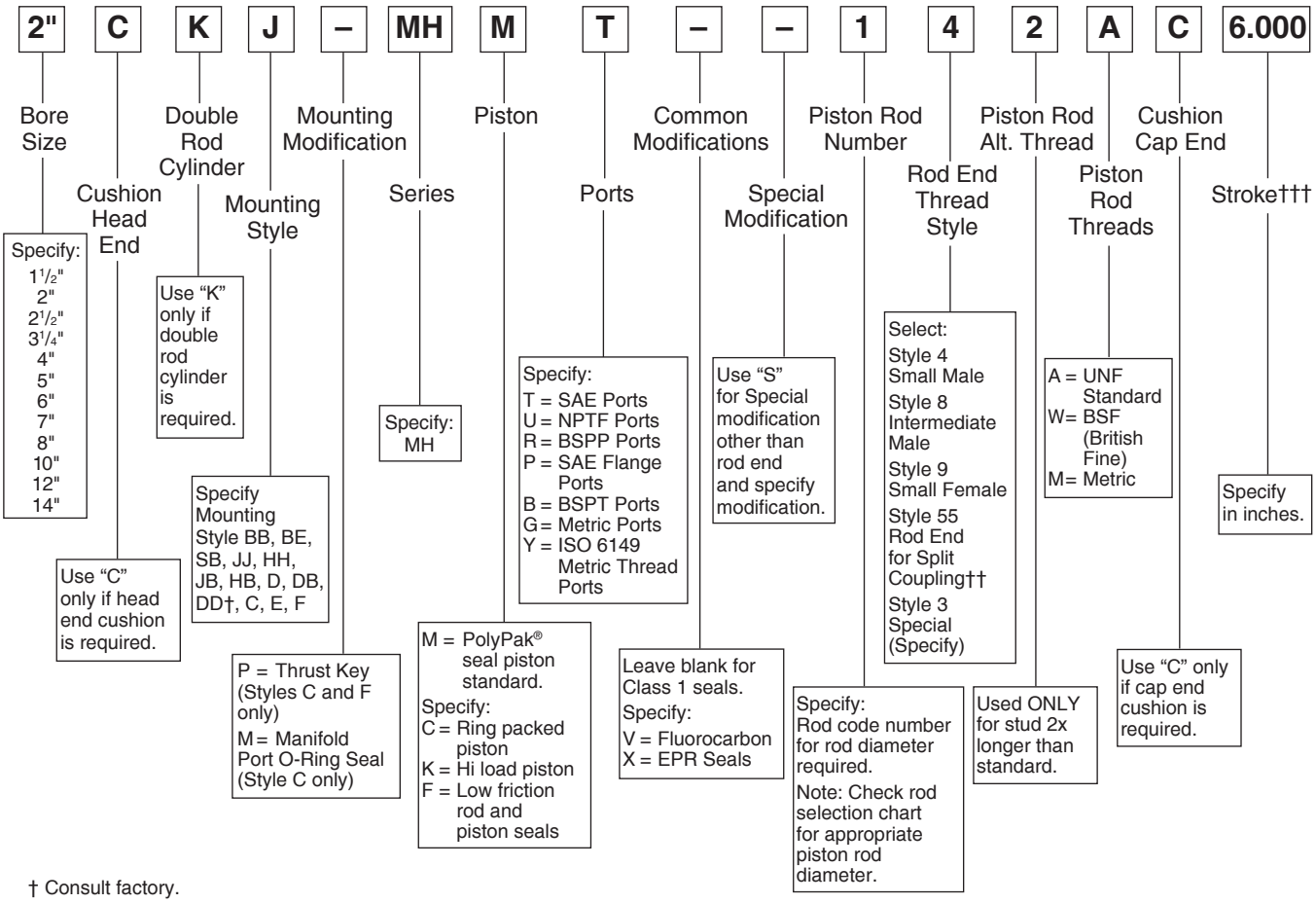
## How to Order Series MH Heavy Duty Mill Hydraulic Cylinders

### How to Order Code




† Consult factory.
†† For information regarding Style 55 Rod Ends, see page 26.
††† In case of Stop Tube, call out gross stroke length (net stroke + stop tube length).

Note: Duplicate cylinders can be ordered by giving the serial number from the rod end head of the original cylinder. Factory records will supply a quick and positive identification. Additional data is required on orders for cylinders with special modifications. For further information, consult factory.



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## Standard Specifications

- Heavy Duty Service – ANSI / (NFPA) T3.6.7R2-1996 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Mill Design
- Nominal Pressure – 2000 P.S.I.*
- Bore Sizes – 1½" through 14" (Larger sizes available)
- Mounting Styles – 14 standard styles at various application ratings
- Piston Rod Diameter – ⅝" through 10"
- Rod Ends – Five Standard Choices – Specials to Order
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10° F to +165° F

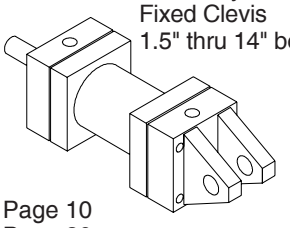
*If hydraulic operating pressure exceeds 2000 P.S.I., send application data for engineering evaluation and recommendation.

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

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

## Mounting Styles

**Style BB**
NFPA Style MP1
Fixed Clevis
1.5" thru 14" bore



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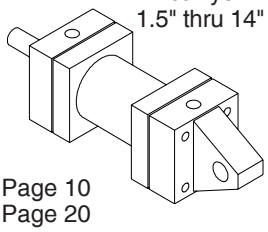
**Style BE**
NFPA Style MP3
Pivot Eye
1.5" thru 14" bore



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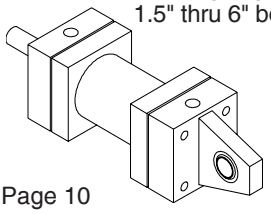
**Style SB**
NFPA Style MPU3
Self-Aligning Eye
1.5" thru 6" bore



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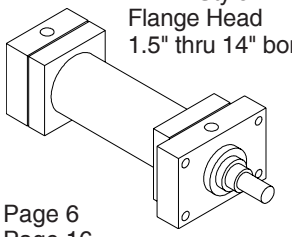
**Style JJ**
NFPA Style ME5
Flange Head
1.5" thru 14" bore



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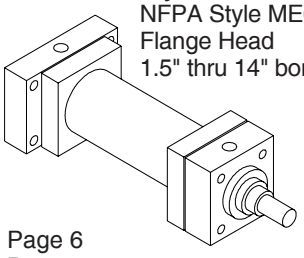
**Style HH**
NFPA Style ME6
Flange Head
1.5" thru 14" bore



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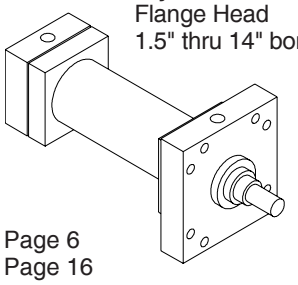
**Style JB**
Flange Head
1.5" thru 14" bore



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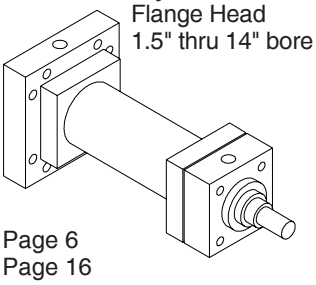
**Style HB**
Flange Head
1.5" thru 14" bore



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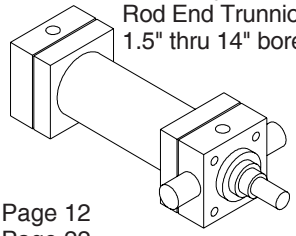
**Style D**
NFPA Style MT1
Rod End Trunnion
1.5" thru 14" bore



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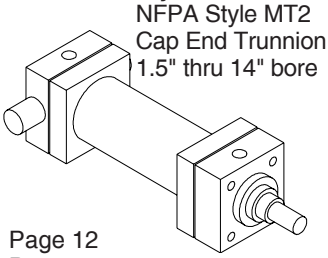
**Style DB**
NFPA Style MT2
Cap End Trunnion
1.5" thru 14" bore



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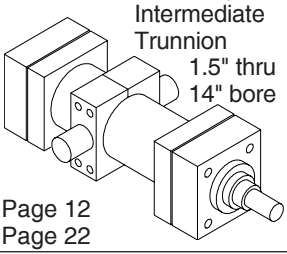
**Style DD**
NFPA Style MT4
Intermediate Trunnion
1.5" thru 14" bore



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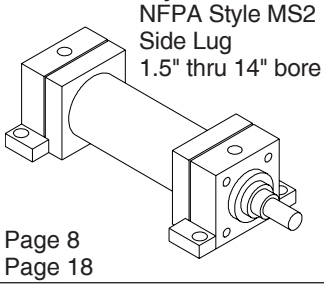
**Style C**
NFPA Style MS2
Side Lug
1.5" thru 14" bore



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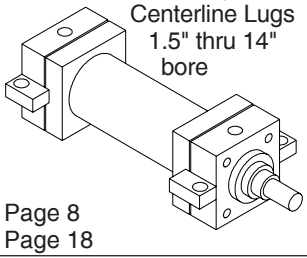
**Style E**
NFPA Style MS3
Centerline Lugs
1.5" thru 14" bore



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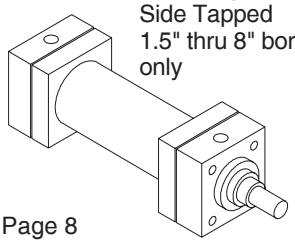
**Style F**
NFPA Style MS4
Side Tapped
1.5" thru 8" bore only



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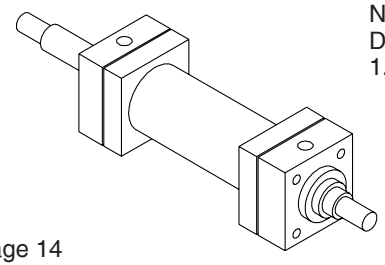
**Style KTB**
NFPA Style MD
Double Rod Cylinder
1.5" thru 14" bore only



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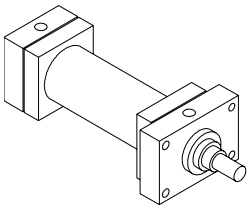
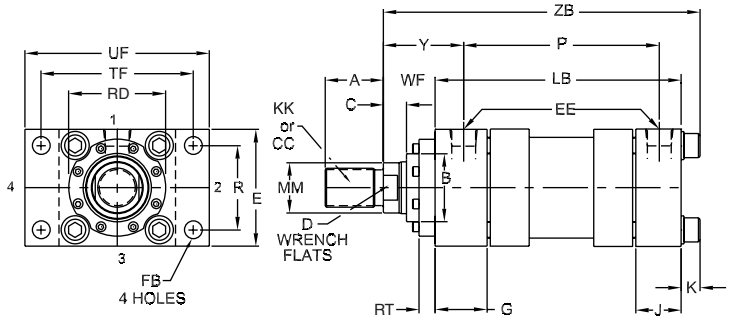
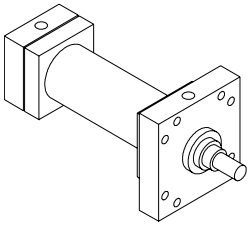
## Rod Head Flange and Cap Head Flange Mounting Styles

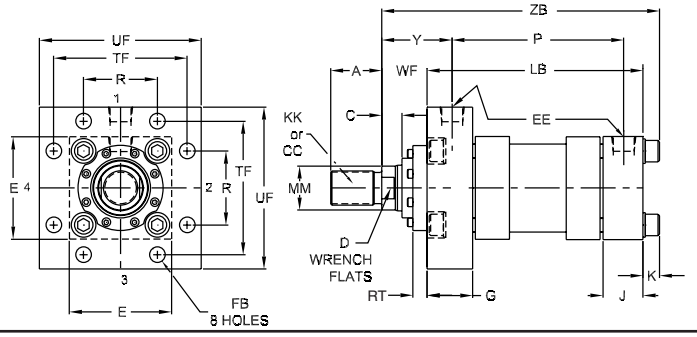
### Rod Head Flange
### Style JJ
NFPA Style ME5
1.5" thru 8" Bore



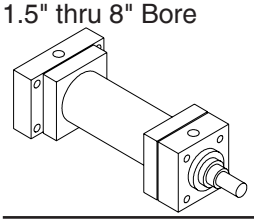


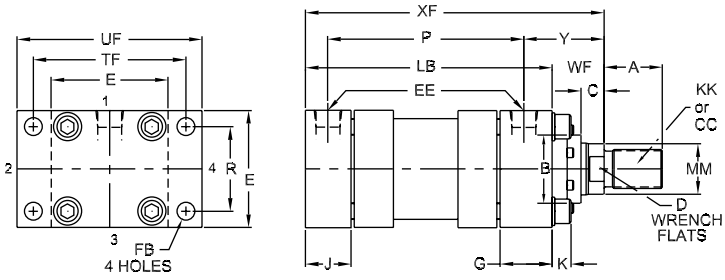

### Rod Head Flange
### Style JB
1.5" thru 8" Bore



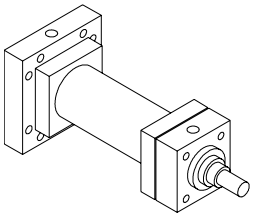


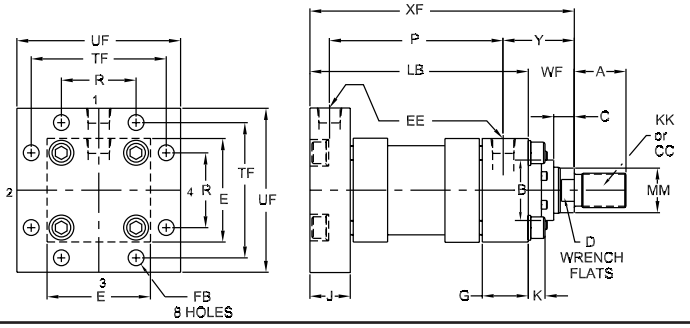

### Cap Head Flange
### Style HH
NFPA Style ME6
1.5" thru 8" Bore





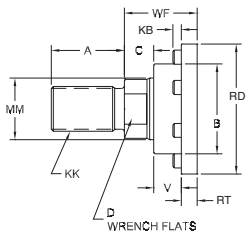

### Cap Head Flange
### Style HB
1.5" thru 8" Bore



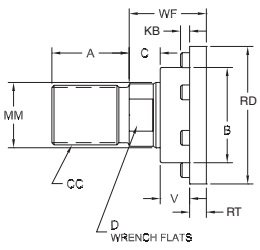



### Rod End Dimensions

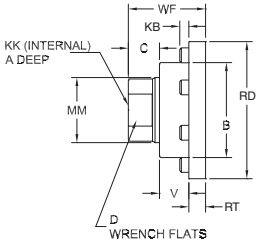
**Style 4**
Standard Male Thread



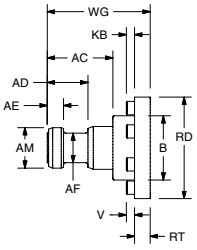

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



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## Envelope and Mounting Dimensions

| BORE | E | EE | | FB | G | J | K | R | TF | UF | Add Stroke | | Minimum Stroke |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SAE | NPTF | | | | | | | | LB | P | |
| 1 1/2 | 2 1/2 | #8 | 1/2 | 7/16 | 1 3/4 | 1 1/2 | .38 | 1.63 | 3 7/16 | 4 1/4 | 4 5/8 | 2 7/8 | 1.63 |
| 2 | 3 | #8 | 1/2 | 9/16 | 1 3/4 | 1 1/2 | .50 | 2.05 | 4 1/8 | 5 1/8 | 4 5/8 | 2 7/8 | 1.63 |
| 2 1/2 | 3 1/2 | #8 | 1/2 | 9/16 | 1 3/4 | 1 1/2 | .50 | 2.55 | 4 5/8 | 5 5/8 | 4 3/4 | 3 | 1.50 |
| 3 1/4 | 4 1/2 | #12 | 3/4 | 11/16 | 2 | 1 3/4 | .63 | 3.25 | 5 7/8 | 7 1/8 | 5 1/2 | 3 1/2 | 1.75 |
| 4 | 5 | #12 | 3/4 | 11/16 | 2 | 1 3/4 | .63 | 3.82 | 6 3/8 | 7 5/8 | 5 3/4 | 3 3/4 | 1.50 |
| 5 | 6 1/2 | #12 | 3/4 | 15/16 | 2 | 1 3/4 | .88 | 4.95 | 8 3/16 | 9 3/4 | 6 1/4 | 4 1/4 | 1.50 |
| 6 | 7 1/2 | #16 | 1 | 1 1/16 | 2 1/4 | 2 1/4 | 1.00 | 5.73 | 9 7/16 | 11 1/4 | 7 3/8 | 4 7/8 | 2.38 |
| 7 | 8 1/2 | #20 | 1 1/4 | 1 3/16 | 2 3/4 | 2 3/4 | 1.13 | 6.58 | 10 5/8 | 12 5/8 | 8 1/2 | 5 1/2 | 3.25 |
| 8 | 9 1/2 | #24 | 1 1/2 | 1 5/16 | 3 | 3 | 1.25 | 7.50 | 11 13/16 | 14 | 9 1/2 | 6 1/4 | 4.75 |

## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | D | RT | V | KB | WF | Y | Add Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | | | XF | ZB |
| | | | KK | CC | | | | | | | | | | | | |
| 1 1/2 | 1* | 5/8 | 7/16 - 20 | 1/2 - 20 | 3/4 | 1.124 | 1 15/16 | 3/8 | 1/2 | 3/8 | 1/4 | 3/16 | 1 | 2 | 5 5/8 | 6 1/8 |
| | 2 | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 6 | 6 1/2 |
| 2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 6 | 6 5/8 |
| | 2 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/8 | 6 1/4 | 6 7/8 |
| 2 1/2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 6 1/8 | 6 3/4 |
| | 3 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/8 | 6 3/8 | 7 |
| | 2 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 7/8 | 6 5/8 | 7 1/4 |
| 3 1/4 | 1* | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 3/4 | 7 1/8 | 7 7/8 |
| | 3 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 3 | 7 3/8 | 8 1/8 |
| | 2 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 7 1/2 | 8 1/4 |
| 4 | 1* | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 3 | 7 5/8 | 8 3/8 |
| | 3 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 7 3/4 | 8 1/2 |
| | 2 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 8 | 8 3/4 |
| 5 | 1* | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 8 1/4 | 9 1/4 |
| | 3 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 8 1/2 | 9 1/2 |
| | 4 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 8 1/2 | 9 1/2 |
| | 2 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 8 1/2 | 9 1/2 |
| 6 | 1* | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/2 | 9 5/8 | 10 3/4 |
| | 3 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/8 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 9 5/8 | 10 3/4 |
| | 4 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 9 5/8 | 10 3/4 |
| | 2 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 9 5/8 | 10 3/4 |
| 7 | 1* | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 10 3/4 | 12 |
| | 3 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 10 3/4 | 12 |
| | 4 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 10 3/4 | 12 |
| | 5 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 10 3/4 | 12 |
| | 2 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 10 3/4 | 12 |
| 8 | 1* | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 11 3/4 | 13 1/4 |
| | 3 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 11 3/4 | 13 1/4 |
| | 4 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 11 3/4 | 13 1/4 |
| | 5 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 11 3/4 | 13 1/4 |
| | 2 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 11 3/4 | 13 1/4 |

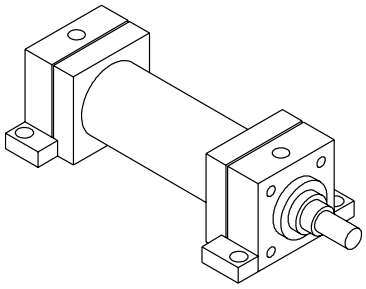
*Indicates standard rod for bore size.
†On 4 1/2" rods and above, (4) .515 dia. spanner wrench holes will be provided instead of wrench flats.

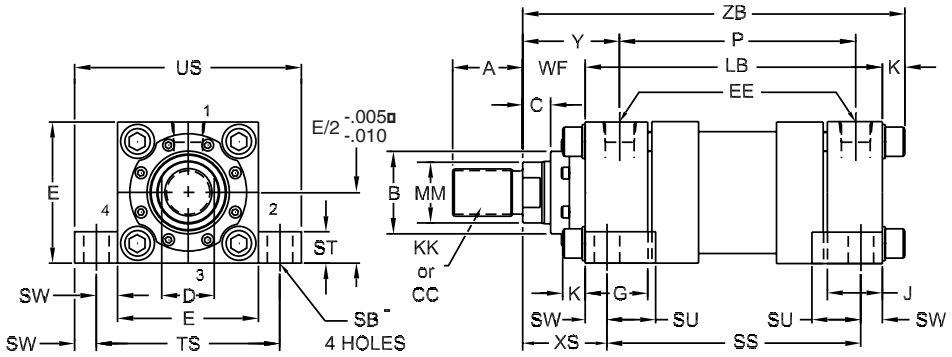


**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

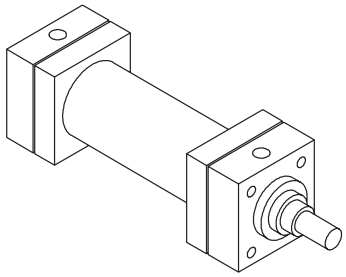
## Side Lug, Center Lug and Side Tapped Mounting Styles

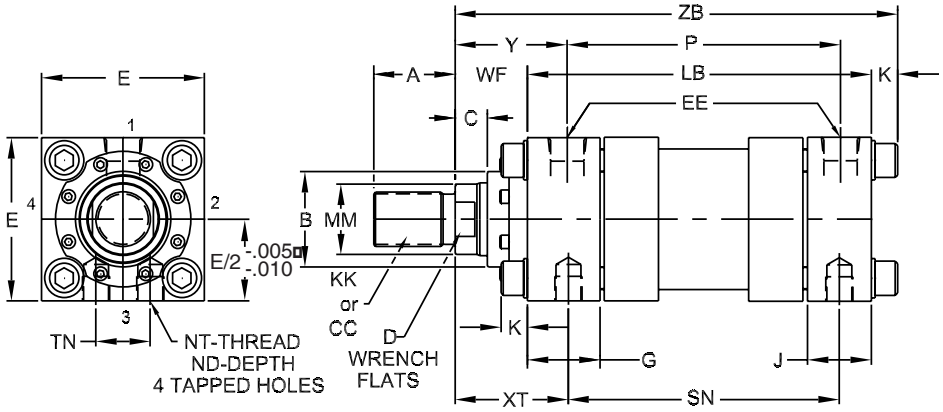
**Side Lug**
**Style C**
NFPA Style MS2
1.5" thru 8" Bore



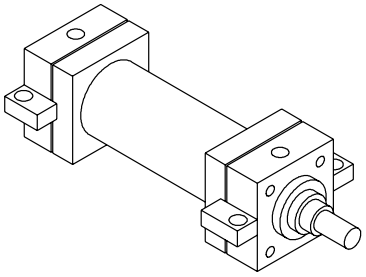


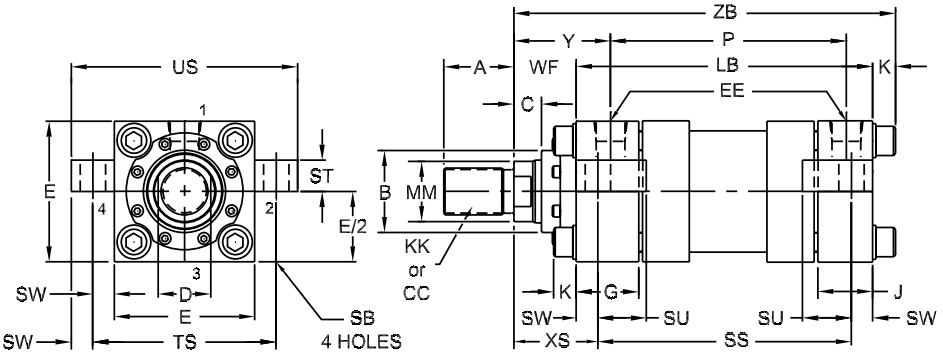

**Side Tapped**
**Style F**
NFPA Style MS4
1.5" thru 8" Bore





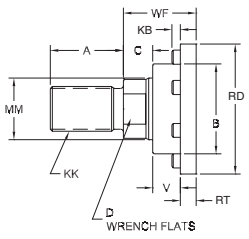

**Center Lug**
**Style E**
NFPA Style MS3
1.5" thru 8" Bore



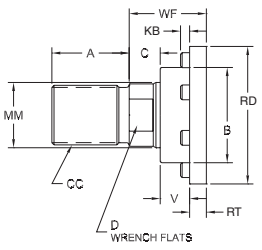



### Rod End Dimensions

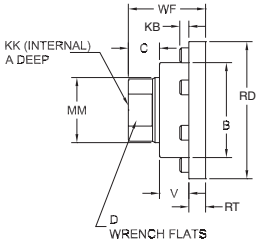
**Style 4**
Standard Male Thread



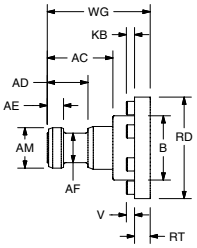

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | E | EE | | G | J | K | ND | NT | SB | ST | SU | SW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SAE | NPTF | | | | | | | | | |
| 1 1/2 | 2 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .38 | 3/8 | 3/8 - 16 | 7/16 | 1/2 | 15/16 | 3/8 |
| 2 | 3 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 7/16 | 1/2 - 13 | 9/16 | 3/4 | 1 1/4 | 1/2 |
| 2 1/2 | 3 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 1/2 | 5/8 - 11 | 13/16 | 1 | 1 9/16 | 11/16 |
| 3 1/4 | 4 1/2 | #12 | 3/4 | 2 | 1 3/4 | .63 | 11/16 | 3/4 - 10 | 13/16 | 1 | 1 9/16 | 11/16 |
| 4 | 5 | #12 | 3/4 | 2 | 1 3/4 | .63 | 11/16 | 1 - 8 | 1 1/16 | 1 1/4 | 2 | 7/8 |
| 5 | 6 1/2 | #12 | 3/4 | 2 | 1 3/4 | .88 | 1 | 1 - 8 | 1 1/16 | 1 1/4 | 2 | 7/8 |
| 6 | 7 1/2 | #16 | 1 | 2 1/4 | 2 1/4 | 1.00 | 1 1/4 | 1 1/4 - 7 | 1 5/16 | 1 1/2 | 2 1/2 | 1 1/8 |
| 7 | 8 1/2 | #20 | 1 1/4 | 2 3/4 | 2 3/4 | 1.13 | 1 1/8 | 1 1/2 - 6 | 1 9/16 | 1 3/4 | 2 7/8 | 1 3/8 |
| 8 | 9 1/2 | #24 | 1 1/2 | 3 | 3 | 1.25 | 1 1/2 | 1 1/2 - 6 | 1 9/16 | 1 3/4 | 2 7/8 | 1 3/8 |

## Envelope and Mounting Dimensions—Continued

| BORE | TN | TS | US | Add Stroke | | | | MIN STROKE |
|---|---|---|---|---|---|---|---|---|
| | | | | LB | P | SN | SS | |
| 1 1/2 | 3/4 | 3 1/4 | 4 | 4 5/8 | 2 7/8 | 2 7/8 | 3 7/8 | 1.63 |
| 2 | 15/16 | 4 | 5 | 4 5/8 | 2 7/8 | 2 7/8 | 3 5/8 | 1.63 |
| 2 1/2 | 1 5/16 | 4 7/8 | 6 1/4 | 4 3/4 | 3 | 3 | 3 3/8 | 1.50 |
| 3 1/4 | 1 1/2 | 5 7/8 | 7 1/4 | 5 1/2 | 3 1/2 | 3 1/2 | 4 1/8 | 1.75 |
| 4 | 2 1/16 | 6 3/4 | 8 1/2 | 5 3/4 | 3 3/4 | 3 3/4 | 4 | 1.50 |
| 5 | 2 15/16 | 8 1/4 | 10 | 6 1/4 | 4 1/4 | 4 1/4 | 4 1/2 | 1.50 |
| 6 | 3 5/16 | 9 3/4 | 12 | 7 3/8 | 4 7/8 | 5 1/8 | 5 1/8 | 2.38 |
| 7 | 3 3/4 | 11 1/4 | 14 | 8 1/2 | 5 1/2 | 5 7/8 | 5 3/4 | 3.25 |
| 8 | 4 1/4 | 12 1/4 | 15 | 9 1/2 | 6 1/4 | 6 5/8 | 6 3/4 | 4.75 |

## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | D | RT | V | KB | WF | XS | XT | Y | Add Stroke |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | | | | | ZB |
| | | | KK | CC | | | | | | | | | | | | | |
| 1 1/2 | 1* | 5/8 | 7/16 - 20 | 1/2 - 20 | 3/4 | 1.124 | 1 15/16 | 3/8 | 1/2 | 3/8 | 1/4 | 3/16 | 1 | 1 3/8 | 1 5/16 | 2 | 6 1/8 |
| | 2 | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 1 3/4 | 2 5/16 | 2 3/8 | 6 1/2 |
| 2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 1 7/8 | 2 5/16 | 2 3/8 | 6 5/8 |
| | 2 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 1/8 | 2 9/16 | 2 5/8 | 6 7/8 |
| 2 1/2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 1/16 | 2 5/16 | 2 3/8 | 6 3/4 |
| | 3 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/16 | 2 9/16 | 2 5/8 | 7 |
| | 2 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 9/16 | 2 13/16 | 2 7/8 | 7 1/4 |
| 3 1/4 | 1* | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/16 | 2 9/16 | 2 3/4 | 7 7/8 |
| | 3 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 9/16 | 2 13/16 | 3 | 8 1/8 |
| | 2 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 2 11/16 | 2 15/16 | 3 1/8 | 8 1/4 |
| 4 | 1* | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 3/4 | 2 15/16 | 3 | 8 3/8 |
| | 3 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 2 7/8 | 3 1/16 | 3 1/8 | 8 1/2 |
| | 2 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/8 | 3 5/16 | 3 3/8 | 8 3/4 |
| 5 | 1* | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 2 7/8 | 3 | 3 1/8 | 9 1/4 |
| | 3 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/8 | 3 1/4 | 3 3/8 | 9 1/2 |
| | 4 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/8 | 3 1/4 | 3 3/8 | 9 1/2 |
| | 2 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 1/8 | 3 1/4 | 3 3/8 | 9 1/2 |
| 6 | 1* | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 3 5/16 | 3 1/2 | 10 3/4 |
| | 3 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/8 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 5/16 | 3 1/2 | 10 3/4 |
| | 4 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 5/16 | 3 1/2 | 10 3/4 |
| | 2 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 5/16 | 3 1/2 | 10 3/4 |
| 7 | 1* | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 13/16 | 3 3/4 | 12 |
| | 3 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 13/16 | 3 3/4 | 12 |
| | 4 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 13/16 | 3 3/4 | 12 |
| | 5 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 13/16 | 3 3/4 | 12 |
| | 2 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 13/16 | 3 3/4 | 12 |
| 8 | 1* | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 15/16 | 3 7/8 | 13 1/4 |
| | 3 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 15/16 | 3 7/8 | 13 1/4 |
| | 4 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 15/16 | 3 7/8 | 13 1/4 |
| | 5 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 15/16 | 3 7/8 | 13 1/4 |
| | 2 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 15/16 | 3 7/8 | 13 1/4 |

*Indicates standard rod for bore size.

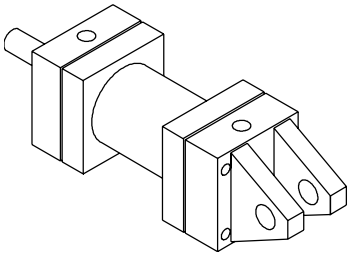
†On 4 1/2" rods and above, (4) .515 dia. spanner wrench holes will be provided instead of wrench flats.

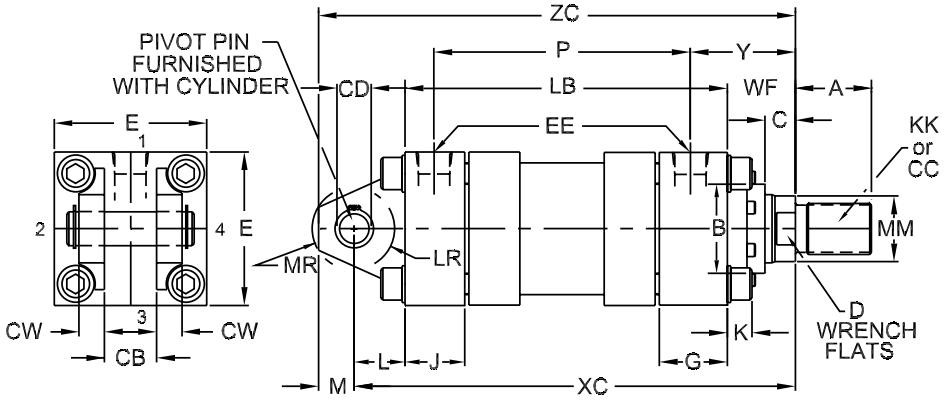


**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

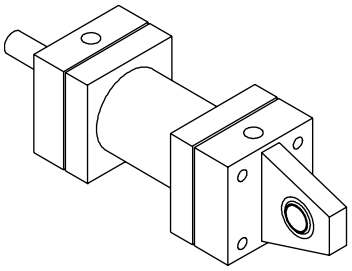
## Fixed Clevis, Pivot Eye and Self Aligning Eye Mounting Styles

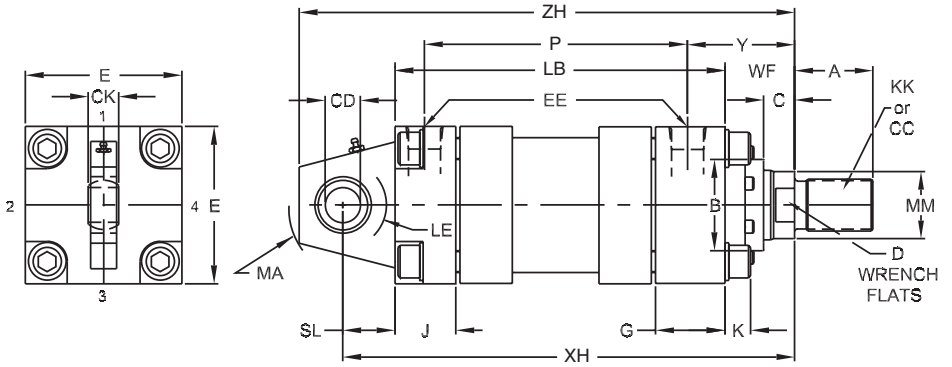
**Fixed Clevis**
**Style BB**
NFPA Style MP1
1.5" thru 8" Bore



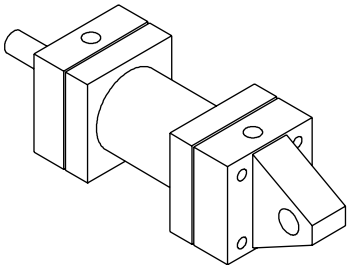


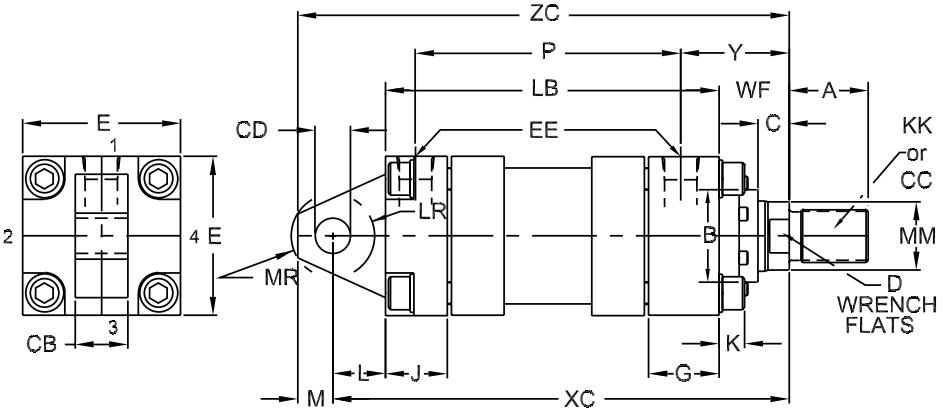

**Self Aligning Eye**
**Style SB**
NFPA Style MPU3
1.5" thru 6" Bore





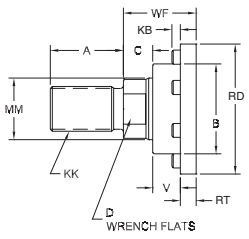

**Pivot Eye**
**Style BE**
NFPA Style MP3
1.5" thru 8" Bore



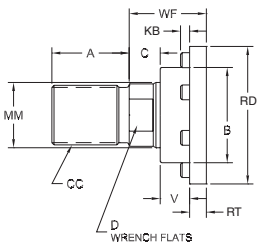



### Rod End Dimensions

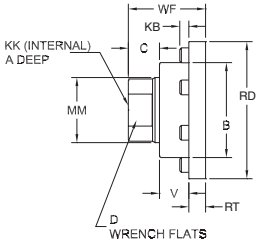
**Style 4**
Standard Male Thread



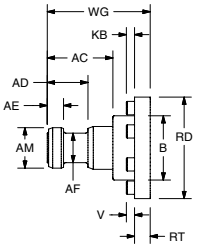

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | CB | CD | EX | CW | E | EE | | G | J | K | L | LE | LR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SAE | NPTF | | | | | | |
| 1 1/2 | 3/4 | 0.501 | 7/16 | 1/2 | 2 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .38 | 3/4 | 7/8 | 9/16 |
| 2 | 1 1/4 | 0.751 | 21/32 | 5/8 | 3 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 1 1/4 | 7/8 | 1 |
| 2 1/2 | 1 1/4 | 0.751 | 21/32 | 5/8 | 3 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 1 1/4 | 7/8 | 15/16 |
| 3 1/4 | 1 1/2 | 1.001 | 7/8 | 3/4 | 4 1/2 | #12 | 3/4 | 2 | 1 3/4 | .63 | 1 1/2 | 1 1/8 | 1 1/4 |
| 4 | 2 | 1.376 | 1 3/16 | 1 | 5 | #12 | 3/4 | 2 | 1 3/4 | .63 | 2 1/8 | 1 1/2 | 1 3/4 |
| 5 | 2 1/2 | 1.751 | 1 17/32 | 1 1/4 | 6 1/2 | #12 | 3/4 | 2 | 1 3/4 | .88 | 2 1/4 | 1 15/16 | 2 1/16 |
| 6 | 2 1/2 | 2.001 | 1 3/4 | 1 1/4 | 7 1/2 | #16 | 1 | 2 1/4 | 2 1/4 | 1.00 | 2 1/2 | 2 3/16 | 2 5/16 |
| 7 | 3 | 2.501 | — | 1 1/2 | 8 1/2 | #20 | 1 1/4 | 2 3/4 | 2 3/4 | 1.13 | 3 | — | 2 3/4 |
| 8 | 3 | 3.001 | — | 1 1/2 | 9 1/2 | #24 | 1 1/2 | 3 | 3 | 1.25 | 3 1/4 | — | 3 1/4 |

## Envelope and Mounting Dimensions—Continued

| BORE | M | MA | MR | SL | Add Stroke | | MIN STROKE |
|---|---|---|---|---|---|---|---|
| | | | | | LB | P | |
| 1 1/2 | 1/2 | 1 1/4 | 5/8 | 3/4 | 4 5/8 | 2 7/8 | 1.63 |
| 2 | 3/4 | 1 1/4 | 15/16 | 1 1/4 | 4 5/8 | 2 7/8 | 1.63 |
| 2 1/2 | 3/4 | 1 1/4 | 15/16 | 1 1/4 | 4 3/4 | 3 | 1.50 |
| 3 1/4 | 1 | 1 1/2 | 1 3/16 | 1 1/2 | 5 1/2 | 3 1/2 | 1.75 |
| 4 | 1 3/8 | 1 3/4 | 1 5/8 | 2 1/8 | 5 3/4 | 3 3/4 | 1.50 |
| 5 | 1 3/4 | 2 1/4 | 2 1/8 | 2 1/4 | 6 1/4 | 4 1/4 | 1.50 |
| 6 | 2 | 2 3/4 | 2 3/8 | 2 1/2 | 7 3/8 | 4 7/8 | 2.38 |
| 7 | 2 1/2 | — | 2 7/8 | — | 8 1/2 | 5 1/2 | 3.25 |
| 8 | 2 3/4 | — | 3 1/8 | — | 9 1/2 | 6 1/4 | 4.75 |

## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread** | | A | B | RD | C | D | RT | V | KB | WF | Y | Add Stroke | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | | | XC | XH | ZC | ZH |
| | | | KK | CC | | | | | | | | | | | | | | |
| 1 1/2 | 1* | 5/8 | 7/16 - 20 | 1/2 - 20 | 3/4 | 1.124 | 1 15/16 | 3/8 | 1/2 | 3/8 | 1/4 | 3/16 | 1 | 2 | 6 3/8 | 6 3/8 | 6 7/8 | 7 1/8 |
| | 2 | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 6 3/4 | 6 3/4 | 7 1/4 | 7 1/2 |
| 2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 7 1/4 | 7 1/4 | 8 | 8 1/4 |
| | 2 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/8 | 7 1/2 | 7 1/2 | 8 1/4 | 8 1/2 |
| 2 1/2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 3/8 | 7 3/8 | 7 3/8 | 8 1/8 | 8 3/8 |
| | 3 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/8 | 7 5/8 | 7 5/8 | 8 3/8 | 8 5/8 |
| | 2 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 7/8 | 7 7/8 | 7 7/8 | 8 5/8 | 8 7/8 |
| 3 1/4 | 1* | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 3/4 | 8 5/8 | 8 5/8 | 9 5/8 | 9 7/8 |
| | 3 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 3 | 8 7/8 | 8 7/8 | 9 7/8 | 10 1/8 |
| | 2 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 9 | 9 | 10 | 10 1/4 |
| 4 | 1* | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 3 | 9 3/4 | 9 3/4 | 11 1/8 | 11 5/8 |
| | 3 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 9 7/8 | 9 7/8 | 11 1/4 | 11 3/4 |
| | 2 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 10 1/8 | 10 1/8 | 11 1/2 | 12 |
| 5 | 1* | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 1/8 | 10 1/2 | 10 1/2 | 12 1/8 | 13 |
| | 3 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 10 3/4 | 10 3/4 | 12 1/2 | 13 1/4 |
| | 4 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 10 3/4 | 10 3/4 | 12 1/2 | 13 1/4 |
| | 2 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 10 3/4 | 10 3/4 | 12 1/2 | 13 1/4 |
| 6 | 1* | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/2 | 12 1/8 | 12 1/8 | 14 1/8 | 14 5/8 |
| | 3 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/8 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 12 1/8 | 12 1/8 | 14 1/8 | 14 5/8 |
| | 4 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 12 1/8 | 12 1/8 | 14 1/8 | 14 5/8 |
| | 2 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/2 | 12 1/8 | 12 1/8 | 14 1/8 | 14 5/8 |
| 7 | 1* | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 13 3/4 | — | 16 1/4 | — |
| | 3 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 13 3/4 | — | 16 1/4 | — |
| | 4 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 13 3/4 | — | 16 1/4 | — |
| | 5 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 13 3/4 | — | 16 1/4 | — |
| | 2 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 13 3/4 | — | 16 1/4 | — |
| 8 | 1* | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 15 | — | 17 3/4 | — |
| | 3 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 15 | — | 17 3/4 | — |
| | 4 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 15 | — | 17 3/4 | — |
| | 5 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 15 | — | 17 3/4 | — |
| | 2 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 7/8 | 15 | — | 17 3/4 | — |

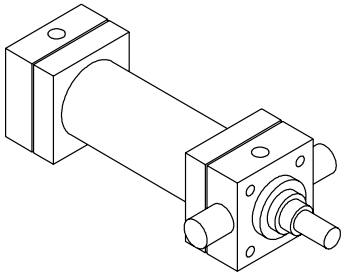
*Indicates standard rod for bore size.
†On 4 1/2" rods and above, (4) .515 dia. spanner wrench holes will be provided instead of wrench flats.
**Please specify the appropriate female KK, A, and WF dimension when a spherical rod eye accessory is purchased.

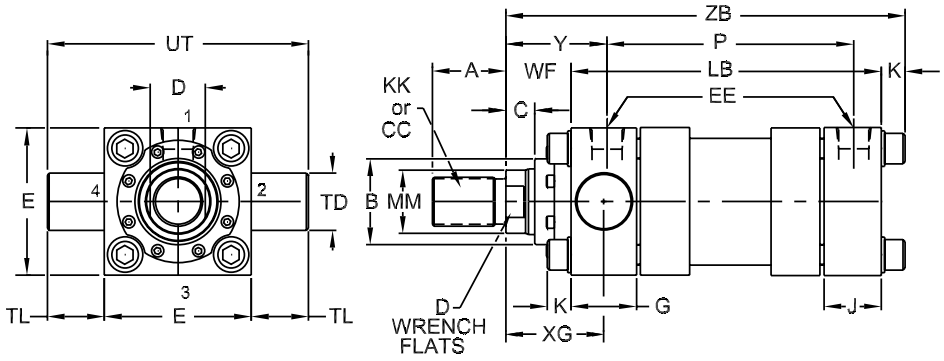


**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

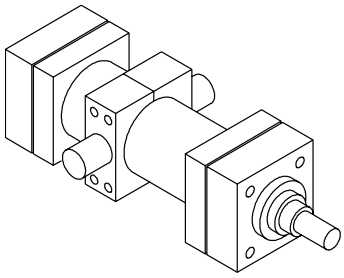
## Trunnion Mounting Styles

**Rod End Trunnion**
**Style D**
NFPA Style MT1
1.5" thru 8" Bore



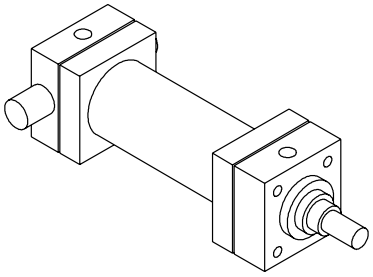


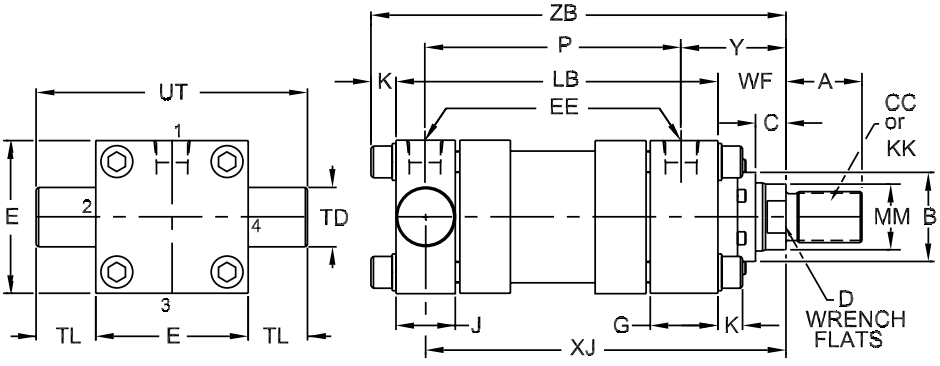

**Intermediate Trunnion**
**Style DD**
NFPA Style MT4
1.5" thru 8" Bore



For all intermediate trunnion applications, please consult factory for appropriate design and dimensions.

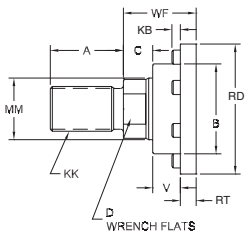
**Cap End Trunnion**
**Style DB**
NFPA Style MT2
1.5" thru 8" Bore



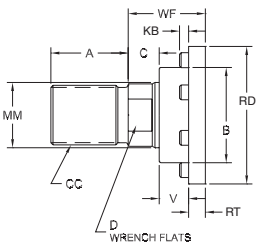



### Rod End Dimensions

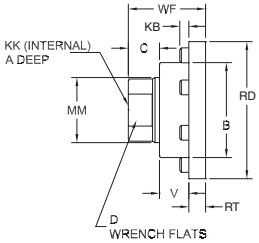
**Style 4**
Standard Male Thread



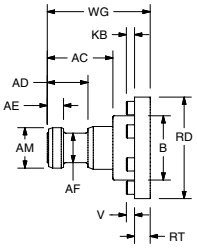

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | BD | E | EE | | G | J | K | TD | TL | UT |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SAE | NPTF | | | | | | |
| 1 1/2 | 1 1/4 | 2 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .38 | 1.000 | 1 | 4 1/2 |
| 2 | 1 1/2 | 3 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 1.375 | 1 3/8 | 5 3/4 |
| 2 1/2 | 1 1/2 | 3 1/2 | #8 | 1/2 | 1 3/4 | 1 1/2 | .50 | 1.375 | 1 3/8 | 6 1/4 |
| 3 1/4 | 2 | 4 1/2 | #12 | 3/4 | 2 | 1 3/4 | .63 | 1.750 | 1 3/4 | 8 |
| 4 | 2 | 5 | #12 | 3/4 | 2 | 1 3/4 | .63 | 1.750 | 1 3/4 | 8 1/2 |
| 5 | 2 | 6 1/2 | #12 | 3/4 | 2 | 1 3/4 | .88 | 1.750 | 1 3/4 | 10 |
| 6 | 3 | 7 1/2 | #16 | 1 | 2 1/4 | 2 1/4 | 1.00 | 2.000 | 2 | 11 1/2 |
| 7 | 3 | 8 1/2 | #20 | 1 1/4 | 2 3/4 | 2 3/4 | 1.13 | 2.500 | 2 1/2 | 13 1/2 |
| 8 | 3 1/2 | 9 1/2 | #24 | 1 1/2 | 3 | 3 | 1.25 | 3.000 | 3 | 15 1/2 |

## Envelope and Mounting Dimensions—Continued

| BORE | Add Stroke | | Minimum Stroke D & DB |
|---|---|---|---|
| | LB | P | |
| 1 1/2 | 4 5/8 | 2 7/8 | 1.63 |
| 2 | 4 5/8 | 2 7/8 | 1.63 |
| 2 1/2 | 4 3/4 | 3 | 1.50 |
| 3 1/4 | 5 1/2 | 3 1/2 | 1.75 |
| 4 | 5 3/4 | 3 3/4 | 1.50 |
| 5 | 6 1/4 | 4 1/4 | 1.50 |
| 6 | 7 3/8 | 4 7/8 | 2.38 |
| 7 | 8 1/2 | 5 1/2 | 3.25 |
| 8 | 9 1/2 | 6 1/4 | 4.75 |

## Dimensions Affected by Rod Size

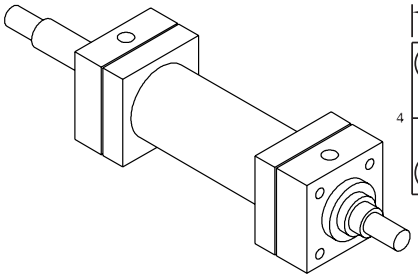
| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | D | RT | V | KB | WF | XG | Y | Add Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | | | | XJ | ZB |
| | | | KK | CC | | | | | | | | | | | | | |
| 1 1/2 | 1* | 5/8 | 7/16 - 20 | 1/2 - 20 | 3/4 | 1.124 | 1 15/16 | 3/8 | 1/2 | 3/8 | 1/4 | 3/16 | 1 | 1 7/8 | 2 | 4 7/8 | 6 1/8 |
| | 2 | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 1/4 | 2 3/8 | 5 1/4 | 6 1/2 |
| 2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 1/4 | 2 3/8 | 5 1/4 | 6 5/8 |
| | 2 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 1/2 | 2 5/8 | 5 1/2 | 6 7/8 |
| 2 1/2 | 1* | 1 | 3/4 - 16 | 7/8 - 14 | 1 1/8 | 1.499 | 2 3/8 | 1/2 | 7/8 | 3/8 | 1/2 | 3/16 | 1 3/8 | 2 1/4 | 2 3/8 | 5 3/8 | 6 3/4 |
| | 3 | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 1/2 | 2 5/8 | 5 5/8 | 7 |
| | 2 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 3/4 | 2 7/8 | 5 7/8 | 7 1/4 |
| 3 1/4 | 1* | 1 3/8 | 1 - 14 | 1 1/4 - 12 | 1 5/8 | 1.999 | 2 7/8 | 5/8 | 1 1/8 | 3/8 | 5/8 | 3/16 | 1 5/8 | 2 5/8 | 2 3/4 | 6 1/4 | 7 7/8 |
| | 3 | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 7/8 | 3 | 6 1/2 | 8 1/8 |
| | 2 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 | 3 1/8 | 6 5/8 | 8 1/4 |
| 4 | 1* | 1 3/4 | 1 1/4 - 12 | 1 1/2 - 12 | 2 | 2.374 | 3 1/2 | 3/4 | 1 1/2 | 5/8 | 1/2 | 3/16 | 1 7/8 | 2 7/8 | 3 | 6 3/4 | 8 3/8 |
| | 3 | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 | 3 1/8 | 6 7/8 | 8 1/2 |
| | 2 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/4 | 3 3/8 | 7 1/8 | 8 3/4 |
| 5 | 1* | 2 | 1 1/2 - 12 | 1 3/4 - 12 | 2 1/4 | 2.624 | 3 3/4 | 7/8 | 1 11/16 | 5/8 | 1/2 | 1/4 | 2 | 3 | 3 1/8 | 7 3/8 | 9 1/4 |
| | 3 | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 1/4 | 3 3/8 | 7 5/8 | 9 1/2 |
| | 4 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 1/4 | 3 3/8 | 7 5/8 | 9 1/2 |
| | 2 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 1/4 | 3 3/8 | 7 5/8 | 9 1/2 |
| 6 | 1* | 2 1/2 | 1 7/8 - 12 | 2 1/4 - 12 | 3 | 3.124 | 4 1/4 | 1 | 2 1/16 | 5/8 | 5/8 | 1/4 | 2 1/4 | 3 3/8 | 3 1/2 | 8 3/8 | 10 3/4 |
| | 3 | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/8 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 1/2 | 8 3/8 | 10 3/4 |
| | 4 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 1/2 | 8 3/8 | 10 3/4 |
| | 2 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/8 | 3 1/2 | 8 3/8 | 10 3/4 |
| 7 | 1* | 3 | 2 1/4 - 12 | 2 3/4 - 12 | 3 1/2 | 3.749 | 5 7/16 | 1 | 2 5/8 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 3/4 | 9 3/8 | 12 |
| | 3 | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 3/4 | 9 3/8 | 12 |
| | 4 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 3/4 | 9 3/8 | 12 |
| | 5 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 3/4 | 9 3/8 | 12 |
| | 2 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 5/8 | 3 3/4 | 9 3/8 | 12 |
| 8 | 1* | 3 1/2 | 2 1/2 - 12 | 3 1/4 - 12 | 3 1/2 | 4.249 | 5 15/16 | 1 | 3 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 3 7/8 | 10 1/4 | 13 1/4 |
| | 3 | 4 | 3 - 12 | 3 3/4 - 12 | 4 | 4.749 | 6 5/16 | 1 | 3 3/8 | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 3 7/8 | 10 1/4 | 13 1/4 |
| | 4 | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 3 7/8 | 10 1/4 | 13 1/4 |
| | 5 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 3 7/8 | 10 1/4 | 13 1/4 |
| | 2 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | † | 15/16 | 5/16 | — | 2 1/4 | 3 3/4 | 3 7/8 | 10 1/4 | 13 1/4 |

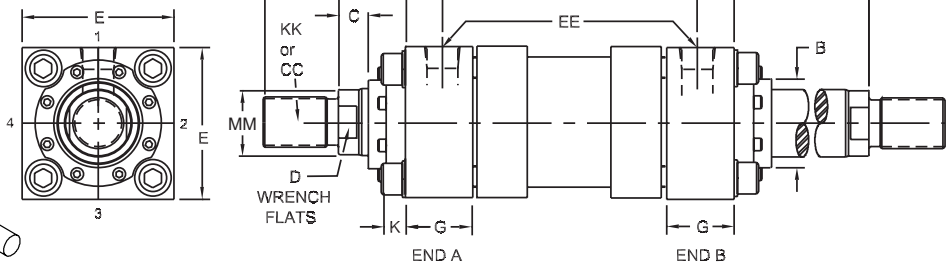
*Indicates standard rod for bore size.
†On 4 1/2" rods and above, (4) .515 dia. spanner wrench holes will be provided instead of wrench flats.



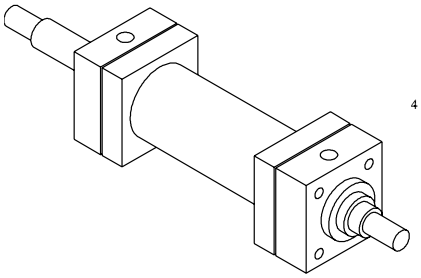
**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

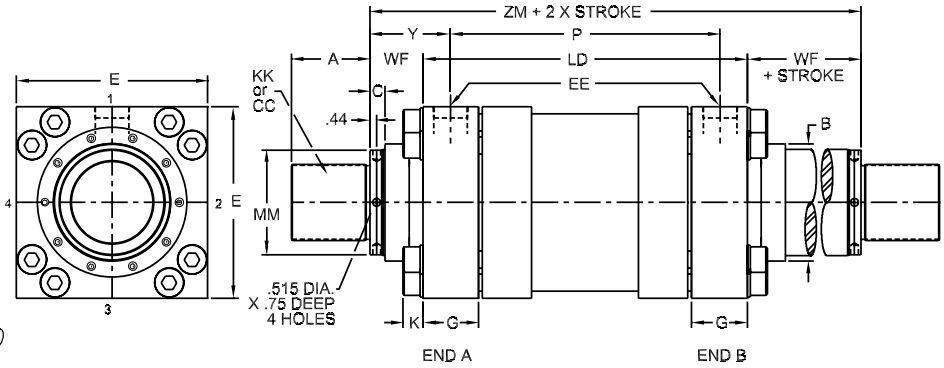
**Double Rod End Mount**
**Style KTB**
NFPA Style MD
1.5" thru 8" Bore





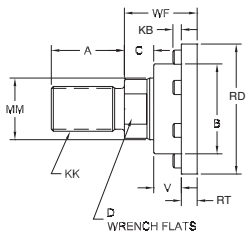

**Double Rod End Mount**
**Style KTB**
NFPA Style MD
10" thru 14" Bore



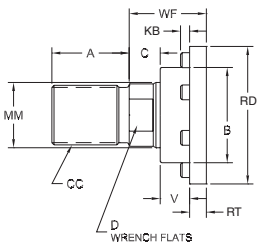



## Rod End Dimensions

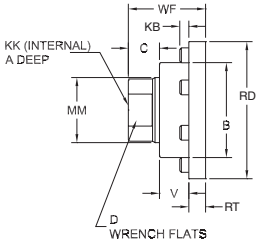
**Style 4**
Standard Male Thread



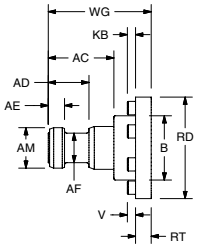

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## How to Use Double Rod Cylinder Dimensioned 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. After selecting necessary dimensions from that drawing, return to this page and supplement the single rod dimensions with those shown on drawing at left and dimension table below. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replaces LB, etc. 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.

**Basic Dimensions for Small Rod Size**

| Bore | LD | SN | SS | ZM |
|---|---|---|---|---|
| 1 1/2 | 4 7/8 | 2 7/8 | 4 1/8 | 6 7/8 |
| 2 | 4 7/8 | 2 7/8 | 3 7/8 | 7 5/8 |
| 2 1/2 | 5 | 3 | 3 5/8 | 7 3/4 |
| 3 1/4 | 5 3/4 | 3 1/2 | 4 3/8 | 9 |
| 4 | 6 | 4 | 4 1/4 | 9 3/4 |
| 5 | 6 1/2 | 4 1/4 | 4 3/4 | 10 1/2 |
| 6 | 7 3/8 | 4 7/8 | 5 1/8 | 11 7/8 |
| 7 | 8 1/2 | 5 3/8 | 5 3/4 | 13 |
| 8 | 9 1/2 | 6 1/8 | 6 3/4 | 14 |
| 10 | * | | | 18 |
| 12 | | | | 20 7/8 |
| 14 | | | | 20 5/8 |

*Envelope dimensions for 10-14" sizes do not change from single rod end style.

Mountings available in double rod end style: JJ, JB, E, F, C, D and DD.



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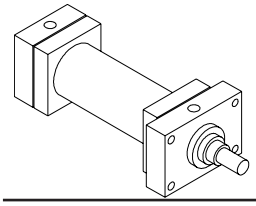
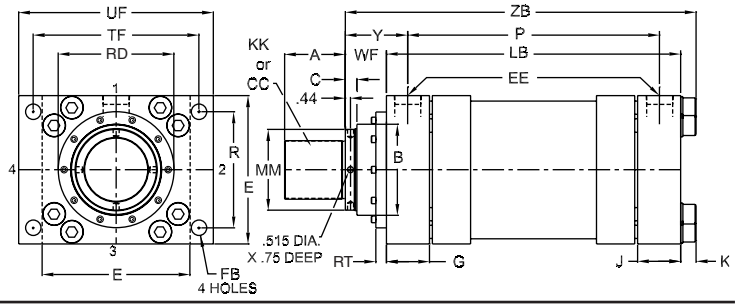
Milton, Ontario Canada

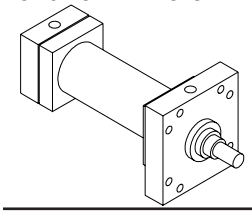
## Rod Head Flange and Cap Head Flange Mounting Styles

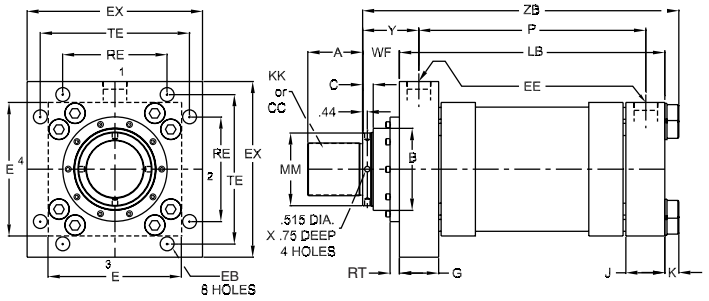
**Rod Head Flange**
**Style JJ**
NFPA Style ME5
10" thru 14" Bore



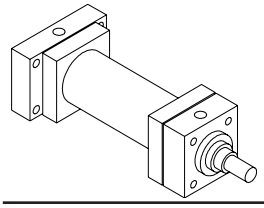


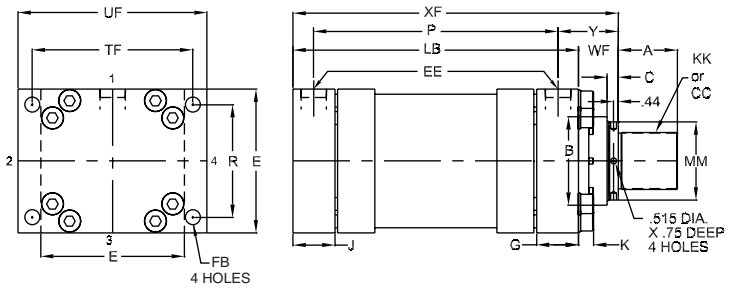

**Rod Head Flange**
**Style JB**
NFPA Style MF5
10" thru 14" Bore



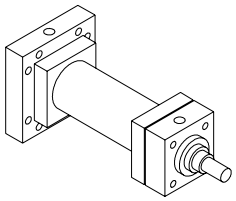


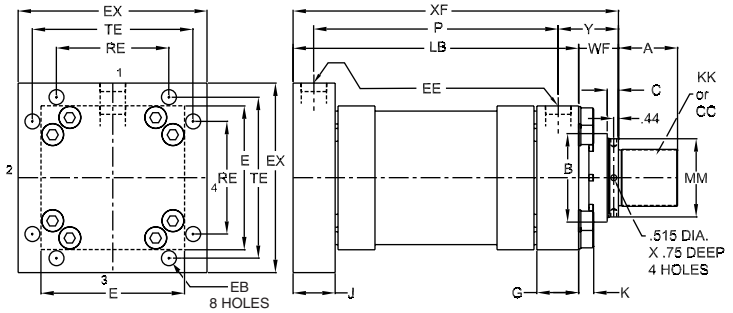

**Cap Head Flange**
**Style HH**
NFPA Style ME6
10" thru 14" Bore





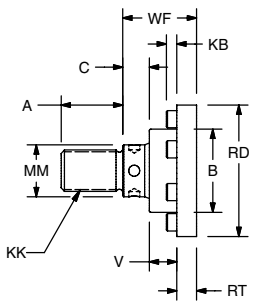

**Cap Head Flange**
**Style HB**
NFPA Style MF6
10" thru 14" Bore



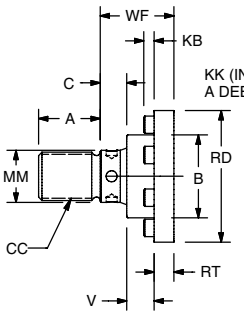



### Rod End Dimensions

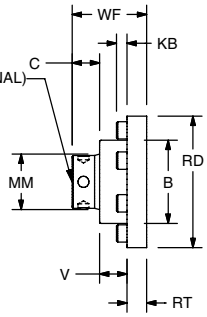
**Style 4**
Standard Male Thread



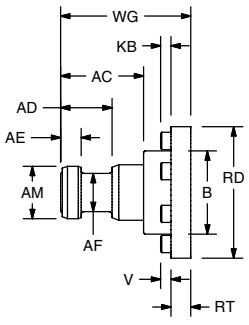

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



**Parker Hannifin Corporation**
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Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | E | EB | EE | | FB | G | J | K | R | TF | UF |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SAE | NPTF | | | | | | | |
| 10 | 12 5/8 | 1 5/16 | #24 | 2 | 1 13/16 | 3 11/16 | 3 11/16 | 1.13 | 9.62 | 15.88 | 19 |
| 12 | 14 7/8 | 1 9/16 | #24 | 2 1/2 | 2 1/16 | 4 7/16 | 4 7/16 | 1.25 | 11.45 | 18.50 | 22 |
| 14 | 17 1/8 | 1 4/5 | #24 | 2 1/2 | 2 5/16 | 4 7/8 | 4 7/8 | 1.25 | 13.26 | 21.00 | 25 |

## Envelope and Mounting Dimensions—Continued

| BORE | EX | RE | TE | ADD STROKE | | MIN STROKE |
|---|---|---|---|---|---|---|
| | | | | LB | P | |
| 10 | 16 5/8 | 9.89 | 14.13 | 12 1/8 | 8 1/2 | 3.50 |
| 12 | 19 3/4 | 11.75 | 16.79 | 14 1/2 | 10 1/8 | 2.63 |
| 14 | 21 3/4 | 12.90 | 18.43 | 15 5/8 | 10 7/8 | 2.38 |

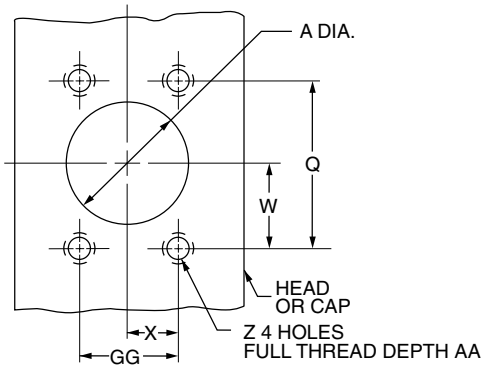
## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | RT | V | WF | Y | Add Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | XF | ZB |
| | | | KK | CC | | | | | | | | | | |
| 10 | 1* | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | 15/16 | 1 | 2 15/16 | 4 3/4 | 15 1/16 | 16 11/32 |
| | 3 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | 15/16 | 1 | 3 3/16 | 5 | 15 5/16 | 16 19/32 |
| | 4 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 | 15 5/16 | 16 19/32 |
| | 2 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 | 15/16 | 1 1/4 | 3 1/2 | 5 5/16 | 15 5/8 | 16 29/32 |
| 12 | 1* | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 3/8 | 17 11/16 | 19 3/32 |
| | 3 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 11/16 | 18 | 19 13/32 |
| | 2 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/16 | 18 1/2 | 19 29/32 |
| 14 | 1* | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 7/8 | 19 1/8 | 20 17/32 |
| | 3 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/8 | 19 5/8 | 21 1/32 |
| | 2 | 10 | 7 1/4 - 12 | — | 10 | 10.749 | 14 | 1 | 1 5/8 | 5/16 | 4 1/2 | 6 7/8 | 20 1/8 | 21 17/32 |

*Indicates standard rod for bore size.

## Optional SAE Flange Port Pattern
## SAE Code 61

| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. |
|---|---|---|---|---|---|---|---|
| 1 1/2 | 1.50 | 2.750 | 1.406 | 1.38 | 0.70 | 1/2-13 | 1.06 |
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 |



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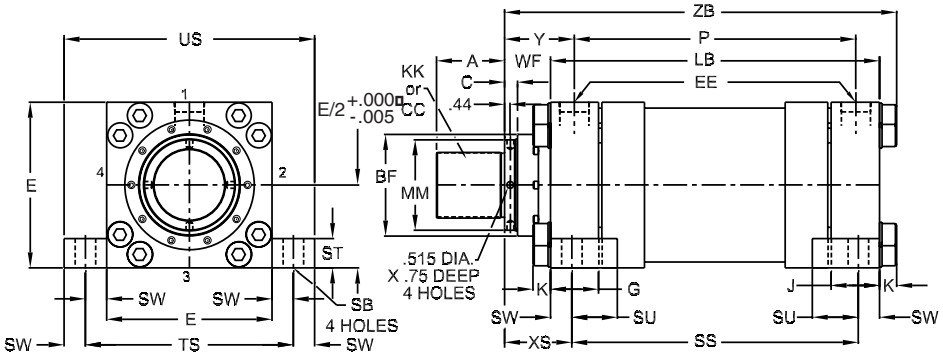
Milton, Ontario Canada

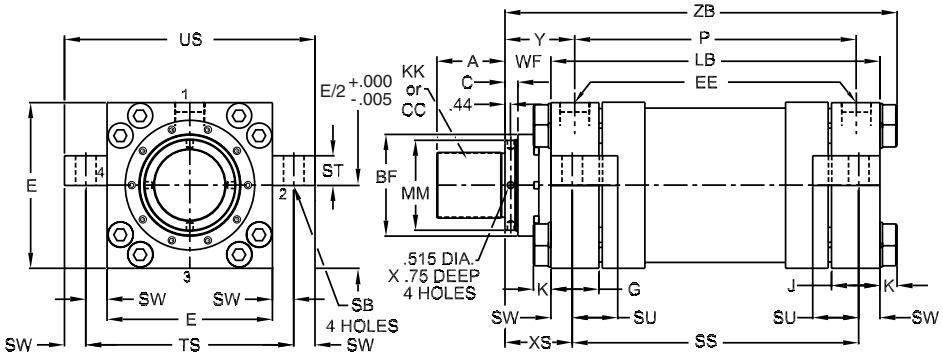
## Side and Centerline Lugs Mounting Styles

**Side Lugs Mounting**
**Style C**
NFPA Style MS2
10" thru 14" Bore



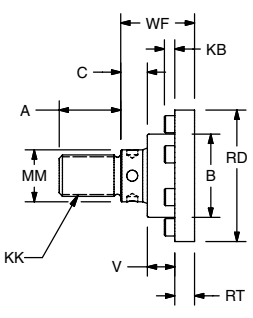

**Note:** Stroke lengths on lug mounted cylinders should not be shorter than the cylinder bore diameter. Consult factory for recommendations on shorter stroke lengths.

**Centerline Lugs Mounting**
**Style E**
NFPA Style MS3
10" thru 14" Bore

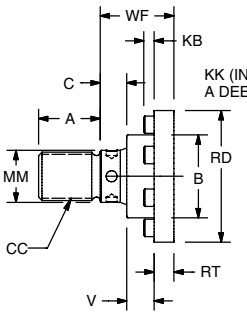



### Rod End Dimensions

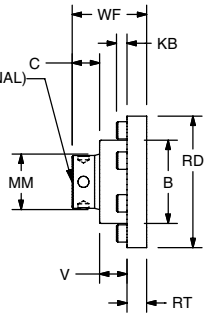
**Style 4**
Standard Male Thread



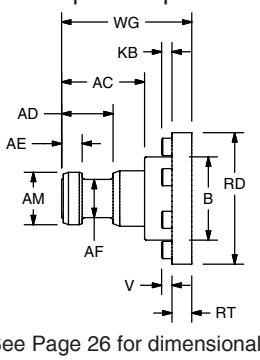

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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Des Plaines, IL USA
Milton, Ontario Canada

### Envelope and Mounting Dimensions

| BORE | E | EE | | G | J | K | SB | ST | SU |
|---|---|---|---|---|---|---|---|---|---|
| | | SAE | NPTF | | | | | | |
| 10 | 12 5/8 | #24 | 2 | 3 11/16 | 3 11/16 | 1.13 | 1 9/16 | 2 1/4 | 3 1/2 |
| 12 | 14 7/8 | #24 | 2 1/2 | 4 7/16 | 4 7/16 | 1.25 | 1 9/16 | 3 | 4 1/4 |
| 14 | 17 1/8 | #24 | 2 1/2 | 4 7/8 | 4 7/8 | 1.25 | 2 5/16 | 4 | 4 3/4 |

### Envelope and Mounting Dimensions—Continued

| BORE | SW | TS | US | ADD STROKE | | | MIN* STROKE |
|---|---|---|---|---|---|---|---|
| | | | | LB | P | SS | |
| 10 | 1 5/8 | 15 7/8 | 19 1/8 | 12 1/8 | 8 1/2 | 8 7/8 | 3.50 |
| 12 | 2 | 18 7/8 | 22 7/8 | 14 1/2 | 10 1/8 | 10 1/2 | 2.63 |
| 14 | 2 1/4 | 21 5/8 | 26 1/8 | 15 5/8 | 10 7/8 | 11 1/8 | 2.38 |

*Consult C drawing on previous page.

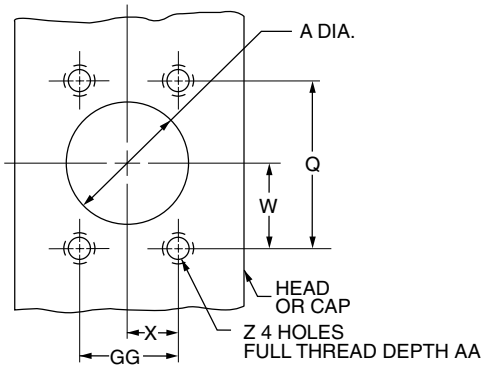
### Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | RT | V | WF | Y | XS | Add Stroke |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | | |
| | | | KK | CC | | | | | | | | | | ZB |
| 10 | 1* | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | 15/16 | 1 | 2 15/16 | 4 3/4 | 4 9/16 | 16 11/32 |
| | 3 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | 15/16 | 1 | 3 3/16 | 5 | 4 13/16 | 16 19/32 |
| | 4 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 | 4 13/16 | 16 19/32 |
| | 2 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 | 15/16 | 1 1/4 | 3 1/2 | 5 5/16 | 5 1/8 | 16 29/32 |
| 12 | 1* | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 3/8 | 5 3/16 | 19 3/32 |
| | 3 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 11/16 | 5 1/2 | 19 13/32 |
| | 2 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/16 | 6 | 19 29/32 |
| 14 | 1* | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 7/8 | 5 3/4 | 20 17/32 |
| | 3 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/8 | 6 1/4 | 21 1/32 |
| | 2 | 10 | 7 1/4 - 12 | — | 10 | 10.749 | 14 | 1 | 1 5/8 | 5/16 | 4 1/2 | 6 7/8 | 6 3/4 | 21 17/32 |

*Indicates standard rod for bore size.

### Optional SAE Flange Port Pattern
### SAE Code 61

| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. |
|---|---|---|---|---|---|---|---|
| 1 1/2 | 1.50 | 2.750 | 1.406 | 1.38 | 0.70 | 1/2-13 | 1.06 |
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 |



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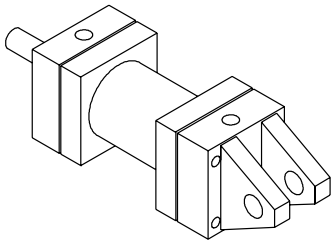
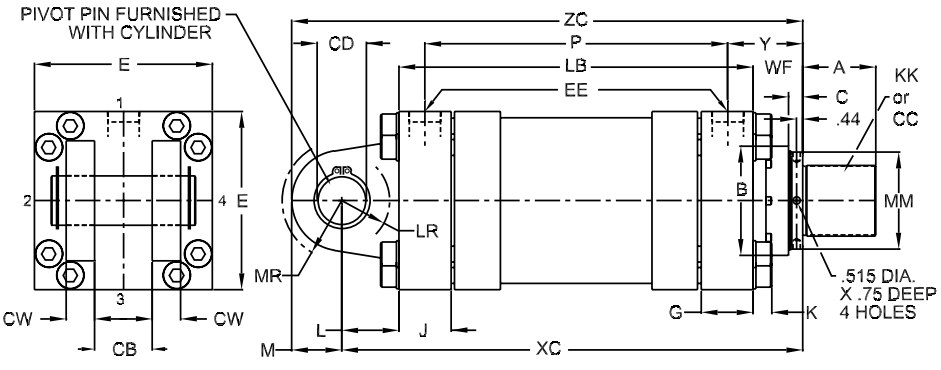
Milton, Ontario Canada

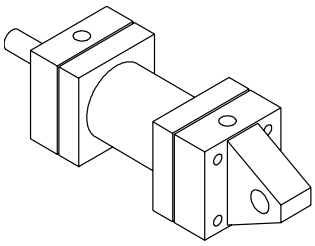
## Side and Centerline Lugs Mounting Styles

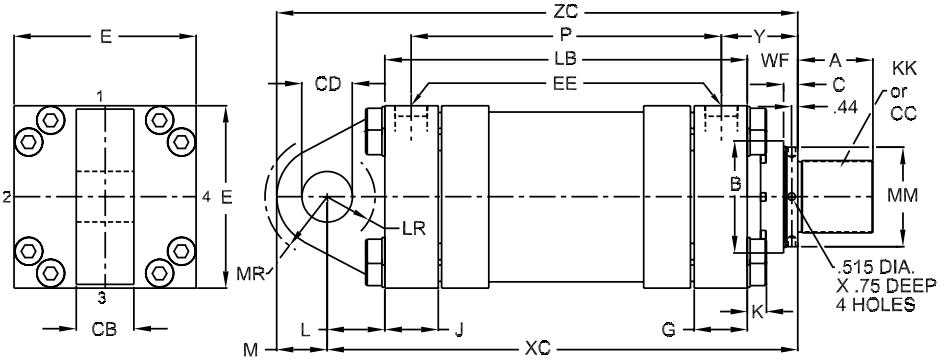
**Cap Fixed Clevis Mounting**
**Style BB**
NFPA Style MP1
10" thru 14" Bore





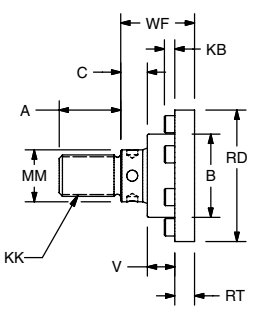

**Pivot Eye**
**Style BE**
NFPA Style MP3
10" thru 14" Bore



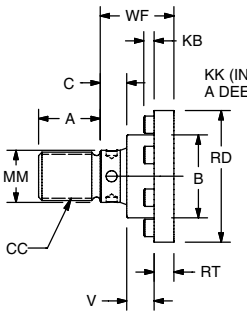



### Rod End Dimensions

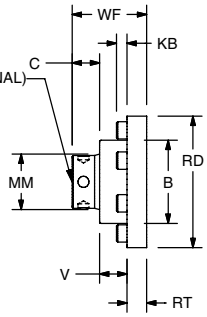
**Style 4**
Standard Male Thread



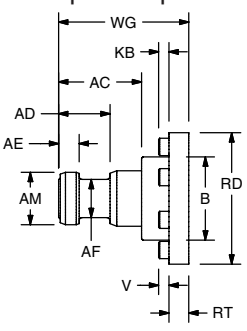

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




See Page 26 for dimensional data.

**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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



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Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | CB | CD | CW | E | EE | | G | J | K |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | SAE | NPTF | | | |
| 10 | 4 | 3.50 | 2 | 12 5/8 | #24 | 2 | 3 11/16 | 3 11/16 | 1.13 |
| 12 | 4 1/2 | 4.00 | 2 1/4 | 14 7/8 | #24 | 2 1/2 | 4 7/16 | 4 7/16 | 1.25 |
| 14 | 6 | 5.00 | 3 | 17 1/8 | #24 | 2 1/2 | 4 7/8 | 4 7/8 | 1.25 |

## Envelope and Mounting Dimensions—Continued

| BORE | L | LR | M/MR | ADD STROKE | | MIN STROKE |
|---|---|---|---|---|---|---|
| | | | | LB | P | |
| 10 | 4 1/16 | 3 3/8 | 3 1/2 | 12 1/8 | 8 1/2 | 3.50 |
| 12 | 4 1/2 | 3 7/8 | 4 | 14 1/2 | 10 1/8 | 2.63 |
| 14 | 5 3/4 | 4 3/16 | 5 | 15 5/8 | 10 7/8 | 2.38 |

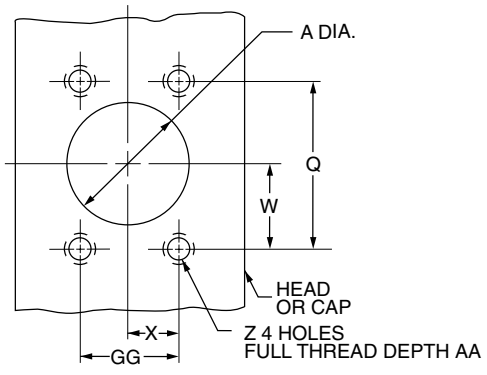
## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | RT | V | WF | Y | Add Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 | Style 8 | | | | | | | | | XC | ZC |
| | | | KK | CC | | | | | | | | | | |
| 10 | 1* | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | 15/16 | 1 | 2 15/16 | 4 3/4 | 19 1/16 | 22 9/16 |
| | 3 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | 15/16 | 1 | 3 3/16 | 5 | 19 5/16 | 22 13/16 |
| | 4 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 | 19 5/16 | 22 13/16 |
| | 2 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 | 15/16 | 1 1/4 | 3 1/2 | 5 5/16 | 19 5/8 | 23 1/8 |
| 12 | 1* | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 3/8 | 22 3/16 | 26 3/16 |
| | 3 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 11/16 | 22 1/2 | 26 1/2 |
| | 2 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/16 | 23 | 27 |
| 14 | 1* | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 7/8 | 24 7/8 | 29 7/8 |
| | 3 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/8 | 25 3/8 | 30 3/8 |
| | 2 | 10 | 7 1/4 - 12 | — | 10 | 10.749 | 14 | 1 | 1 5/8 | 5/16 | 4 1/2 | 6 7/8 | 25 7/8 | 30 7/8 |

*Indicates standard rod for bore size.

## Optional SAE Flange Port Pattern
## SAE Code 61

| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. |
|---|---|---|---|---|---|---|---|
| 1 1/2 | 1.50 | 2.750 | 1.406 | 1.38 | 0.70 | 1/2-13 | 1.06 |
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 |



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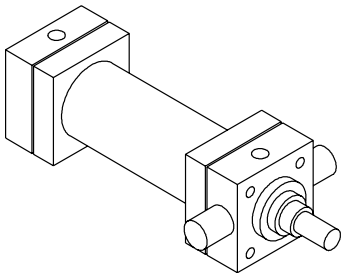
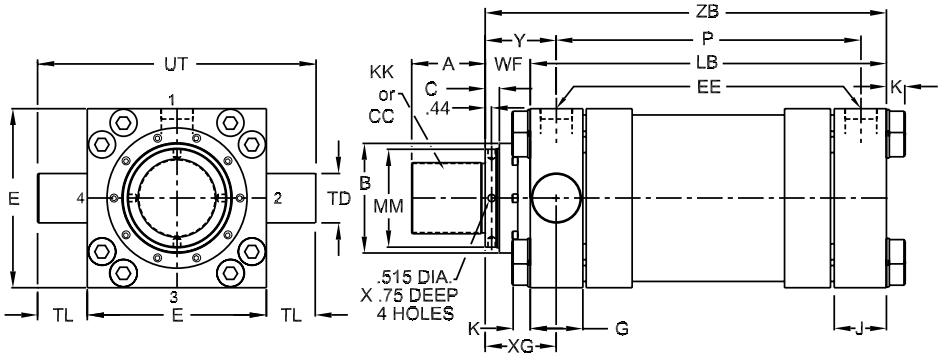
Milton, Ontario Canada

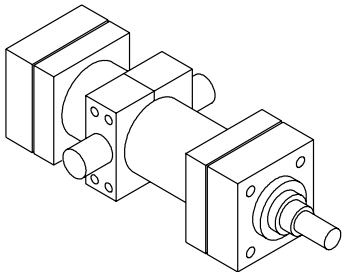
## Trunnion Mounting Styles

### Head Trunnion Mounting
**Style D**
NFPA Style MT1
10" thru 14" Bore



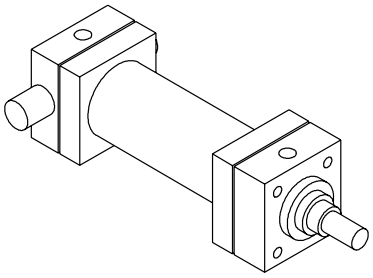


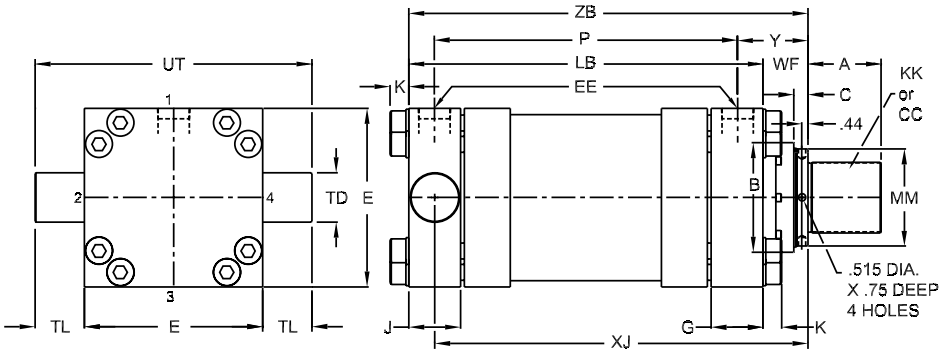

### Intermediate Fixed Trunnion Mounting
**Style DD**
NFPA Style MT4
10" thru 14" Bore



For all intermediate trunnion applications, please consult factory for appropriate design and dimensions.

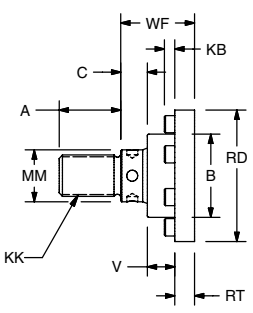
### Cap Trunnion Mounting
**Style DB**
NFPA Style MT2
10" thru 14" Bore



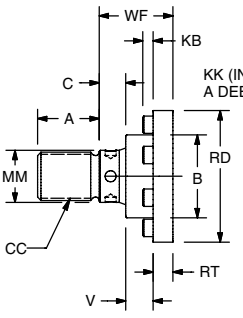



### Rod End Dimensions

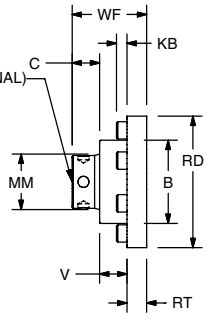
**Style 4**
Standard Male Thread



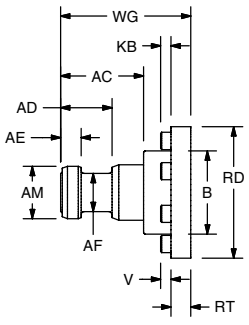

**Style 8**
Oversize Male Thread




**Style 9**
Female Thread




**Style 55**
Split Coupler




**Style 3**
"Specials"
Thread Style 3
Special thread, extension, rod eye, blank, etc., are also available.

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

See Page 26 for dimensional data.



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Envelope and Mounting Dimensions

| BORE | BD | E | EE | | G | J | K | TD | TL | UT | ADD STROKE | | MIN STROKE D & DB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SAE | NPTF | | | | | | | LB | P | |
| 10 | 4 1/2 | 12 5/8 | #24 | 2 | 3 11/16 | 3 11/16 | 1.13 | 3.500 | 3 1/2 | 19 5/8 | 12 1/8 | 8 1/2 | 3.50 |
| 12 | 5 1/2 | 14 7/8 | #24 | 2 1/2 | 4 7/16 | 4 7/16 | 1.25 | 4.000 | 4 | 22 7/8 | 14 1/2 | 10 1/8 | 2.63 |
| 14 | 5 1/2 | 17 1/8 | #24 | 2 1/2 | 4 7/8 | 4 7/8 | 1.25 | 4.500 | 4 1/2 | 26 1/8 | 15 5/8 | 10 7/8 | 2.38 |

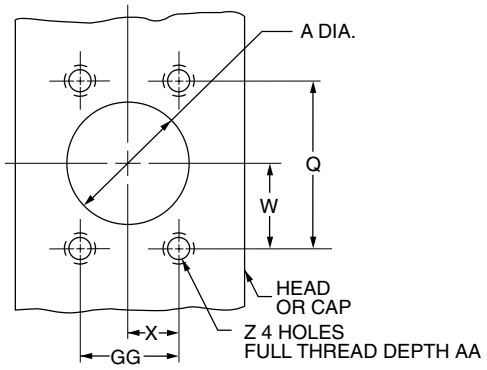
## Dimensions Affected by Rod Size

| BORE | Rod No. | MM Rod Size | Thread | | A | B | RD | C | RT | V | WF | XG | Y | Add Stroke | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Style 4 & 9 KK | Style 8 CC | | | | | | | | | | XJ | ZB |
| 10 | 1* | 4 1/2 | 3 1/4 - 12 | 4 1/4 - 12 | 4 1/2 | 5.249 | 6 15/16 | 1 | 15/16 | 1 | 2 15/16 | 4 3/4 | 4 3/4 | 13 3/8 | 16 11/32 |
| | 3 | 5 | 3 1/2 - 12 | 4 3/4 - 12 | 5 | 5.749 | 7 7/16 | 1 | 15/16 | 1 | 3 3/16 | 5 | 5 | 13 5/8 | 16 19/32 |
| | 4 | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 | 5 | 13 5/8 | 16 19/32 |
| | 2 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 | 15/16 | 1 1/4 | 3 1/2 | 5 5/16 | 5 5/16 | 13 15/16 | 16 29/32 |
| 12 | 1* | 5 1/2 | 4 - 12 | 5 1/4 - 12 | 5 1/2 | 6.249 | 7 15/16 | 1 | 15/16 | 1 1/4 | 3 3/16 | 5 3/8 | 5 3/8 | 15 1/2 | 19 3/32 |
| | 3 | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 11/16 | 5 11/16 | 15 13/16 | 19 13/32 |
| | 2 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 3/16 | 6 3/16 | 16 5/16 | 19 29/32 |
| 14 | 1* | 7 | 4 - 12 | 5 1/2 - 12 | 5 1/2 | 7.749 | 9 7/8 | 1 1/4 | 15/16 | 1 1/4 | 3 1/2 | 5 15/16 | 5 7/8 | 16 11/16 | 20 17/32 |
| | 3 | 8 | 4 1/2 - 12 | 6 - 12 | 8 | 8.749 | 10 15/16 | 1 | 15/16 | 1 1/2 | 4 | 6 7/16 | 6 3/8 | 17 3/16 | 21 1/32 |
| | 2 | 10 | 7 1/4 - 12 | — | 10 | 10.749 | 14 | 1 | 1 5/8 | 5/16 | 4 1/2 | 6 15/16 | 6 7/8 | 17 11/16 | 21 17/32 |

*Indicates standard rod for bore size.

## Optional SAE Flange Port Pattern
## SAE Code 61

| Nom. Flange Size | A | Q | GG | W | X | Z-THD UNC-2B | AA Min. |
|---|---|---|---|---|---|---|---|
| 1 1/2 | 1.50 | 2.750 | 1.406 | 1.38 | 0.70 | 1/2-13 | 1.06 |
| 2 | 2.00 | 3.062 | 1.688 | 1.53 | 0.84 | 1/2-13 | 1.06 |
| 2 1/2 | 2.50 | 3.500 | 2.000 | 1.75 | 1.00 | 1/2-13 | 1.19 |
| 3 | 3.00 | 4.188 | 2.438 | 2.09 | 1.22 | 5/8-11 | 1.19 |






**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Cylinder Accessories

Parker offers a complete range of cylinder accessories to assure you of greatest 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.

| Thread Size | Mating Parts | | | Mating Parts | | |
|---|---|---|---|---|---|---|
| | Rod Clevis | Eye Bracket | Pin | Knuckle | Clevis Bracket | Pin |
| 5/16-24 | 51221 | 74077 | — | 74075 | 74076 | 74078 |
| 7/16-20 | 50940 | 69195 | 68368 | 69089 | 69205 | 68368 |
| 1/2-20 | 50941 | 69195 | 68368 | 69090 | 69205 | 68368 |
| 3/4-16 | 50942 | 69196 | 68369 | 69091 | 69206 | 68369 |
| 3/4-16 | 133284 | 69196 | 68369 | 69091 | 69206 | 68369 |
| 7/8-14 | 50943 | *85361 | 68370 | 69092 | 69207 | 68370 |
| 1-14 | 50944 | *85361 | 68370 | 69093 | 69207 | 68370 |
| 1-14 | 133285 | *85361 | 68370 | 69093 | 69207 | 68370 |
| 1 1/4-12 | 50945 | 69198 | 68371 | 69094 | 69208 | 68371 |
| 1 1/4-12 | 133286 | 69198 | 68371 | 69094 | 69208 | 68371 |
| 1 1/2-12 | 50946 | *85362 | 68372 | 69095 | 69209 | 68372 |
| 1 3/4-12 | 50947 | *85363 | 68373 | 69096 | 69210 | 69215 |
| 1 7/8-12 | 50948 | *85363 | 68373 | 69097 | 69210 | 69215 |
| 2 1/4-12 | 50949 | *85364 | 68374 | 69098 | 69211 | 68374 |
| 2 1/2-12 | 50950 | *85365 | 68375 | 69099 | 69212 | 68375 |
| 2 3/4-12 | 50951 | *85365 | 68375 | 69100 | 69213 | 69216 |
| 3 1/4-12 | 50952 | 73538 | 73545 | 73536 | 73542 | 73545 |
| 3 1/2-12 | 50953 | 73539 | 73547 | 73437 | 73542 | 73545 |
| 4-12 | 50954 | 73539 | 73547 | 73438 | 73543 | 82181 |

## Chart A

*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 types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

## Accessory Load Capacity

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

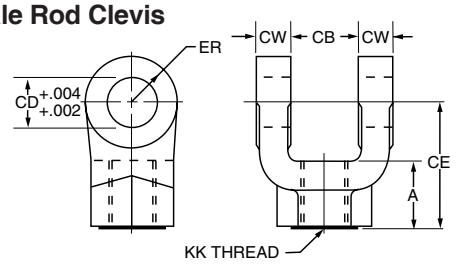
## Chart B

| Mtg. Plate Part No. | Series 2H Bore Size |
|---|---|
| 69195 | 1 1/2" |
| 69196 | 2", 2 1/2" |
| *85361 | 3 1/4" |
| 69198 | 4" |
| *85362 | 5" |
| *85363 | 6" |

## Mounting Plates

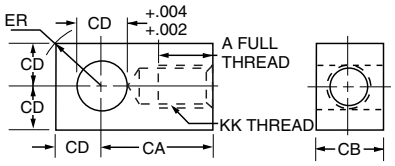
Mounting Plates for Style BB (clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B, above right.

## Female Rod Clevis



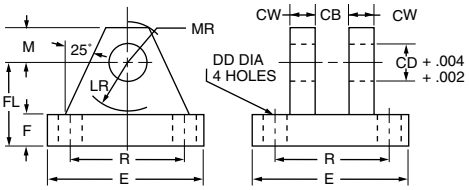

Order to fit thread size.

## Knuckle (Female Rod Eye)



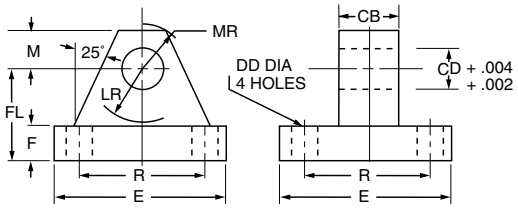

Order to fit thread size.

## Clevis Bracket for Knuckle



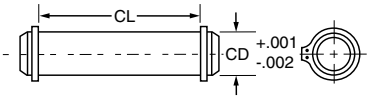

Order to fit Knuckle.

## Mounting Plate or Eye Bracket




1. When used to mate with the Rod Clevis, select from Chart A.
2. When used to mount the Style BB cylinders, select from the Mounting Plate Selection Table. See Chart B at lower left.

## Pivot Pin




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 separate item if to be used with Knuckles, Rod Clevises, or Clevis Brackets.



**Parker Hannifin Corporation**
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Milton, Ontario Canada

| | Female Rod Clevis Part Number | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 51221† | 50940 | 50941 | 50942 | 133284 | 50943 | 50944 | 133285 | 50945 | 133286 | 50946 | 50947 | 50948 | 50949 | 50950 | 50951 | 50952 | 50953 | 50954 |
| **A** | 13/16 | 3/4 | 3/4 | 1 1/8 | 1 1/8 | 1 5/8 | 1 5/8 | 1 5/8 | 1 7/8 | 2 | 2 1/4 | 3 | 3 | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2‡† | 4‡† | 4‡† |
| **CB** | 11/32 | 3/4 | 3/4 | 1 1/4 | 1 1/4 | 1 1/2 | 1 1/2 | 1 1/2 | 2 | 2 | 2 1/2 | 2 1/2 | 2 1/2 | 3 | 3 | 3 | 4 | 4 1/2 | 4 1/2 |
| **CD** | 5/16 | 1/2 | 1/2 | 3/4 | 3/4 | 1 | 1 | 1 | 1 3/8 | 1 3/8 | 1 3/4 | 2 | 2 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 |
| **CE** | 2 1/4 | 1 1/2 | 1 1/2 | 2 1/8 | 2 3/8 | 2 15/16 | 2 15/16 | 3 1/8 | 3 3/4 | 4 1/8 | 4 1/2 | 5 1/2 | 5 1/2 | 6 1/2 | 6 3/4 | 6 3/4 | 7 3/4 | 8 13/16 | 8 13/16 |
| **CW** | 13/64 | 1/2 | 1/2 | 5/8 | 5/8 | 3/4 | 3/4 | 3/4 | 1 | 1 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/2 | 1 1/2 | 1 1/2 | 2 | 2 1/4 | 2 1/4 |
| **ER** | 19/64 | 1/2 | 1/2 | 3/4 | 3/4 | 1 | 1 | 1 | 1 3/8 | 1 3/8 | 1 3/4 | 2 | 2 | 2 1/2 | 2 3/4 | 2 3/4 | 3 1/2 | 4 | 4 |
| **KK** | 5/16-24 | 7/16-20 | 1/2-20 | 3/4-16 | 3/4-16 | 7/8-14 | 1-14 | 1-14 | 1 1/4-12 | 1 1/4-12 | 1 1/2-12 | 1 3/4-12 | 1 7/8-12 | 2 1/4-12 | 2 1/2-12 | 2 3/4-12 | 3 1/4-12 | 3 1/2-12 | 4-12 |
| **Load Capacity Lbs. Θ** | 2600 | 4250 | 4900 | 11200 | 11200 | 18800 | 19500 | 19500 | 33500 | 33500 | 45600 | 65600 | 65600 | 98200 | 98200 | 98200 | 156700 | 193200 | 221200 |

| | Knuckle Part Number | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 74075 | 69089 | 69090 | 69091 | 69092 | 69093 | 69094 | 69095 | 69096 | 69097 | 69098 | 69099 | 69100 | 73536 | 73437 | 73438 | 73439 |
| **A** | 3/4 | 3/4 | 3/4 | 1 1/8 | 1 1/8 | 1 5/8 | 2 | 2 1/4 | 2 1/4 | 3 | 3 1/2 | 3 1/2 | 3 5/8 | 4 1/2 | 5 | 5 1/2 | 5 1/2 |
| **CA** | 1 1/2 | 1 1/2 | 1 1/2 | 2 1/16 | 2 3/8 | 2 13/16 | 3 7/16 | 4 | 4 3/8 | 5 | 5 13/16 | 6 1/8 | 6 1/2 | 7 5/8 | 7 5/8 | 9 1/8 | 9 1/8 |
| **CB** | 7/16 | 3/4 | 3/4 | 1 1/4 | 1 1/2 | 1 1/2 | 2 | 2 1/2 | 2 1/2 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 | 4 1/2 | 5 |
| **CD** | 7/16 | 1/2 | 1/2 | 3/4 | 1 | 1 | 1 3/8 | 1 3/4 | 2 | 2 | 2 1/2 | 3 | 3 | 3 1/2 | 3 1/2 | 4 | 4 |
| **ER** | 19/32 | 23/32 | 23/32 | 1 1/16 | 1 7/16 | 1 7/16 | 1 31/32 | 2 1/2 | 2 27/32 | 2 27/32 | 3 9/16 | 4 1/4 | 4 1/4 | 4 31/32 | 4 31/32 | 5 11/16 | 5 11/16 |
| **KK** | 5/16-24 | 7/16-20 | 1/2-20 | 3/4-16 | 7/8-14 | 1-14 | 1 1/4-12 | 1 1/2-12 | 1 3/4-12 | 1 7/8-12 | 2 1/4-12 | 2 1/2-12 | 2 3/4-12 | 3 1/4-12 | 3 1/2-12 | 4-12 | 4 1/2-12 |
| **Load Capacity Lbs. Θ** | 3300 | 5000 | 5700 | 12100 | 13000 | 21700 | 33500 | 45000 | 53500 | 75000 | 98700 | 110000 | 123300 | 161300 | 217300 | 273800 | 308500 |

| | Clevis Bracket for Knuckle Part Number | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 74076 | 69205 | 69206 | 69207 | 69208 | 69209 | 69210 | 69211 | 69212 | 69213 | 73542 | 73543 | 73544 |
| **CB** | 15/32 | 3/4 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 1/2 | 5 |
| **CD** | 7/16 | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 |
| **CW** | 3/8 | 1/2 | 5/8 | 3/4 | 1 | 1 1/4 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2 | 2 | 2 |
| **DD** | 17/64 | 13/32 | 17/32 | 21/32 | 21/32 | 29/32 | 1 1/16 | 1 3/16 | 1 5/16 | 1 5/16 | 1 13/16 | 2 1/16 | 2 1/16 |
| **E** | 2 1/4 | 3 1/2 | 5 | 6 1/2 | 7 1/2 | 9 1/2 | 12 3/4 | 12 3/4 | 12 3/4 | 12 3/4 | 15 1/2 | 17 1/2 | 17 1/2 |
| **F** | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 7/8 | 1 | 1 | 1 | 1 | 1 11/16 | 1 15/16 | 1 15/16 |
| **FL** | 1 | 1 1/2 | 1 7/8 | 2 1/4 | 3 | 3 5/8 | 4 1/4 | 4 1/2 | 6 | 6 | 6 11/16 | 7 11/16 | 7 11/16 |
| **LR** | 5/8 | 3/4 | 1 3/16 | 1 1/2 | 2 | 2 3/4 | 3 3/16 | 3 1/2 | 4 1/4 | 4 1/4 | 5 | 5 3/4 | 5 3/4 |
| **M** | 3/8 | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 1/4 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 |
| **MR** | 1/2 | 5/8 | 29/32 | 1 1/4 | 1 21/32 | 2 7/32 | 2 25/32 | 3 1/8 | 3 19/32 | 3 19/32 | 4 1/8 | 4 7/8 | 4 7/8 |
| **R** | 1.75 | 2.55 | 3.82 | 4.95 | 5.73 | 7.50 | 9.40 | 9.40 | 9.40 | 9.40 | 12.00 | 13.75 | 13.75 |
| **Load Capacity Lbs. Θ** | 3600 | 7300 | 14000 | 19200 | 36900 | 34000 | 33000 | 34900 | 33800 | 36900 | 83500 | 102600 | 108400 |

| | Eye Bracket and Mounting Plate Part Number | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 74077 | 69195 | 69196 | 85361* | 69198 | 85362* | 85363* | 85364* | 85365* | 73538 | 73539 |
| **CB** | 5/16 | 3/4 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 2 1/2 | 3 | 3 | 4 | 4 1/2 |
| **CD** | 5/16 | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 | 2 1/2 | 3 | 3 1/2 | 4 |
| **DD** | 17/64 | 13/32 | 17/32 | 21/32 | 21/32 | 29/32 | 1 1/16 | 1 3/16 | 1 5/16 | 1 13/16 | 2 1/16 |
| **E** | 2 1/4 | 2 1/2 | 3 1/2 | 4 1/2 | 5 | 6 1/2 | 7 1/2 | 8 1/2 | 9 1/2 | 12 5/8 | 14 7/8 |
| **F** | 3/8 | 3/8 | 5/8 | 7/8 | 7/8 | 1 1/8 | 1 1/2 | 1 3/4 | 2 | 1 11/16 | 1 15/16 |
| **FL** | 1 | 1 1/8 | 1 7/8 | 2 3/8 | 3 | 3 3/8 | 4 | 4 3/4 | 5 1/4 | 5 11/16 | 6 7/16 |
| **LR** | 5/8 | 3/4 | 1 1/4 | 1 1/2 | 2 1/8 | 2 1/4 | 2 1/2 | 3 | 3 1/4 | 4 | 4 1/2 |
| **M** | 3/8 | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 | 2 1/2 | 2 3/4 | 3 1/2 | 4 |
| **MR** | 1/2 | 9/16 | 7/8 | 1 1/4 | 1 5/8 | 2 1/8 | 2 7/16 | 3 | 3 1/4 | 4 1/8 | 5 1/4 |
| **R** | 1.75 | 1.63 | 2.55 | 3.25 | 3.82 | 4.95 | 5.73 | 6.58 | 7.50 | 9.62 | 11.45 |
| **Load Capacity Lbs. Θ** | 1700 | 4100 | 10500 | 20400 | 21200 | 49480 | 70000 | 94200 | 121900 | 57400 | 75000 |

| | Pivot Pin Part Number | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 74078 | 68368 | 68369 | 68370 | 68371 | 68372 | 68373 | 69215 | 68374 | 68375 | 69216 | 73545 | 82181 | 73547• |
| **CD** | 7/16 | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 | 2 | 2 1/2 | 3 | 3 | 3 1/2 | 4 | 4 |
| **CL** | 1 5/16 | 1 7/8 | 2 5/8 | 3 1/8 | 4 1/8 | 5 3/16 | 5 3/16 | 5 11/16 | 6 3/16 | 6 1/4 | 6 3/4 | 8 1/4 | 8 5/8 | 9 |
| **Shear Capacity Lbs. Θ** | 6600 | 8600 | 19300 | 34300 | 65000 | 105200 | 137400 | 137400 | 214700 | 309200 | 309200 | 420900 | 565800 | 565800 |

*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 types. Parker adopted this standard in April, 1985. Eye Brackets or Mounting Plates shipped before this date may have different dimensions and will not necessarily interchange with the NFPA standard. For dimensional information on older style Eye Brackets or Mounting Plates consult Drawing #144805 or previous issues of this catalog.

Θ See Accessory Load Capacity note on previous page.

•These sizes supplied with cotter pins.

†Includes Pivot Pin.

Consult appropriate cylinder rod end dimensions for compatibility.



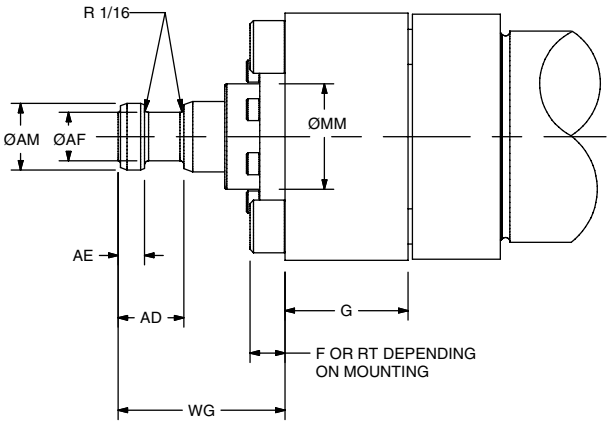
**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

# Parker "Style 55" Piston Rod End

## Rod end split coupling for Parker Series MH Hydraulic

- Simplifies alignment
- Reduces assembly time
- Allows full rated hydraulic pressure in push and pull directions
- Available in 5/8" through 10" piston rod diameters

## Style 55 Rod End




## Dimensions Style 55 Rod End

| MM Rod Dia. | AD | AE | AF | AM | WG |
|---|---|---|---|---|---|
| 5/8 | 5/8 | 1/4 | 3/8 | .57 | 1 3/4 |
| 1 | 15/16 | 3/8 | 11/16 | .95 | 2 3/8 |
| 1 3/8 | 1 1/16 | 3/8 | 7/8 | 1.32 | 2 3/4 |
| 1 3/4 | 1 5/16 | 1/2 | 1 1/8 | 1.70 | 3 1/8 |
| 2 | 1 11/16 | 5/8 | 1 3/8 | 1.95 | 3 3/4 |
| 2 1/2 | 1 15/16 | 3/4 | 1 3/4 | 2.45 | 4 1/2 |
| 3 | 2 7/16 | 7/8 | 2 1/4 | 2.95 | 4 7/8 |
| 3 1/2 | 2 11/16 | 1 | 2 1/2 | 3.45 | 5 5/8 |
| 4 | 2 11/16 | 1 | 3 | 3.95 | 5 3/4 |
| 4 1/2 | 3 3/16 | 1 1/2 | 3 1/2 | 4.45 | 6 1/2 |
| 5 | 3 3/16 | 1 1/2 | 3 7/8 | 4.95 | 6 5/8 |
| 5 1/2 | 3 15/16 | 1 7/8 | 4 3/8 | 5.45 | 7 1/2 |
| 7 | 4 1/16 | 2 | 5 3/4 | 6.95 | 8 7/16 |
| 8 | 4 1/16 | 2 | 6 1/2 | 7.95 | 8 11/16 |
| 9 | 4 5/8 | 2 3/8 | 7 1/4 | 8.95 | 8 3/4 |
| 10 | 4 5/8 | 2 3/8 | 8 | 9.95 | 9 3/4 |

See Cylinder Catalog for F, G and RT per bore and series.

Consult Factory for availability of mounting accessories and Hardware

### How To Order

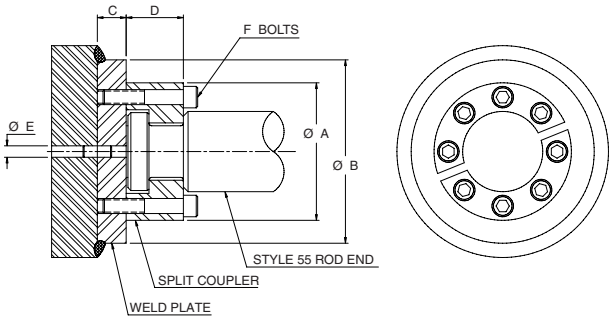
Complete Model Number and place a "55" in the Piston Rod End designator position

Example: 6.0JJMHKT355X12.0



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

# 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.

**Table 1 — Part Numbers and Dimensions**

| ROD DIA. | A | B | C | D | E | F | BOLT SIZE | BOLT CIRCLE | SPLIT COUPLER PART NO. | WELD PLATE PART NO. |
|---|---|---|---|---|---|---|---|---|---|---|
| .625 | 1.50 | 2.00 | .50 | .56 | .250 | 4 | #10-24 x .94 LG | 1.125 | 147234 0062 | 148174 0062 |
| 1.00 | 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 1.50 LG | 2.000 | 147234 0138 | 148174 0138 |
| 1.75 | 3.00 | 4.00 | .63 | 1.25 | .250 | 8 | .312-18 x 1.75 LG | 2.375 | 147234 0175 | 148174 0175 |
| 2.00 | 3.50 | 4.00 | .75 | 1.63 | .375 | 12 | .375-16 x 2.25 LG | 2.687 | 147234 0200 | 148174 0200 |
| 2.50 | 4.00 | 4.50 | .75 | 1.88 | .375 | 12 | .375-16 x 2.50 LG | 3.187 | 147234 0250 | 148174 0250 |
| 3.00 | 5.00 | 5.50 | 1.00 | 2.38 | .375 | 12 | .500-13 x 3.25 LG | 4.000 | 147234 0300 | 148174 0300 |
| 3.50 | 5.88 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 4.687 | 147234 0350 | 148174 0350 |
| 4.00 | 6.38 | 7.00 | 1.00 | 2.63 | .375 | 12 | .625-11 x 3.50 LG | 5.187 | 147234 0400 | 148174 0400 |
| 4.50 | 6.88 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 5.687 | 147234 0450 | 148174 0450 |
| 5.00 | 7.38 | 8.00 | 1.00 | 3.13 | .375 | 12 | .625-11 x 4.00 LG | 6.187 | 147234 0500 | 148174 0500 |
| 5.50 | 8.25 | 9.00 | 1.25 | 3.88 | .375 | 12 | .750-10 x 5.00 LG | 6.875 | 147234 0550 | 148174 0550 |

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

# Linear Alignment Couplers are available in 12 standard thread sizes...

### Cost Saving Features and Benefits Include...

- Maximum reliabilty 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

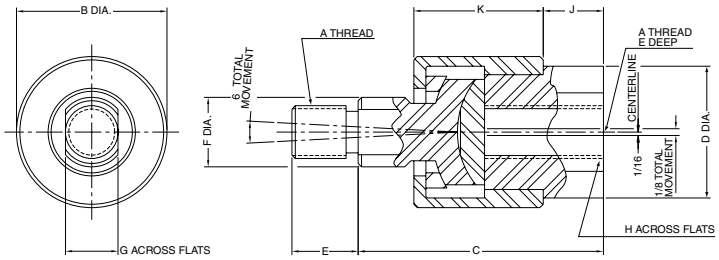



**Table 1 — Part Numbers and Dimensions**

| Part No. | A | B | C* | D | E | F | G | H | J | K | Max. Pull Load (lbs.) | Approx. Weight (lbs.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1347570031 | 5/16-24 | 1 1/8 | 1 3/4 | 15/16 | 1/2 | 1/2 | 3/8 | 3/4 | 3/8 | 15/16 | 1200 | .35 |
| 1347570038 | 3/8-24 | 1 1/8 | 1 3/4 | 15/16 | 1/2 | 1/2 | 3/8 | 3/4 | 3/8 | 15/16 | 2425 | .35 |
| 1347570044 | 7/16-20 | 1 3/8 | 2 | 1 1/8 | 3/4 | 5/8 | 1/2 | 7/8 | 3/8 | 1 3/32 | 3250 | .55 |
| 1347570050 | 1/2-20 | 1 3/8 | 2 | 1 1/8 | 3/4 | 5/8 | 1/2 | 7/8 | 3/8 | 1 3/32 | 4450 | .55 |
| 1347570063 | 5/8-18 | 1 3/8 | 2 | 1 1/8 | 3/4 | 5/8 | 1/2 | 7/8 | 3/8 | 1 3/32 | 6800 | .55 |
| 1347570075 | 3/4-16 | 2 | 2 5/16 | 1 5/8 | 1 1/8 | 15/16 | 3/4 | 1 5/16 | 7/16 | 1 9/32 | 9050 | 1.4 |
| 1347570088 | 7/8-14 | 2 | 2 5/16 | 1 5/8 | 1 1/8 | 15/16 | 3/4 | 1 5/16 | 7/16 | 1 9/32 | 14450 | 1.4 |
| 1347570100 | 1-14 | 3 1/8 | 3 | 2 3/8 | 1 5/8 | 1 7/16 | 1 1/4 | 1 7/8 | 3/4 | 1 25/32 | 19425 | 4.8 |
| 1347570125 | 1 1/4-12 | 3 1/8 | 3 | 2 3/8 | 1 5/8 | 1 7/16 | 1 1/4 | 1 7/8 | 3/4 | 1 25/32 | 30500 | 4.8 |
| 1337390125 | 1 1/4-12 | 3 1/2 | 4 | 2 | 2 | 1 1/2 | 1 1/4 | 1 11/16 | 3/4 | 2 1/2 | 30500 | 6.9 |
| 1337390150 | 1 1/2-12 | 4 | 4 3/8 | 2 1/4 | 2 1/4 | 1 3/4 | 1 1/2 | 1 15/16 | 7/8 | 2 3/4 | 45750 | 9.8 |
| 1337390175 | 1 3/4-12 | 4 | 4 3/8 | 2 1/4 | 2 1/4 | 1 3/4 | 1 1/2 | 1 15/16 | 7/8 | 2 3/4 | 58350 | 9.8 |
| 1337390188 | 1 7/8-12 | 5 | 5 5/8 | 3 | 3 | 2 1/4 | 1 15/16 | 2 5/8 | 1 3/8 | 3 3/8 | 67550 | 19.8 |

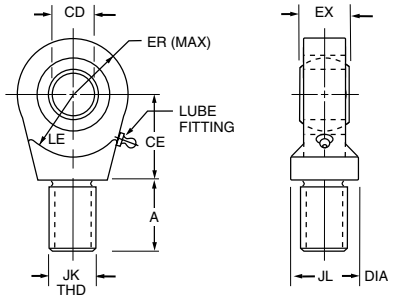


**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

# Spherical Bearing Mounting Accessories

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.

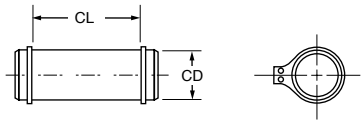
## Spherical Rod Eye




| Bore Sizes | Series MH | 1 1/2 | 2 & 2 1/2 | 3 1/4 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Rod Eye | Part No. | 132290 | 132291 | 132292 | 132293 | 132294 | 132295 |
| | CD | .5000 -0005 | .7500 -0005 | 1.0000 -0005 | 1.3750 -0005 | 1.7500 -0005 | 2.0000 -0005 |
| | A | 11/16 | 1 | 1 1/2 | 2 | 2 1/8 | 2 7/8 |
| | CE | 7/8 | 1 1/4 | 1 7/8 | 2 1/8 | 2 1/2 | 2 3/4 |
| | EX | 7/16 | 21/32 | 7/8 | 1 3/16 | 1 17/32 | 1 3/4 |
| | ER | 13/16 | 1 1/8 | 1 1/4 | 1 11/16 | 2 1/16 | 2 1/2 |
| | LE | 3/4 | 1 1/16 | 1 7/16 | 1 7/8 | 2 1/8 | 2 1/2 |
| | JK | 7/16-20 | 3/4-16 | 1-14 | 1 1/4-12 | 1 1/2-12 | 1 7/8-12 |
| | JL | 7/8 | 1 5/16 | 1 1/2 | 2 | 2 1/4 | 2 3/4 |
| | LOAD CAPACITY LBS. | 2644 | 9441 | 16860 | 28562 | 43005 | 70193 |

Order to fit Piston Rod Thread Size.

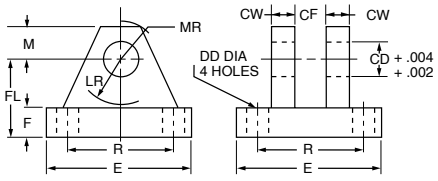
## Pivot Pin




| Bore Sizes | Series MH | 1 1/2 | 2 & 2 1/2 | 3 1/4 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Pivot Pin | Part No. | 83962 | 83963 | 83964 | 83965 | 83966 | 83967 |
| | CD | .4997 -0004 | .7497 -0005 | .9997 -0005 | 1.3746 -0006 | 1.7496 -0006 | 1.9996 -0007 |
| | CL | 1 9/16 | 2 1/32 | 2 1/2 | 3 5/16 | 4 7/32 | 4 15/16 |
| | SHEAR CAPACITY LBS. | 8600 | 19300 | 34300 | 65000 | 105200 | 137400 |

Pivot Pins are furnished with (2) Retainer Rings.

## Clevis Bracket

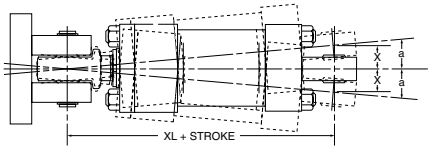



| Bore Sizes | Series MH | 1 1/2 | 2 & 2 1/2 | 3 1/4 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Clevis Bracket | Part No. | 83947 | 83948 | 83949 | 83950 | 83951 | 83952 |
| | CD | 1/2 | 3/4 | 1 | 1 3/8 | 1 3/4 | 2 |
| | CF | 7/16 | 21/32 | 7/8 | 1 3/16 | 1 17/32 | 1 3/4 |
| | CW | 1/2 | 5/8 | 3/4 | 1 | 1 1/4 | 1 1/2 |
| | DD | 13/32 | 17/32 | 17/32 | 21/32 | 29/32 | 29/32 |
| | E | 3 | 3 3/4 | 5 1/2 | 6 1/2 | 8 1/2 | 10 5/8 |
| | F | 1/2 | 5/8 | 3/4 | 7/8 | 1 1/4 | 1 1/2 |
| | FL | 1 1/2 | 2 | 2 1/2 | 3 1/2 | 4 1/2 | 5 |
| | LR | 15/16 | 1 3/8 | 1 11/16 | 2 7/16 | 2 7/8 | 3 5/16 |
| | M | 1/2 | 7/8 | 1 | 1 3/8 | 1 3/4 | 2 |
| | MR | 5/8 | 1 | 1 3/16 | 1 5/8 | 2 1/16 | 2 3/8 |
| | R | 2.05 | 2.76 | 4.10 | 4.95 | 6.58 | 7.92 |
| | LOAD CAPACITY LBS. | 5770 | 9450 | 14300 | 20322 | 37800 | 50375 |

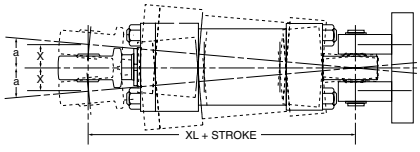
Order to fit Mounting Plate or Rod Eye.

## Mounting Information

Head End Mounting




Cap End Mounting




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

**Table 1**

| Bore | Head End Mounted | | Cap End Mounted | |
|---|---|---|---|---|
| | Angle a | Tan. of a | Angle a | Tan. of a |
| 1 1/2 | 2° | .035 | 2° | .035 |
| 2 | 2 1/2° | .044 | 4 1/2° | .079 |
| 2 1/2 | 2 1/2° | .044 | 4 1/2° | .079 |
| 3 1/4 | 3° | .052 | 3° | .052 |
| 4 | 2 1/2° | .044 | 3° | .052 |
| 5 | 3° | .052 | 3° | .052 |
| 6 | 3° | .052 | 3° | .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 times 2X stroke.



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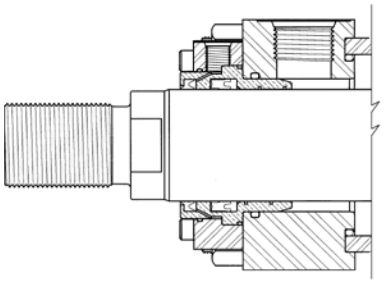
### Metallic Rod Wiper
When specified metallic rod wipers can be supplied instead of the standard synthetic rubber wiperseal. Recommended in applications where contaminants tend to cling to the extended piston rod and would damage the synthetic rubber wiperseal. Installation of metallic rod wiper does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

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

An SAE #4 gland drain port can be provided in the gland retainer. A passage in the gland between the wiperseal and rod seal is provided to drain off any accumulation of fluid between the seals. See drawing below.

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



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

## 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.

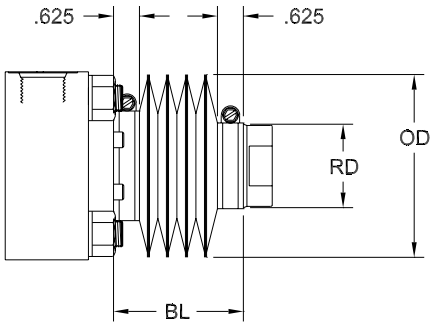
| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LF** | .13 | .13 | .13 | .13 | .13 | .13 | .13 | .10 | .10 | .10 | .10 | .10 |
| **OD** | 2 1/4 | 2 1/4 | 2 5/8 | 3 | 3 3/8 | 3 3/4 | 4 3/8 | 5 1/8 | 5 5/8 | 6 1/4 | 7 | 7 1/2 |
| **RD** | 1/2 | 5/8 | 1 | 1 3/8 | 1 3/4 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 5 1/2 |

To determine extra length of piston rod required to accommodate boot, calculate

BL = Stroke x LF + 1 1/8"

BL + VA + C = WF for piston rod with rod boot.

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



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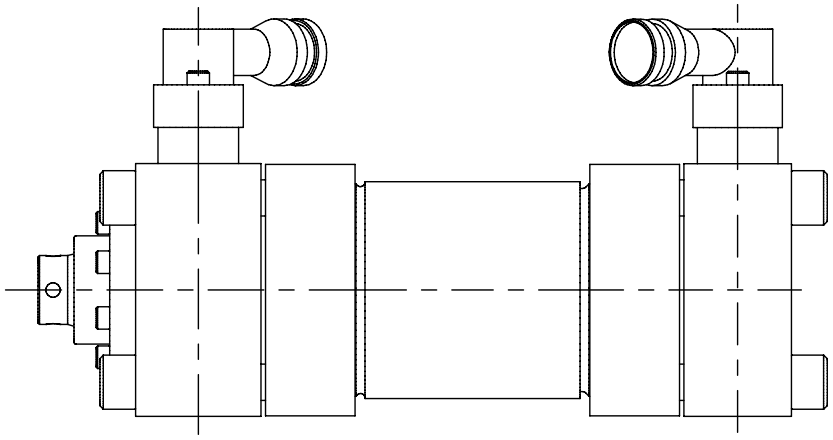
# Parker EPS-7 Solid State Proximity Switches



The Parker EPS-7 is an inductive type proximity switch that provides full extend or retract indication. The completely solid state electronics are epoxy potted in housings that meet enclosure types listed below. The non-contact probe senses the presence of the ferrous cushion spear or sleeve. There are no cams, plungers, mechanical switches or dynamic seals to wear out or go out of adjustment. By mounting the EPS proximity switch in the cylinder head or cap, costly design and set-up time associated with external limit switches is eliminated. Also, since the probe is sealed within the cylinder body the switch cannot be tampered with. The EPS meets UL requirements and is designed to operate within one inch of resistance welder tips carrying 20,000 Amperes.

The standard Parker EPS-7 is a 2-wire AC/DC switch which will operate from 20 to 250 VAC/DC.

The low 1.7 mA off-state leakage current allows the EPS to operate relay coil loads or act as a direct input into a PLC. The standard short circuit protection protects the switch from shorts in the load or line. Upon sensing a short condition (5 Amp or greater current) the switch assumes a non-conducting mode. The fault condition must be removed and the power removed to reset, preventing automatic restarts.

A ready LED indicator illuminates to indicate that the power is on and the switch is not conducting. The target LED will illuminate when the switch is activated. One LED will flash to indicate a short circuit condition.

For more information or applications requiring intrinsically-safe switches contact the Parker Hannifin Cylinder Division.

## Features

- Completely Solid State – no moving parts to wear out
- Low Leakage Current – directly compatible with programmable controllers
- Meets enclosure types IEC IP67
- UL Approved
- Standard Short Circuit Protection – operates safely near high magnetic fields such as those in welding equipment and large electric motors
- Shock and Vibration Resistant – withstands up to 30g's vibration to 2000 Hz



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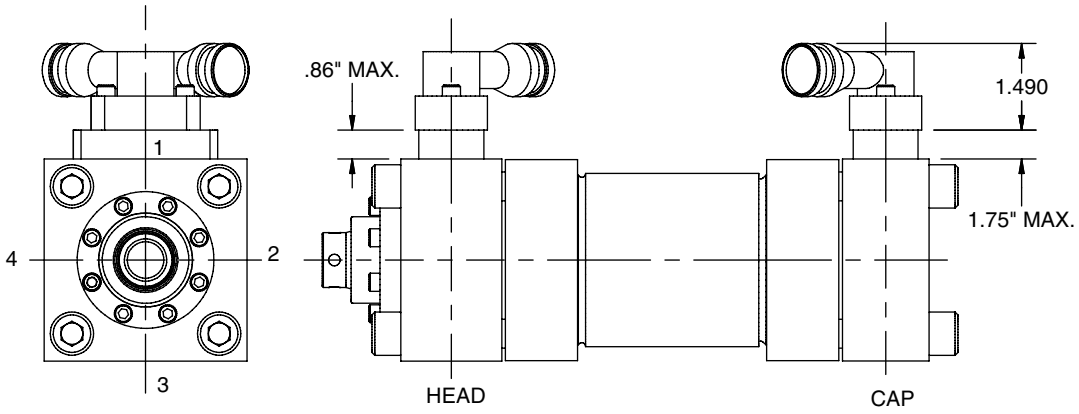
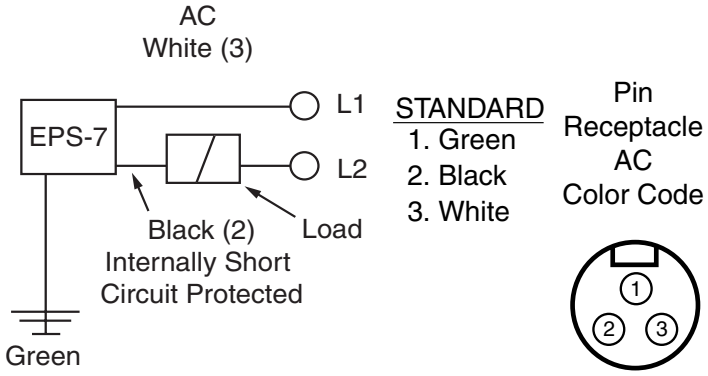
## EPS-7 Heavy Duty Industrial Applications

For top view, see EPS-6.




## Wiring Diagrams and Information




**Connectors**

The male quick disconnect on the Parker EPS-7 is a Brad Harrison 40909 connector.

Female connects must be purchased with one of the following cable lengths.

| | Parker Part No. |
|---|---|
| **Cable Length** | **Standard** |
| 3' | 0853550003 |
| 6' | 0853550006 |
| 9' | — |
| 12' | 0853550012 |

**Series and Parallel Wiring**

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

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

Parker EPS-6 or 7 switches may also be hard wired for parallel operation. However, the leakage current of each switch 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 switches in parallel will require the use of a bypass (shunt) resistor.



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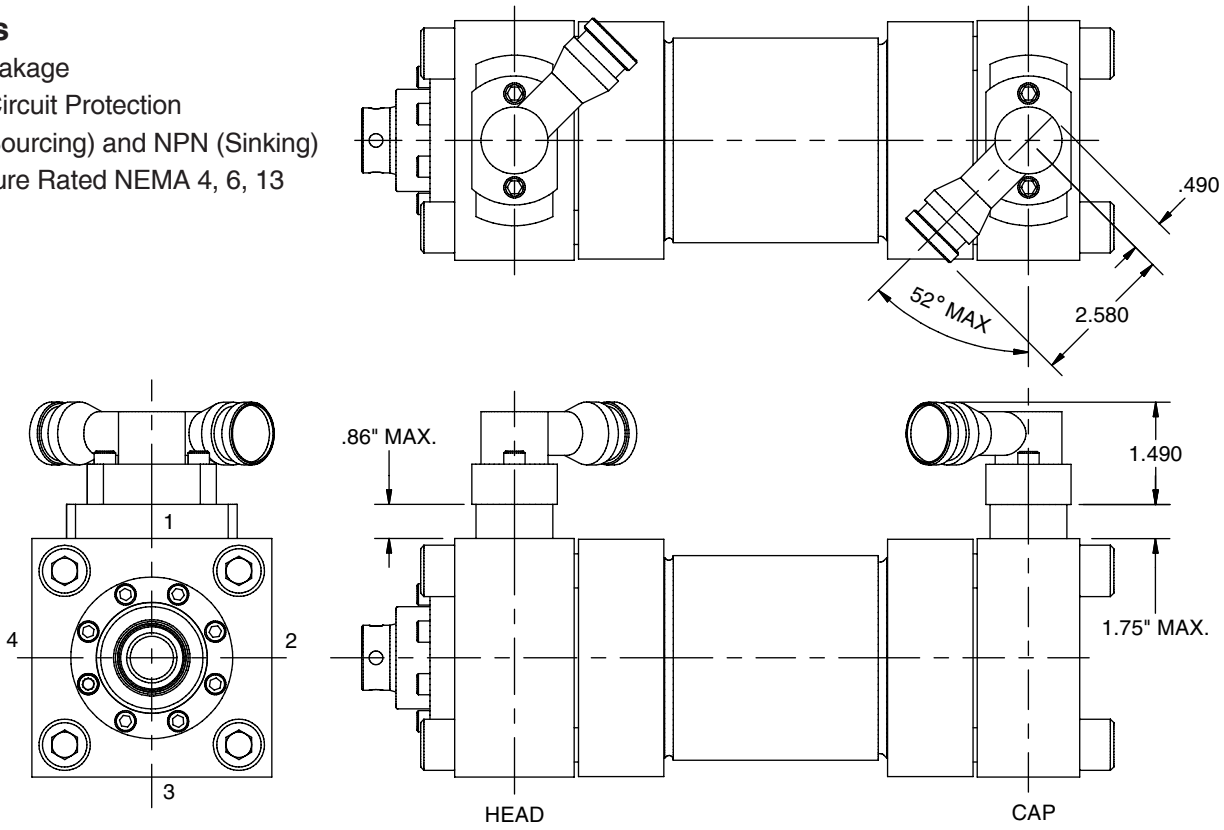
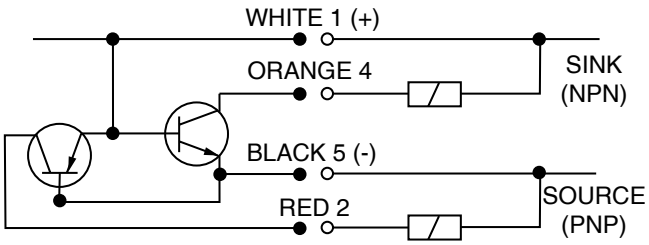
# Parker EPS-6 Low Voltage DC Proximity Switches

## Features

- Low Leakage
- Short Circuit Protection
- PNP (Sourcing) and NPN (Sinking)
- Enclosure Rated NEMA 4, 6, 13




## Wiring Diagrams and Information

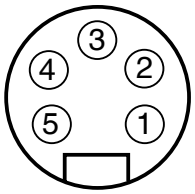



| LED Function | "Ready" | "Target" |
|---|---|---|
| Power Applied (No Target) | ON | OFF |
| Target Present | OFF | ON |
| Short Circuit Condition | FLASH | FLASH |

**Connectors**

The male quick disconnect on the Parker EPS-6 is a Brad Harrison 41310 connector.

**Plug Pin and Cable Identification**




1) +10 to 30 VDC (White)
2) Source (Red)
3) Grounded not connected nor required
4) Sink (Orange)
5) Common (Black)

| Cable Length | Parker No. |
|---|---|
| 3 | 085917 0003 |
| 6 | 085917 0006 |
| 12 | 085917 0012 |



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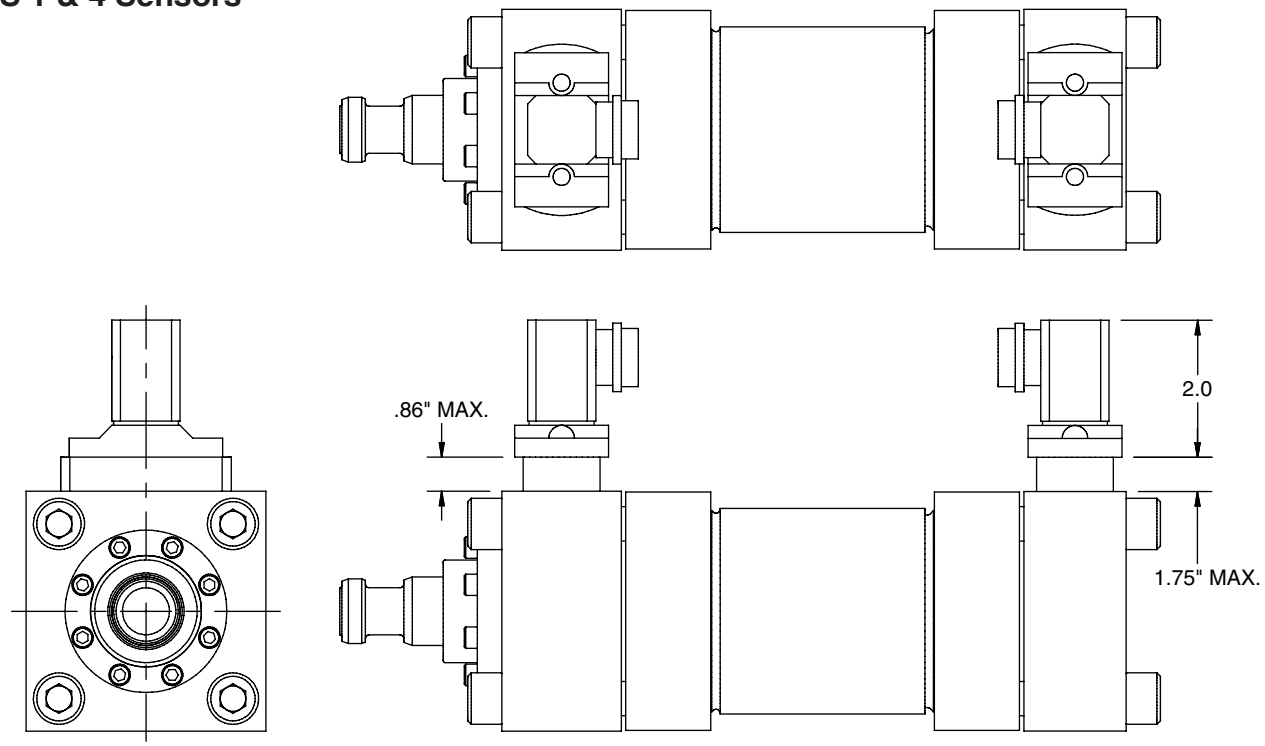
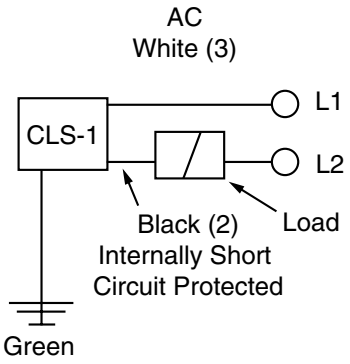
# Cylinder End-of-Stroke Proximity Sensors

## CLS 1 & 4 Sensors

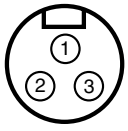



## Wiring Diagrams and Information




STANDARD
1. Green
2. Black
3. White

Pin
Receptacle
AC
Color Code




### Connectors

The male quick disconnect on the Parker CLS-1 is a Brad Harrison 40909 connector.

Female connects must be purchased with one of the following cable lengths.

| | Parker Part No. |
|---|---|
| **Cable Length** | **Standard** |
| 3' | 0853550003 |
| 6' | 0853550006 |
| 9' | — |
| 12' | 0853550012 |

The connection for the CLS-4 are 144" PTFE insulated flying leads with 1/2" conduit hub. 3-wire: Common (black), Normally open(blue), and Normally closed (red).

## Cylinder End-of-Stroke Proximity Sensors: 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 24 VDC 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 | NA | NA | NA |
| **Load Current, max:** | 300 mA | 200 mA | 4 AMPS @ 120 VAC<br>3 AMPS @ 24 VDC | 4 AMPS @ 120 VAC<br>3 AMPS @ 24 VDC |
| **Leakage Current:** | 1.7 mA, max. | 10 micro amps max. | – | – |
| **Voltage Drop:** | 7 V, max. | 2 VDC max. | NA | 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**** | 148896**** | 148275**** | 149109**** |
| **Part Number Suffix**** :** | ****4-digit suffix indicates probe length: 0125=1.25", 0206=2.06", 0287=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 | No | No |
| **Short Circuit Protection:** | Yes | Yes | No | No |
| **Weld Field Immunity:** | Yes | Yes | Yes | Yes |
| **Output:** | 2 wire, Normally Open with leakage | 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 | UL or CSA |
| **Make/Break Location:** | 0.125" from end of stroke, typical. Tolerance is ± .125. | | | |
| **Wiring Instructions:** | Pin 1: AC Ground (Green)<br>Pin 2: Output (Black)<br>Pin 3: AC Line (White) | Pin 1) +10 to 30 VDC (White)<br>Pin 2) Sourcing Output (Red)<br>Pin 3) Grounded (not connected or required)<br>Pin 4) Sinking Output (Orange)<br>Pin 5) DC Common (Black) | Pin 1: Common (Green)<br>Pin 2: Normally Closed (Black)<br>Pin 3: Normally Open (White) | Common: (Black)<br>Normally Open: (Blue)<br>Normally Closed: (Red) |
| **Cable: 6'** | 085355-0006 | 085917-0006 | 085355-0006 | – |
| **Cable: 12'** | 085355-0012 | 085917-0012 | 085355-0012 | – |
| **Cable: 6', Right Angle** | 087547-0006 | – | 087547-0006 | – |



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# Cylinder End-of-Stroke Proximity Sensors – How to Order

Parker EPS proximity switches may be ordered 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 E, D, DB, JJ, JB, or HB 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.

## How to Specify EPS Switches

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 = BXXXX-42BGG denotes a switch on the cap end only, CLS-4

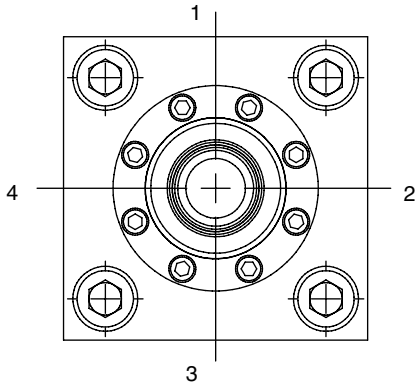
**Head End**

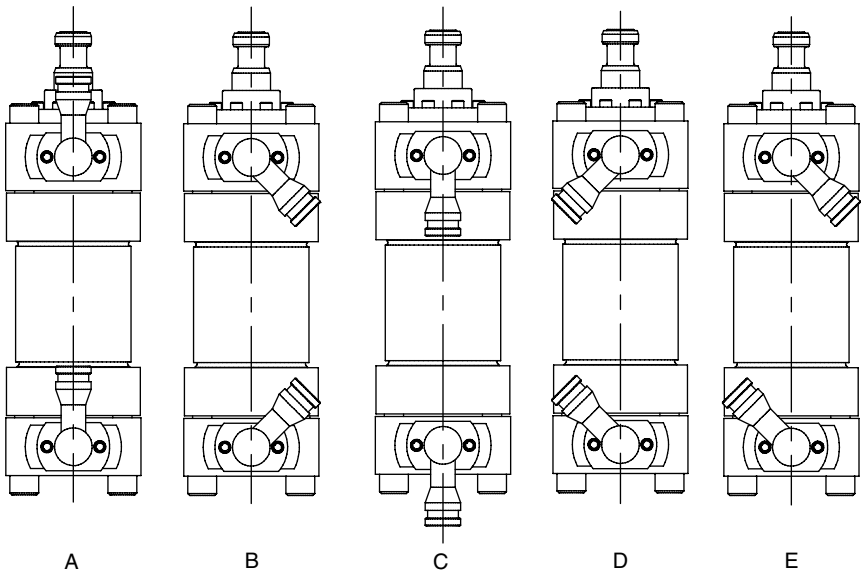
| R | 1 | 3 | A | GG |
|---|---|---|---|---|
| Specify:<br>“H” = EPS-7<br>“D” = EPS-6<br>“F” = CLS-1<br>“B” = CLS-4<br>“N” = Prep for switches only | Port Location See Figure 1. | Switch Location See Figure 1. | Switch Orientation See Figure 2 for EPS-7 and EPS-6 only. | Actuation Point<br>GG = End of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

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



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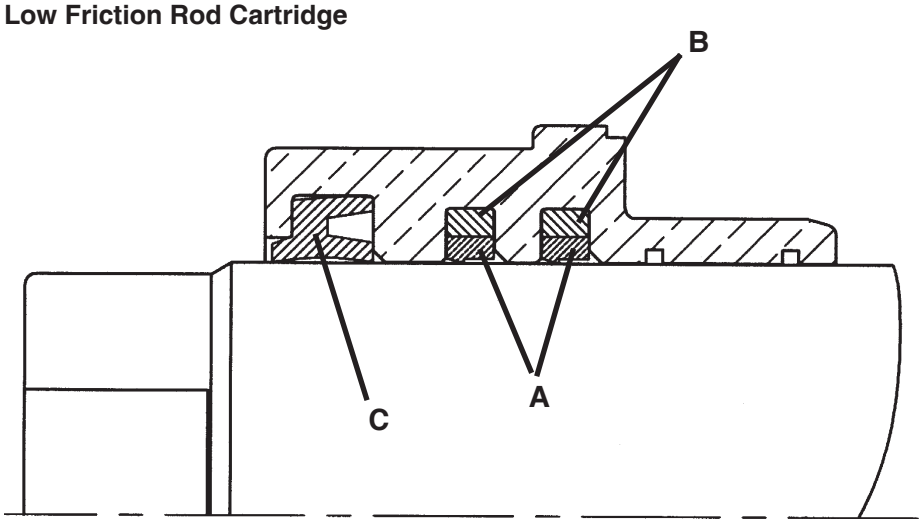
Milton, Ontario Canada

## Parker Series MH 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
- Filled PTFE material for low friction, rapid break-in and long service life
- Innovative seal geometry for maximum sealing efficiency

### Low Friction Rod Cartridge

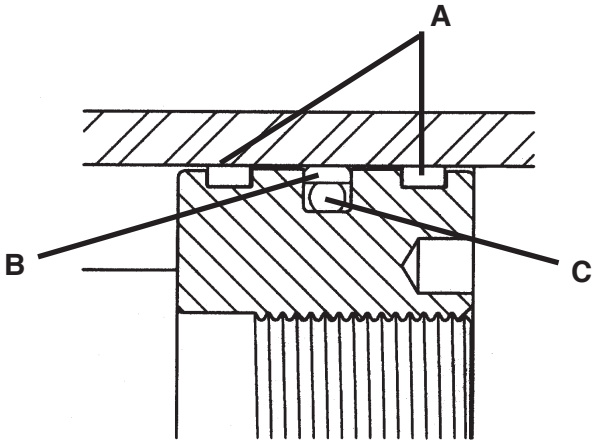



**A -** Dual step-seal rod seals insure positive sealing and smooth operation up to 2,000 PSI.

**B -** Elastomer expander for pressure compensation and low pressure effectiveness.

**C -** Dual lip wiper keeps contaminants out.

### Low Friction Piston



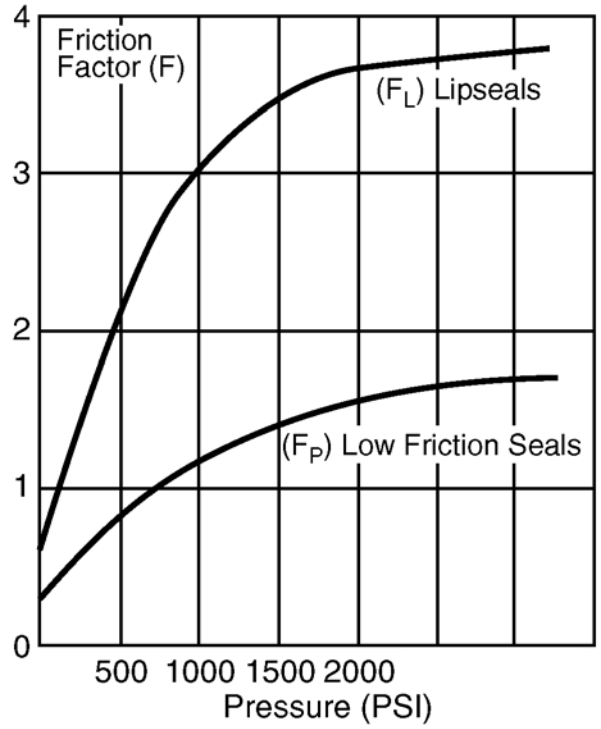

**A -** Dual filled PTFE piston bearings for high load capacity, low friction and no metal-to-metal contact.

**B -** Filled PTFE piston seal insures maximum sealing efficiency.

**C -** Elastomer expander for pressure compensation.

## 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:

| **Seal Option:** | **Formula:** |
|---|---|
| Lipseal Rod + Piston | $12d + 12\ F_Ld + 24\ F^LD$ |
| Lipseal Rod w/Low Friction Piston | $12d + 12\ F_Ld + 12F^pD$ |
| Low Friction Rod + Piston | $12 + 30\ F_pd + 6\ F^pD$ |

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: $F_L$ x 1.5
Low Friction: $F_p$ x 1.0

### Sample Calculation:

MH Cylinder with 3.25 dia. bore + 1.75 dia. piston rod with low friction seals at 1500 PSI.

### Running Friction Calculation:

Friction (lbs. force) ≈ $12d + 30F_pd + 6F_pD$

Friction (lbs. force) ≈ 12(1.75) + 30 (1.3 x 1.75) + 6(1.3 x 3.25)

Friction (lbs.force) ≈ 115

### Breakaway Friction Calculation:

$F^p$ x 1.0 ≈ $F_p$

Based on zero pressure:

Friction (lbs. force) ≈ $12d + 30F_pd + 6F_pD$

Friction (lbs. force) ≈ 12(1.75) + 30(.3 x 1.75) + 6(.3 x 3.25)

Friction (lbs. force) ≈ 43

### Specifications for Low Friction Option:

Operating Pressure: 0 - 2000 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

When ordering series MH cylinders, place an “S” in the model number for “special” and specify the following:

“Low friction piston and rod seals.”



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Ports

Parker hydraulic and pneumatic cylinders can be supplied with S.A.E. straight O-ring ports or N.P.T.F. pipe thread ports. For the type of port recommended and port size, see respective product catalogs. 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 valves.

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.

## Cylinder Port Options

Option "T" SAE Straight Thread O-Ring Port. Recommended for most hydraulic applications.

Option "U" Conventional NPTF Ports (Dry-Seal Pipe Threads). Recommended for pneumatic applications only.

Option "R" BSPP Port (British Parallel Thread). ISO 228 port commonly used in Europe. See Figure R-G below.

Option "P" SAE Flange Ports Code 61 (3000 psi). Recommended for hydraulic applications requiring larger port sizes.

Option "B" BSPT (British Tapered Thread).

Option "G" Metric Straight Thread Port similar to Option "R" with metric thread. Popular in some European applications. See Figure R-G below.

Option "Y" ISO-6149-1 Metric Straight Thread Port. Recommended for all hydraulic applications designed per ISO standards. See Figure Y below.

**Figure 1**

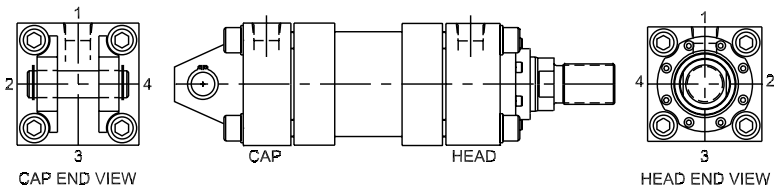



**Figure R-G**

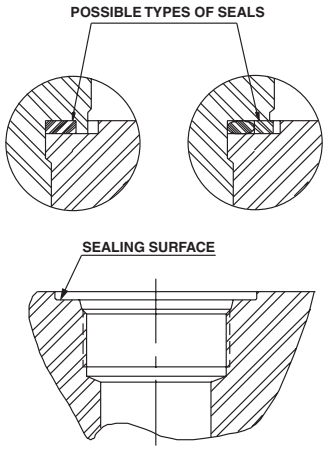



**Figure Y**

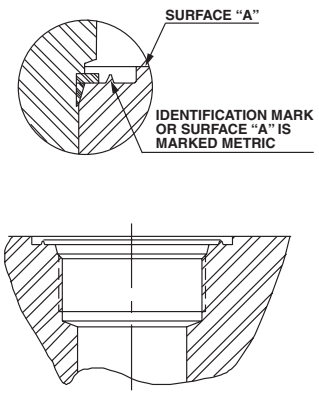



**Table A**

| Mounting Style | Port Position Available | |
|---|---|---|
| | Head End | Cap End |
| HB, JB, DD | 1, 2, 3 or 4 | 1, 2, 3 or 4 |
| BE, BB, DB, HH, SB | 1, 2, 3 or 4 | 1 or 3 |
| D, JJ | 1 or 3 | 1, 2, 3 or 4 |
| C, E, F | 1 | 1 |

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

**Available Ports for MH Series Cylinders**

| Bore | "T" SAE Standard | "U" NPTF Pipe Thread | "R" BSPP Parallel Thread | "P" SAE 4-Bolt Flange Nom. Size | "B" BSPT Taper Thread | "G" Metric Straight Thread | "Y" ISO-6149-1 Metric Straight Thread |
|---|---|---|---|---|---|---|---|
| 1 1/2 | #8 | 1/2 | 1/2 | N/A | 1/2 | M22 x 1.5 | M22 x 1.5 |
| 2 | #8 | 1/2 | 1/2 | N/A | 1/2 | M22 x 1.5 | M22 x 1.5 |
| 2 1/2 | #8 | 1/2 | 1/2 | 1/2 | 1/2 | M22 x 1.5 | M22 x 1.5 |
| 3 1/4 | #12 | 3/4 | 3/4 | 3/4 | 3/4 | M27 x 2 | M27 x 2 |
| 4 | #12 | 3/4 | 3/4 | 3/4 | 3/4 | M27 x 2 | M27 x 2 |
| 5 | #12 | 3/4 | 3/4 | 3/4 | 3/4 | M27 x 2 | M27 x 2 |
| 6 | #16 | 1 | 1 | 1 | 1 | M33 x 2 | M33 x 2 |
| 7 | #20 | 1 1/4 | 1 1/4 | 1 1/4 | 1 1/4 | M42 x 2 | M42 x 2 |
| 8 | #24 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | M48 x 2 | M48 x 2 |
| 10 | #24 | 1 1/2 | 1 1/2 | 2 | 1 1/2 | M48 x 2 | M48 x 2 |
| 12 | #24 | 1 1/2 | 1 1/2 | 2 1/2 | 1 1/2 | M48 x 2 | M48 x 2 |
| 14 | #24 | 1 1/2 | 1 1/2 | 2 1/2 | 1 1/2 | M48 x 2 | M48 x 2 |



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**HYDRAULIC CYLINDER SPEEDS**

Figures in the body of this chart are cylinder rod travel speeds in "inches per minute." Lines with rod diameter as NONE are extension speeds, using the full piston area. Lines with rod diameters are retraction speeds, using "net" piston area

| CYL BORE | ROD DIA | 1 GPM | 3 GPM | 5 GPM | 8 GPM | 12 GPM | 15 GPM | 20 GPM | 25 GPM | 30 GPM | 40 GPM | 50 GPM | 75 GPM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1½ | NONE | 130▫ | 392▫ | 654▫ | 1034▫ | | | | | | | | |
| | 5/8 | 158▫ | 476▫ | 792 | 1265▫ | | | | | | | | |
| | 1 | 235 | 706▫ | 1176 | 1880 | | | | | | | | |
| 2 | NONE | 73▫ | 221▫ | 368▫ | 588▫ | 883 | 1120▫ | | | | | | |
| | 1 | 97 | 294▫ | 490▫ | 782 | 1175▫ | 1465▫ | | | | | | |
| | 1 3/8 | 139 | 418▫ | 697▫ | 1115 | 1673 | 2090 | | | | | | |
| 2½ | NONE | 47▫ | 141▫ | 235▫ | 376▫ | 565▫ | 675▫ | 940 | 1175▫ | | | | |
| | 1 | 56▫ | 168▫ | 280▫ | 448▫ | 672▫ | 840 | 1120▫ | 1400▫ | | | | |
| | 1 3/8 | 67▫ | 203▫ | 339▫ | 542▫ | 813 | 1015▫ | 1355▫ | 1695▫ | | | | |
| | 1 3/4 | 92▫ | 277 | 463▫ | 740▫ | 1110 | 1385 | 1850 | 2310 | | | | |
| 3¼ | NONE | 28▫ | 83 | 139▫ | 223▫ | 334▫ | 417▫ | 557▫ | 696▫ | 836 | 1115▫ | | |
| | 1 3/8 | 34▫ | 102▫ | 170▫ | 271▫ | 407▫ | 510▫ | 680▫ | 850▫ | 1020▫ | 1360▫ | | |
| | 1 3/4 | 39▫ | 118▫ | 196▫ | 313▫ | 472▫ | 588▫ | 784▫ | 980 | 1176▫ | 1568▫ | | |
| | 2 | 44▫ | 134 | 224 | 358▫ | 537▫ | 672▫ | 896▫ | 1120 | 1344 | 1792 | | |
| 4▫ | NONE | 18▫ | 55▫ | 92 | 147▫ | 220▫ | 276▫ | 368▫ | 460▫ | 552▫ | 736▫ | 920 | |
| | 1 3/4 | 22▫ | 68▫ | 113▫ | 182▫ | 273▫ | 339▫ | 452▫ | 565▫ | 678▫ | 904▫ | 1130▫ | |
| | 2 | 24▫ | 73▫ | 122▫ | 196▫ | 294▫ | 366▫ | 488▫ | 610▫ | 732▫ | 976 | 1220▫ | |
| | 2 1/2 | 30▫ | 90▫ | 150 | 241 | 362▫ | 450▫ | 600▫ | 750▫ | 900▫ | 1200 | 1500 | |
| 5▫ | NONE | 12▫ | 35▫ | 58▫ | 94 | 141▫ | 174▫ | 232▫ | 290▫ | 348▫ | 464▫ | 500▫ | 870 |
| | 2 | 14▫ | 42▫ | 70▫ | 112▫ | 168▫ | 210▫ | 280▫ | 350▫ | 420▫ | 560▫ | 700▫ | 1050▫ |
| | 2 1/2 | 16▫ | 47▫ | 78▫ | 125▫ | 188▫ | 235▫ | 315▫ | 390▫ | 470▫ | 630▫ | 780▫ | 1170▫ |
| | 3 | 18▫ | 55▫ | 92 | 147▫ | 221▫ | 276▫ | 368▫ | 460▫ | 551▫ | 735▫ | 919 | 1379▫ |
| | 3 1/2 | 22 | 66▫ | 111 | 178 | 266 | 333▫ | 444▫ | 555▫ | 665▫ | 888▫ | 1110 | 1665 |
| 6▫ | NONE | 8 | 24▫ | 41▫ | 65▫ | 98 | 123▫ | 162▫ | 202▫ | 245▫ | 320▫ | 405▫ | 606▫ |
| | 2 1/2 | 10▫ | 30▫ | 50▫ | 79▫ | 118▫ | 150▫ | 200▫ | 250▫ | 300▫ | 400▫ | 495▫ | 750▫ |
| | 3 | 11▫ | 33▫ | 54▫ | 87▫ | 130▫ | 165▫ | 217▫ | 270▫ | 325▫ | 435▫ | 545▫ | 810▫ |
| | 3 1/2 | 12▫ | 37▫ | 62▫ | 99 | 149▫ | 186▫ | 248▫ | 310▫ | 372▫ | 495▫ | 619▫ | 929 |
| | 4 | 15 | 44▫ | 73▫ | 117 | 176 | 220 | 295▫ | 365▫ | 440▫ | 585▫ | 735▫ | 1095 |
| 7▫ | NONE | 6▫ | 18▫ | 30▫ | 48▫ | 72▫ | 90 | 120▫ | 150▫ | 180▫ | 240▫ | 300▫ | 450▫ |
| | 3 | 7▫ | 22▫ | 37▫ | 59▫ | 88▫ | 110▫ | 145▫ | 185▫ | 220▫ | 295▫ | 365▫ | 555▫ |
| | 3 1/2 | 8▫ | 24▫ | 40▫ | 64▫ | 96 | 120▫ | 160▫ | 200▫ | 240▫ | 320▫ | 400▫ | 600▫ |
| | 4 | 9 | 27▫ | 45▫ | 71▫ | 107▫ | 134▫ | 178▫ | 223▫ | 267▫ | 357▫ | 446▫ | 668▫ |
| | 4 1/2 | 10▫ | 31▫ | 51▫ | 82▫ | 123▫ | 153▫ | 205▫ | 256▫ | 307▫ | 409▫ | 512▫ | 767▫ |
| | 5 | 12 | 37▫ | 61▫ | 98▫ | 147 | 185 | 245 | 305▫ | 370▫ | 490▫ | 615▫ | 915▫ |
| 8 | NONE | 4 | 14▫ | 23▫ | 36▫ | 55▫ | 69▫ | 92 | 115▫ | 135▫ | 185▫ | 230▫ | 345▫ |
| | 3 1/2 | 5.5 | 17▫ | 28▫ | 45▫ | 68▫ | 85▫ | 115▫ | 140▫ | 170▫ | 230▫ | 285▫ | 420▫ |
| | 4 | 6▫ | 18▫ | 30▫ | 49▫ | 73▫ | 90 | 122▫ | 150▫ | 180▫ | 240▫ | 305▫ | 450▫ |
| | 4 1/2 | 7▫ | 20▫ | 34▫ | 54▫ | 81▫ | 101▫ | 134▫ | 168▫ | 202▫ | 269▫ | 336▫ | 504▫ |
| | 5 | 8 | 23▫ | 38▫ | 60▫ | 90 | 113▫ | 151▫ | 189▫ | 226▫ | 302▫ | 377▫ | 566▫ |
| | 5 1/2 | 8.5 | 26 | 43▫ | 70▫ | 104 | 129 | 172 | 215 | 255 | 345▫ | 430▫ | 645▫ |
| 10 | NONE | 3 | 9 | 15▫ | 23▫ | 35▫ | 44▫ | 60▫ | 73▫ | 88 | 115▫ | 145▫ | 220▫ |
| | 4 1/2 | 3.5 | 11▫ | 18▫ | 29▫ | 44▫ | 55▫ | 75▫ | 92▫ | 111▫ | 150▫ | 185▫ | 275▫ |
| | 5 | 4 | 12▫ | 20▫ | 31▫ | 47▫ | 59▫ | 78▫ | 98 | 118▫ | 157▫ | 196▫ | 294▫ |
| | 5 1/2 | 4.5▫ | 13▫ | 21▫ | 34▫ | 50▫ | 63▫ | 84 | 105▫ | 132▫ | 165▫ | 210▫ | 315▫ |
| | 7 | 5.5 | 17 | 29▫ | 46▫ | 69▫ | 87▫ | 115 | 145 | 174 | 230 | 285▫ | 435▫ |
| 12▫ | NONE | 2 | 6▫ | 10▫ | 16▫ | 25▫ | 31▫ | 41▫ | 51▫ | 61▫ | 82 | 102▫ | 153▫ |
| | 5 1/2 | 2.5 | 8▫ | 13▫ | 21▫ | 31▫ | 39▫ | 52▫ | 65▫ | 78▫ | 103▫ | 129▫ | 194▫ |
| | 7▫ | 3 | 9 | 15▫ | 25▫ | 37▫ | 46▫ | 62▫ | 77▫ | 93 | 124▫ | 155▫ | 232▫ |
| | 8 | 3.5 | 11▫ | 18▫ | 29▫ | 44▫ | 55▫ | 74▫ | 92 | 110▫ | 147▫ | 184▫ | 276▫ |
| | 8 1/2 | 4 | 12 | 20 | 33 | 49 | 61 | 82 | 102 | 123 | 164 | 205 | 307 |
| 14▫ | NONE | 1.5▫ | 4.5▫ | 7.5 | 12.0▫ | 18.0▫ | 22.5▫ | 30.0▫ | 37.5▫ | 45.0▫ | 60.0▫ | 75.0 | 112.5▫ |
| | 7▫ | 2.0 | 6.0▫ | 10.0▫ | 16.0▫ | 24.0▫ | 30.0▫ | 10.0▫ | 50.0▫ | 60.0▫ | 80.0▫ | 100.0▫ | 150.0▫ |
| | 8 | 2.22▫ | 6.7▫ | 11.0▫ | 17.8▫ | 26.7▫ | 33.4▫ | 11.6 | 55.7 | 66.8▫ | 89.0 | 111.4 | 167.0▫ |
| | 10 | 3.06▫ | 9.2 | 15.3▫ | 24.5 | 36.8 | 46.0 | 61.27 | 76.59▫ | 91.9▫ | 122.5 | 153.18 | 229.8▫ |



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## Acceleration and Deceleration Force Determination

The uniform acceleration force factor chart and the accompanying formula can be used to rapidly determine the forces required to accelerate and decelerate a cylinder load. To determine these forces, the following factors must be known: total weight to be moved, maximum piston speed, distance available to start or stop the weight (load), direction of movement, i.e. horizontal or vertical, and load friction. By use of the known factors and the "g" factor from chart, the force necessary to accelerate or decelerate a cylinder load may be found by solving the formula (as shown in chart below) application to a given set of conditions.

## Nomenclature

V = Velocity in feet per minute
S = Distance in inches
F = Force in lbs.
W = Weight of load in pounds
g = Force factor
f = Friction of load on machine ways in pounds

To determine the force factor "g" from the chart, locate the intersection of the maximum piston velocity line and the line representing the available distance. Project downward to locate "g" on the horizontal axis. To calculate the "g" factor for distances and velocities exceeding those shown on the chart, the following formula can be used:

g = v2/s x .0000517

**Example:** Horizontal motion of a free moving 6,000 lb. load is required with a distance of 1/2" to a maximum speed of 120 feet per minute.

Formula (1) F = Wg should be used.

F = 6,000 pounds x 1.50 (from chart) = 9,000 pounds

Assuming a maximum available pump pressure of 1,000 p.s.i., a 4" bore cylinder should be selected, operating on push stroke at approximately 750 p.s.i. pressure at the cylinder to allow for pressure losses from the pump to the cylinder.

Assume the same load to be sliding on ways with a coefficient of friction of 0.15. The resultant friction load would be 6,000 x 0.15 = 900 lbs.

Formula (2) F = Wg + f should be used.

F = 6,000 lbs. x 1.5 (from chart) + 900 = 9,900 lbs.

Again allowing 750 p.s.i. pressure at the cylinder, a 5" bore cylinder is indicated.

**Example:** Horizontal deceleration of a 5000 pound load is required by using a 1" long cushion in a 5" bore cylinder having a 1 3/4" diameter piston rod. Cylinder bore area (19.64 Sq. In.) minus the rod area results in a minor area of 17.23 Sq. In. at head end of cylinder. A pump delivering 500 p.s.i. at the cylinder is used to push the load at 120 feet per minute. Friction coefficient is 0.15 or 750 lbs.

In this example, the total deceleration force is the sum of the force needed to decelerate the 5,000 pounds load, and the force required to counteract the thrust produced by the pump.

W = Load in lbs. = 5000
S = Deceleration distance in inches = 1"
V = Maximum piston speed in feet per minute = 120
g = .74 (from chart)
f = 750 pounds

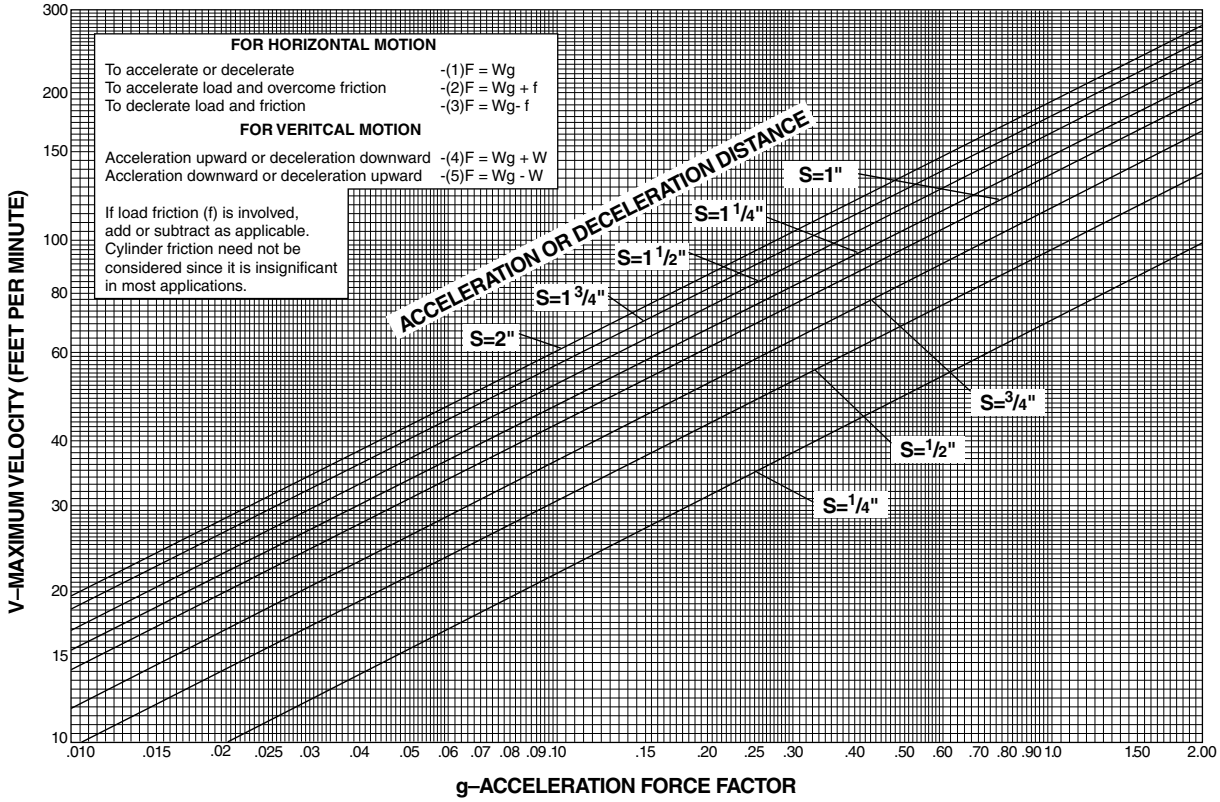
Use formula (3) F = Wg - f

(F = Wg - f) = (F = 5000 x .74 - 750) = 2,950 Pounds

The pump is delivering 500 p.s.i. acting on the 19.64 Sq. In. piston area producing a force (F2) of 9820 pounds. This force must be included in our calculations. Thus F + F2 = 2950 + 9820 = 12,770 pounds total force to be decelerated.

The total deceleration force is developed by the fluid trapped between the piston and the head. The fluid pressure is equal to the force (12,770 pounds) divided by the minor area (17.23 Sq. In.) equals 741 p.s.i. This pressure should not exceed the non-shock rating of the cylinder.

Cushioning practice is to select a "g" factor between .2 and 1.5.



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## Stop Tubing

Stop tube is recommended to lengthen the distance between the gland 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 below shows stop tube construction for a cushioned cylinder. Non-cushioned cylinders use the same construction, but the cushion sleeves are eliminated. Dual piston stop tubes can also be utilized to add additional bearing when the stop tube length is significant. Refer to the chart to determine recommended stop tube length.

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.

Refer to piston rod/stroke selection chart to determine stop tube length.

**Stop Tube Information: Max. Stroke per Mount**

| Bore | Case 1, 2 Rigid Mounts with rod support | Case 3 Rigid Mounts without support | Case 4, 5, 6 Pivot Mounts |
|---|---|---|---|
| 1 1/2 & 2" | 48 in. | 30 in. | 24 in. |
| 2 1/2 to 4" | 48 in. | 38 in. | 30 in. |
| 5 to 14" | 48 in. | 40 in. | 36 in. |

Extra rod extension is added into stroke.

1" of stop tube for every 10" over maximum.

**Mounting Classes**

Standard mountings fall into three basic groups, which are summarized as follows:

**Group 1** Straight line force transfer with fixed mounting which absorbs forces on the cylinder centerline.

Heavy duty service
- thrust E, HB, HH
- tension E, JB, JJ

**Group 2** Pivot force transfer with mounting which permits alignment to change in a single plane along cylinder centerline. Stroke length will influence service rating.

Heavy duty service
- thrust D, DD
- tension BE, BB, D, DB, DD

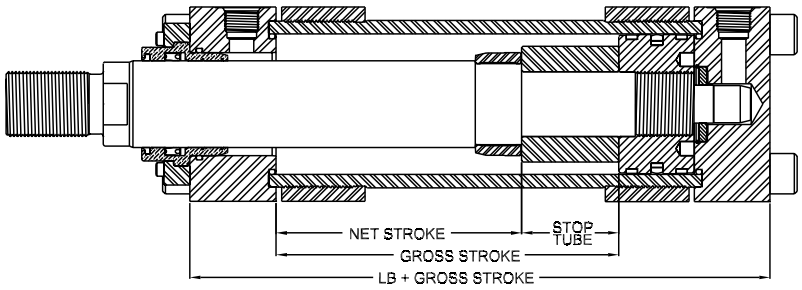
Medium duty service
- thrust BE, BB

**Group 3** Straight line force transfer with fixed mounting which does not absorb force on the centerline.

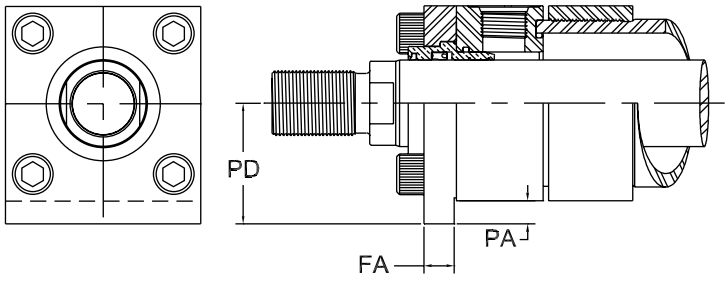
Heavy duty service
- thrust C
- tension C

Medium duty service
- thrust F
- tension F

**Drawing A**




**Thrust-Key Retainer Plate Option**




| BORE | E | FA+.000 | PA | PD |
|---|---|---|---|---|
| 1.50 | 2.50 | .312—.002 | .188 | 1.437 |
| 2.00 | 3.00 | .562—.002 | .312 | 1.812 |
| 2.50 | 3.50 | .562—.002 | .312 | 2.062 |
| 3.25 | 4.50 | .687—.003 | .375 | 2.625 |
| 4.00 | 5.00 | .812—.003 | .437 | 2.937 |
| 5.00 | 6.50 | .812—.003 | .437 | 3.687 |
| 6.00 | 7.50 | .937—.003 | .500 | 4.250 |
| 7.00 | 8.50 | .937—.003 | .500 | 4.750 |
| 8.00 | 9.50 | .937—.003 | .500 | 5.250 |

NOTE: A full retainer plate can be included as an option instead of the packing cap on bore sizes 1 1/2" through 6".



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## 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:

   Basic Length = Actual Stroke X Stroke Factor

   The graph is prepared for standard rod extensions beyond the face of the 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.

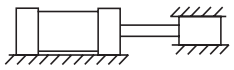
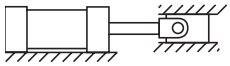
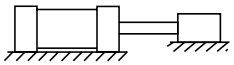
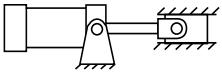
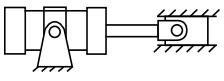
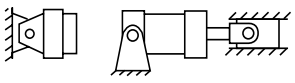
   B) The required length of stop tube is read from the right of the graph by following the shaded band in which the point of intersection lies.

   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 (Dim. "LA") 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.

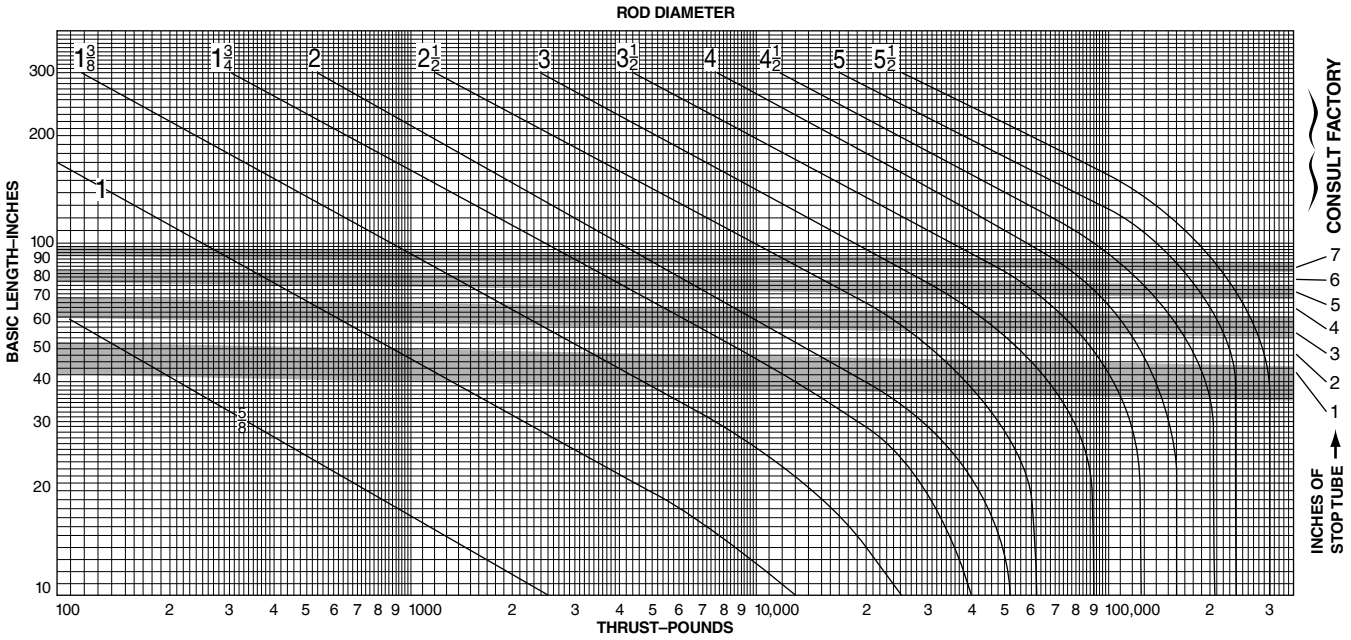
**⚠ Warning**

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**<br>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. 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**<br>Style D — Trunnion on Head | Pivoted and Rigidly Guided | IV  | 1.00 |
| Style DD — Intermediate Trunnion | Pivoted and Rigidly Guided | V  | 1.50 |
| Style DB — Trunnion on Cap or<br>Style BB — Clevis on Cap | Pivoted and Rigidly Guided | VI  | 2.00 |

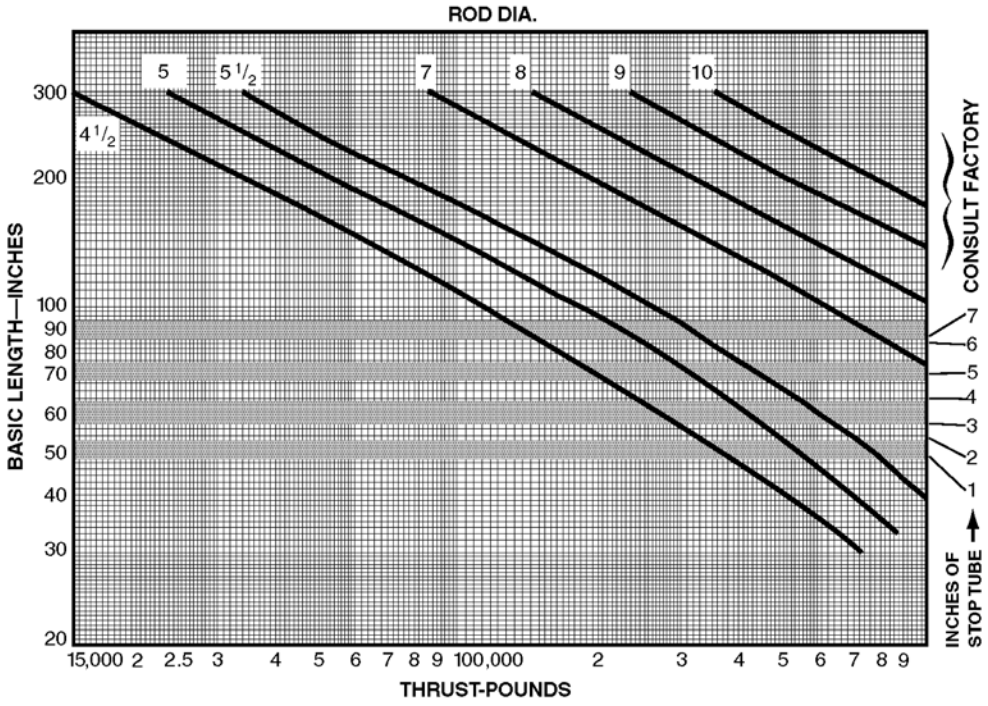
## Piston Rod — Stroke Selection Chart

1 1/2" Through 8" Bore




## Piston Rod — Stroke Selection Chart

10" Through 14" Bore






**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

## Selecting the Proper Size Cylinder

DETERMINE THE FORCE REQUIRED — To select a cylinder for an application, first determine the maximum push and/or pull force required to do the job. Then use the pressure table to select the cylinder that gives the necessary force for your application. It should be noted that the force requirements derived by formula are only theoretically correct. Other factors must be provided for.

Pressure drop—which means that working pressure at the cylinder port will be somewhat less than system pressure—should be allowed for in such calculations. A margin for overcoming friction in the cylinder likewise must be added.

After selecting the proper size cylinder for the job use the envelope and mounting dimension charts to determine cylinder dimensions.

## Pressure Table

| CYL. BORE DIA. | PRESSURE RATINGS HEAVY DUTY SERVICE | PRESSURE RATINGS 4:1 SAFETY FACTOR | PISTON ROD DIA. | CYL. WORK ACTION | WORK AREA (SQ. IN.) | HYDRAULIC WORKING PRESSURE PSI 350 | 500 | 750 | 1000 | 1500 | 2000 | FLUID REQUIRED PER IN. OF STROKE GAL. | CU. FT. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.50 | 2000 | 1246 | 5/8 | Push | 1.767 | 618 | 884 | 1325 | 1767 | 2651 | 3534 | .00765 | .00102 |
| | | | 1 | Pull | 1.460 | 511 | 730 | 1095 | 1460 | 2190 | 2920 | .00632 | .00084 |
| | | | | Pull | .982 | 344 | 491 | 737 | 982 | 1473 | 1964 | .00425 | .00057 |
| 2.00 | 2000 | 1000 | 1 | Push | 3.141 | 1099 | 1571 | 2356 | 3141 | 4712 | 6282 | .01360 | .00182 |
| | | | 1 3/8 | Pull | 2.356 | 825 | 1178 | 1767 | 2356 | 3534 | 4712 | .01020 | .00136 |
| | | | | Pull | 1.656 | 580 | 828 | 1252 | 1656 | 2484 | 3312 | .00717 | .00096 |
| 2.50 | 2000 | 1000 | 1 | Push | 4.909 | 1718 | 2455 | 3682 | 4909 | 7364 | 9818 | .02125 | .00284 |
| | | | 1 3/8 | Pull | 4.124 | 1443 | 2062 | 3093 | 4124 | 6186 | 8248 | .01785 | .00239 |
| | | | 1 3/4 | Pull | 3.424 | 1198 | 1712 | 2568 | 3424 | 5136 | 6848 | .01482 | .00198 |
| | | | | Pull | 2.504 | 876 | 1252 | 1878 | 2504 | 3756 | 5008 | .01084 | .00145 |
| 3.25 | 2000 | 1912 | 1 3/8 | Push | 8.296 | 2904 | 4148 | 6222 | 8296 | 12444 | 16592 | .0359 | .00480 |
| | | | 1 3/4 | Pull | 6.811 | 2384 | 3406 | 5108 | 6811 | 10217 | 13622 | .0295 | .00394 |
| | | | 2 | Pull | 5.891 | 2062 | 2946 | 4418 | 5891 | 8837 | 11782 | .0255 | .00341 |
| | | | | Pull | 5.154 | 1804 | 2577 | 3866 | 5154 | 7731 | 10308 | .0223 | .00298 |
| 4.00 | 2000 | 1490 | 1 3/4 | Push | 12.566 | 4398 | 6283 | 9425 | 12566 | 18849 | 25132 | .0544 | .00727 |
| | | | 2 | Pull | 10.161 | 3556 | 5081 | 7621 | 10161 | 15242 | 20322 | .0440 | .00588 |
| | | | 2 1/2 | Pull | 9.424 | 3298 | 4712 | 7068 | 9424 | 14136 | 18848 | .0408 | .00545 |
| | | | | Pull | 7.657 | 2680 | 3829 | 5743 | 7657 | 11486 | 15314 | .0331 | .00443 |
| 5.00 | 2000 | 1348 | 2 | Push | 19.635 | 6872 | 9818 | 14726 | 19635 | 29453 | 39270 | .0850 | .01136 |
| | | | 2 1/2 | Pull | 16.492 | 5772 | 8246 | 12369 | 16492 | 24738 | 32984 | .0714 | .00954 |
| | | | 3 | Pull | 14.726 | 5154 | 7363 | 11045 | 14726 | 22089 | 29452 | .0637 | .00852 |
| | | | 3 1/2 | Pull | 12.566 | 4398 | 6283 | 9425 | 12566 | 18849 | 25132 | .0544 | .00728 |
| | | | | Pull | 10.014 | 3505 | 5007 | 7511 | 10014 | 15021 | 20028 | .0433 | .00580 |
| 6.00 | 2000 | 1099 | 2 1/2 | Push | 28.274 | 9896 | 14137 | 21206 | 28274 | 42411 | 56548 | .1224 | .01636 |
| | | | 3 | Pull | 23.365 | 8178 | 11683 | 17524 | 23365 | 35048 | 46730 | .1011 | .01352 |
| | | | 3 1/2 | Pull | 21.205 | 7422 | 10603 | 15904 | 21205 | 31808 | 42410 | .0918 | .01227 |
| | | | 4 | Pull | 18.653 | 6529 | 9327 | 13990 | 18653 | 27980 | 37306 | .0808 | .01079 |
| | | | | Pull | 15.708 | 5498 | 7854 | 11781 | 15708 | 23562 | 31416 | .0680 | .00909 |
| 7.00 | 2000 | 1384 | 3 | Push | 38.485 | 13470 | 19243 | 28864 | 38485 | 57728 | 76970 | .1666 | .02227 |
| | | | 3 1/2 | Pull | 31.416 | 10996 | 15708 | 23562 | 31416 | 47124 | 62832 | .1360 | .01818 |
| | | | 4 | Pull | 28.864 | 10102 | 14432 | 21648 | 28864 | 43296 | 57728 | .1250 | .01670 |
| | | | 4 1/2 | Pull | 25.915 | 9070 | 12958 | 19436 | 25915 | 38873 | 51830 | .1122 | .01500 |
| | | | 5 | Pull | 22.585 | 7905 | 11293 | 16939 | 22585 | 33878 | 45170 | .0977 | .01307 |
| | | | | Pull | 18.850 | 6598 | 9425 | 14138 | 18850 | 28375 | 37700 | .0816 | .01091 |
| 8.00 | 2000 | 1121 | 3 1/2 | Push | 50.265 | 17593 | 25133 | 37699 | 50265 | 75398 | 100530 | .2176 | .02909 |
| | | | 4 | Pull | 40.644 | 14225 | 20322 | 30483 | 40644 | 60966 | 81288 | .1759 | .02352 |
| | | | 4 1/2 | Pull | 37.699 | 13195 | 18850 | 28274 | 37699 | 56549 | 75398 | .1632 | .02182 |
| | | | 5 | Pull | 34.365 | 12028 | 17183 | 25774 | 34365 | 51548 | 68730 | .1488 | .01989 |
| | | | 5 1/2 | Pull | 30.630 | 10721 | 15315 | 22973 | 30630 | 45945 | 61260 | .1326 | .01772 |
| | | | | Pull | 26.507 | 9277 | 13254 | 19880 | 26507 | 39761 | 53014 | .1147 | .01534 |
| 10.00 | 2000 | 2000 | 4 1/2 | Push | 78.540 | 27489 | 39270 | 58905 | 78540 | 117810 | 157080 | .3400 | .04545 |
| | | | 5 | Pull | 62.636 | 21923 | 31318 | 46977 | 62636 | 93954 | 125272 | .2712 | .03625 |
| | | | 5 1/2 | Pull | 58.905 | 20617 | 29453 | 44179 | 58905 | 88358 | 117810 | .2549 | .03408 |
| | | | 7 | Pull | 54.782 | 19174 | 27391 | 41087 | 54782 | 82173 | 109564 | .2372 | .03170 |
| | | | | Pull | 40.055 | 14019 | 20028 | 30041 | 40055 | 60083 | 80110 | .1740 | .02319 |
| 12.00 | 2000 | 1112 | 5 1/2 | Push | 113.100 | 34585 | 56550 | 84825 | 113100 | 169650 | 226200 | .4896 | .06545 |
| | | | 7 | Pull | 89.399 | 31269 | 44670 | 67004 | 89339 | 134009 | 178678 | .3868 | .05170 |
| | | | 8 | Pull | 74.613 | 26115 | 37307 | 55960 | 74613 | 111920 | 149226 | .3230 | .04333 |
| | | | 8 1/2 | Pull | 62.830 | 21991 | 31415 | 47123 | 62830 | 94245 | 125660 | .2719 | .03636 |
| | | | | Pull | 56.352 | 19723 | 28176 | 42264 | 56352 | 84528 | 112704 | .2441 | .03259 |
| 14.00 | 2000 | 1221 | 7 | Push | 153.94 | 53879 | 76970 | 115455 | 153940 | 230910 | 307880 | .6664 | .0089 |
| | | | 8 | Pull | 115.45 | 40408 | 57725 | 86588 | 115450 | 173175 | 230900 | .4998 | .0668 |
| | | | 10 | Pull | 103.67 | 36285 | 51835 | 77753 | 103670 | 155505 | 207340 | .4488 | .06 |
| | | | | Pull | 75.40 | 26390 | 37700 | 56550 | 75400 | 113100 | 150800 | .3264 | .0436 |

4:1 SAFETY FACTOR BASED ON BURST PRESSURE ONLY



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### Recommended Head Screw Torque Values for Series "MH" Cylinders

| BORE | 1 1/2 | 2 | 2 1/2 | 3 1/4 | 4 | 5 | 6 | 7 | 8 | 10 | 12 | 14 | 16", 18", 20" |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HEAD BOLT THREAD | 3/8 - 24 | 1/2 - 20 | 1/2 - 20 | 5/8 - 18 | 5/8 - 18 | 7/8 - 14 | 1-14 | 1 1/8 -12 | 1 1/4 -12 | 1 1/8 -12 | 1 1/4 -12 | 1 1/4 -12 | Consult Factory |
| TORQUE FT. LBS. | 11 | 28 | 30 | 50 | 75 | 160 | 220 | 325 | 375 | 350 | 620 | 500 | |

### Recommended Retainer Screw Torque Values for Series "MH" Cylinders

| Screw Size | #10-24 UNC | 1/4-20 UNC | 3/8-16 UNC |
|---|---|---|---|
| Torque | 24 in. lb. | 120 in. lb. | 240 in. lb. |

### Approximate Net Weights of Series "MH" Cylinders Based on Standard Rod Diameters (All weights expressed in lbs.)

| BORE | ROD DIA. | SINGLE ROD END | | DOUBLE ROD END | |
|---|---|---|---|---|---|
| | | BASE | PER INCH | DRE BASE | DRE PER INCH |
| 1.50 | 0.63 | 11.5 | 0.4 | 13.2 | 0.5 |
| | 1 | 11.8 | 0.5 | 13.3 | 0.7 |
| 2.00 | 1 | 16.4 | 0.6 | 20.0 | 0.8 |
| | 1.38 | 20.3 | 0.8 | 23.8 | 1.2 |
| 2.50 | 1 | 23.2 | 0.9 | 28.2 | 1.1 |
| | 1.75 | 29.2 | 1.3 | 33.7 | 2.0 |
| 3.25 | 1.38 | 48.8 | 1.5 | 59.8 | 1.9 |
| | 2 | 53.8 | 1.9 | 64.8 | 2.8 |
| 4.00 | 1.75 | 64.9 | 2.2 | 74.9 | 2.9 |
| | 2 | 69.9 | 2.9 | 108.9 | 4.3 |
| 5.00 | 2 | 98.1 | 2.8 | 118.1 | 4.2 |
| | 3.5 | 102.1 | 4.6 | 139.1 | 7.3 |
| 6.00 | 2.5 | 156.2 | 4.4 | 182.2 | 5.8 |
| | 4 | 163.2 | 6.5 | 213.2 | 10.1 |
| 7.00 | 3 | 276.2 | 5.7 | 373.2 | 7.7 |
| | 5 | 287.2 | 9.3 | 394.2 | 14.9 |
| 8.00 | 3.5 | 325.0 | 7.8 | 380.0 | 10.5 |
| | 5.5 | 358.0 | 11.8 | 460.0 | 18.5 |

| BORE | ROD DIA. | SINGLE ROD END | | | | | DOUBLE ROD END | |
|---|---|---|---|---|---|---|---|---|
| | | D, DB BASE | DD, JJ, HH BASE | JB, HB BASE | BE, BB, E, C BASE | PER INCH OF STROKE | ADD TO ALL | ADD PER INCH |
| 10.00 | 4.50 | 672.4 | 756.4 | 794.4 | 717.4 | 13.0 | 43 | 18.0 |
| | 5.00 | 684.4 | 766.4 | 805.4 | 729.4 | 14.0 | 50 | 19.0 |
| | 5.50 | 693.4 | 777.4 | 815.4 | 738.4 | 15.0 | 64 | 22.0 |
| | 7.00 | 730.4 | 814.4 | 852.4 | 775.4 | 19.0 | 101 | 30.0 |
| 12.00 | 5.50 | 1068.5 | 1201.5 | 1280.5 | 1144..5 | 19.5 | 64 | 26.5 |
| | 7.00 | 1105.5 | 1238.5 | 1317.5 | 1180.5 | 23.5 | 101 | 34.5 |
| | 8.00 | 1166.5 | 1299.5 | 1378.5 | 1241.5 | 26.5 | 162 | 40.5 |
| 14.00 | 7.00 | 1480.0 | 1665.0 | 1727.0 | 1630.0 | 24.3 | 101 | 35.3 |
| | 8.00 | 1541.0 | 1726.0 | 1788.0 | 1691.0 | 27.3 | 162 | 41.3 |
| | 10.00 | 1641.0 | 1826.0 | 1888.0 | 1791.0 | 35.3 | 262 | 57.3 |



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

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

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

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

Before selecting or using Parker (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 1-800-CPARKER, 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 review 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:

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

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

**3.0 Cylinder and Accessories Installation and Mounting**

**3.1 Installation**

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



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

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

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

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

**3.2 Mounting Recommendations**

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

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

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

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

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

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

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

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

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

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

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

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

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

**4.2 Cylinder Trouble Shooting**

**4.2.1** – **External Leakage**

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

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

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

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

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

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

**4.2.2** – **Internal Leakage**

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

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

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

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

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

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

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

**4.3 Erratic or Chatter Operation**

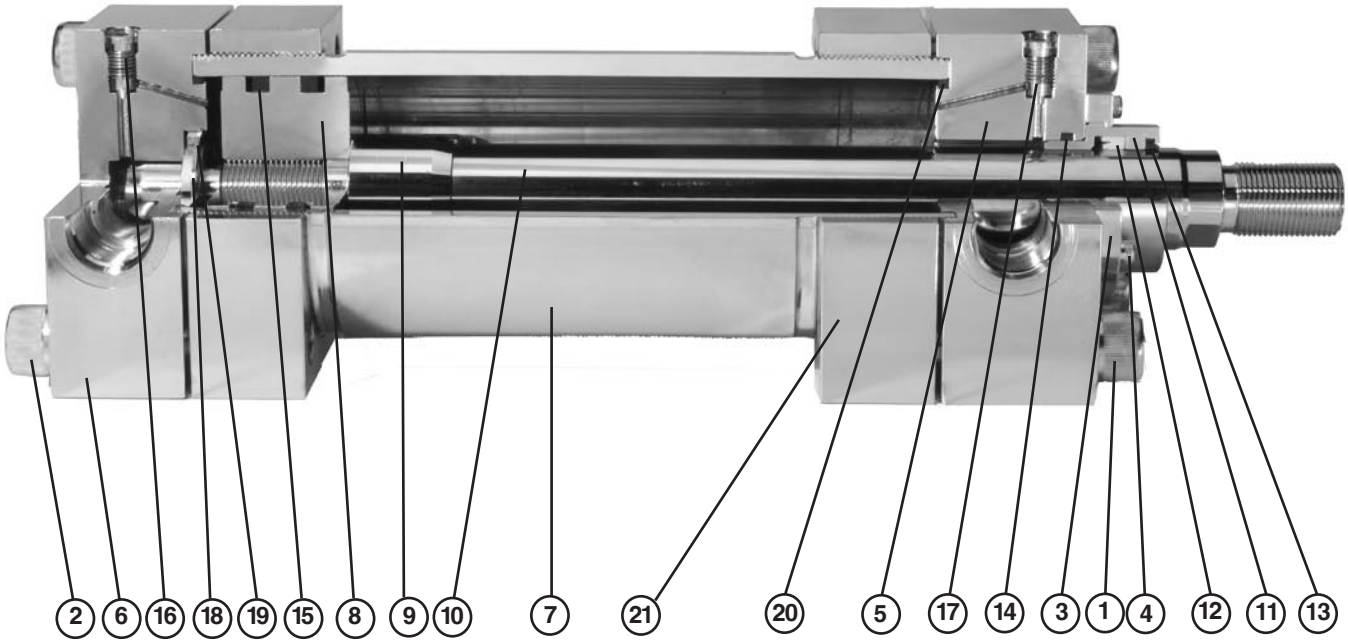
**4.3.1** – Excessive friction at rod gland or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

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

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

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

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

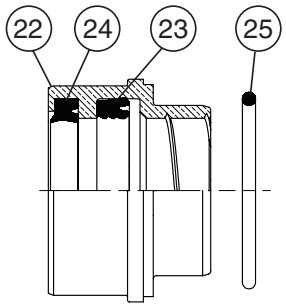



01. Rod Head Screw
02. Cap Head Screw
03. Retainer
04. Retainer Screw
05. Rod Head
06. Cap Head
07. Cylinder Body
08. Piston
09. Rod End Cushion Sleeve
10. Piston Rod
11. Rod Gland
12. Rod Seal
13. Rod Wiper
14. Gland O.D. Seal
15. Piston O.D. Seal
16. Needle Valve Assembly
17. Ball Check Assembly
18. Cushion Bushing
19. Retaining Ring
20. Cylinder Body Seal
21. Cylinder Body Flange

**Cylinder Repair Kit Contents**
Items 11, 12, 13, 14, 15, 20

To speed the handling of orders for parts or Repair kits, please specify:

1. Cylinder serial number
2. Cylinder bore diameter
3. Stroke
4. Piston rod diameter
5. Operating medium




22. Rod Gland
23. Rod Seal
24. Rod Wiper
25. Gland O.D. Seal



**Parker Hannifin Corporation**
Des Plaines, IL USA
Milton, Ontario Canada

# Offer of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and Divisions ("Company") and its authorized distributors, are hereby offered for sale at prices to be established by the Company, its subsidiaries and its authorized distributors. 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 such item, when communicated to the Company, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

**1. Terms and Conditions of Sale:** All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer. Acceptance of Seller's products shall in all events constitute such assent.

**2. Payment:** Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

**3. Delivery:** Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

**4. Warranty:** Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from the Company. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED.**

**NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGN OR SPECIFICATIONS.**

**5. Limitation of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.**

**6. Changes, Reschedules and Cancellations:** Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

**7. Special Tooling:** A tooling charge may be imposed for any special tooling, including without limitations, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. 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 items sold hereunder, 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.

**8. 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 (2) 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.

**9. Taxes:** Unless otherwise indicated on the face hereof, 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 the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

**10. 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 Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter "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 an item sold pursuant to this contract 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 an item sold hereunder 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 said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item 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 items 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 item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgements resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

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

**12. Entire Agreement/Governing Law:** The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.



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