H Series
Hydraulic Cylinder

Catalog M1112  October, 2003

Nominal Pressure 3000 PSI
Bore Sizes 1\(\frac{1}{2}\)" through 20"
NFPA Interchangeable
### AV Series Cylinders
Up to 250 PSI Permanently Lubricated

Series AV air cylinders are available in bore sizes from 1-1/2” through 14” and up to 250 PSI operating pressure. Standard NFPA dimensions and proven Miller design features.

### BT & BTM Series Cylinders
Up to 250 PSI

Our BT & BTM Series Air Cylinders are available in bore sizes from 5/16” through 3”. Operating pressures up to 250 PSI. 28 available mounting styles.

### IPA Series Cylinders
10 BAR

Up to 10 BAR pressure. Bore sizes 32mm through 200mm. Meets and approved to GM pneumatic cylinder specifications CC-001. VDMA 24562 and ISO 6431 compatible.

### HV2 Series Cylinders
3000 PSI

Miller’s heavy-duty cylinder line for demanding hydraulic applications. Bore sizes from 1-1/2” to 8”.

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⚠️ **Warning**

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The product described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by The Company and its subsidiaries at any time without notice.

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# Table Of Contents

Hydraulic Cylinder Features .................................................................................................................. 2-3
Mounting Styles .................................................................................................................................. 4-5
1 1/2"-20" Bore Cylinder Reference Chart .......................................................................................... 6-7
Cylinder Mountings (1 1/2"-8" Bores) ............................................................................................... 8-43
  Model 50 Series, Tie Rods Extended ............................................................................................... 8-9
  Model 61, Rectangular Flange - Head End ...................................................................................... 10-11
  Model 62, Rectangular Flange - Cap End ......................................................................................... 12-13
  Model 65, Square Flange - Head End ............................................................................................. 14-15
  Model 66, Square Flange - Cap End ............................................................................................... 16-17
  Model 67 & 68, Rectangular Head or Cap ..................................................................................... 18-19
  Model 72, Side Lugs ........................................................................................................................ 20-21
  Model 73, Centerline Lugs ............................................................................................................. 22-23
  Model 74, Side Tapped .................................................................................................................... 24-25
  Model 77, End Lugs ........................................................................................................................ 26-27
  Model 71, End Angles ..................................................................................................................... 28-29
  Model 81, Trunnion - Head End .................................................................................................... 30-31
  Model 82, Trunnion - Cap End ....................................................................................................... 32-33
  Model 89, Intermediate Trunnion ................................................................................................. 34-35
  Model 84, Fixed Clevis ................................................................................................................... 36-37
  Model 86, Detachable Clevis .......................................................................................................... 38-39
  Model 90, Rear Eye ........................................................................................................................ 40-41
  Model 94, Spherical Rear Eye ....................................................................................................... 42-44
Double Rod End .................................................................................................................................... 45
Large Bore Cylinder Dimensions (10"-20" Bores) ............................................................................ 46-57
  Models 50 & D50, No Mounting ................................................................................................... 46-47
  Models 63 & 64, Square Head or Cap .......................................................................................... 48-49
  Models 72 & 73, Side Lug or Centerline Lug ............................................................................... 50-51
  Models 81 & 82, Trunnion Head End or Cap End ...................................................................... 52-53
  Model 89, Intermediate Trunnion ................................................................................................. 54-55
  Models 84 & 90, Fixed Clevis or Rear Eye .................................................................................... 56-57
Rod End Styles and Dimensions ........................................................................................................... 58
Rod End Couplers ................................................................................................................................. 59
Rod End Accessories ............................................................................................................................. 60-62
Cylinder Stroke Adjustment & Other Modifications ........................................................................... 63
Proximity Switches ............................................................................................................................... 64-67
Determining Proper Bore Size ............................................................................................................ 68
Operating Fluids and Temperature Range ........................................................................................ 69
Position Sensing Cylinders .................................................................................................................. 70-74
Cylinder Pressure Ratings / Oversize Ports ...................................................................................... 75
Determining Stop Tube Requirements ............................................................................................... 76-77
Determining Column Strength of Piston Rod ................................................................................... 78
Non-Sag Piston Rods ............................................................................................................................ 79
Keying and Pinning of Cylinders ......................................................................................................... 80
Cylinder Parts List and Seal Kits ......................................................................................................... 81
Cylinder Storage, Installation, Mounting Recommendations, Trouble Shooting ......................... 82-83
Selection Guide / How To Order ......................................................................................................... 84-85
Offer of Sale ......................................................................................................................................... 86
Safety Guidelines ................................................................................................................................. 87
Cushion

Unique, optional, self-regulating cushion automatically adjusts to pressure, load and speed variations. This reduces shock and cushioning time, which permits quick out-of-cushion starts, thus increasing machine cycle rates.

Piston Seals

Rugged PTFE U-cup seals are mechanically locked to prevent rolling or blowout. Temperatures to 200°F standard. To 450° when spring-loaded.

Piston

One-piece piloted piston provides maximum strength. Piston threads increase in size for added strength when oversize rods are required.

Ports

SAE “O” ring ports are standard. NPTF ports are optional.

Piston Wear Band

Durable, non-metallic (11/4" - 6" Bores) (bronze 7" -20" bores) piston wear band reduces possibility of damaging piston which can score expensive tubing. Reduces need for piston replacement.

Piston Rod

Case-hardened to 54 Rockwell C and chrome-plated rod resists mechanical damage and side loads.
**Miller H Series Hydraulic Cylinders**

**Standard Design Features to Maximize Performance and Uptime**

**Tube End Seal**
PTFE “SHEF” tube-end seal resists heat, extrusion, shearing, and hydraulic fluids. Patented strip-type seal repairs all bore sizes with minimum inventory and downtime.

**Rod Seal**
Durable urethane rod seal is pressure-energized and wear-compensating for long, leak-free service.

**Bushing**
Nodular iron bushing provides longer bearing life than conventional bronze bushings. Protects against side loads. Removes easily using a common Allen wrench. Cylinder tie rods not disturbed.

**Tie Rods**
High strength, 100,000 to 125,000 PSI minimum yield material. Provides protection against shock pressures.

**Wiper Seal**
Wipes away dirt that may have accumulated on piston rod and prevents it from oversizing bushing. Also provides secondary rod seal.
Miller H Series hydraulic cylinders operate at internal pressures up to 3000 PSI, and incorporate proven Miller design characteristics to provide safe, reliable power for many heavy-duty industrial applications. Available in 23 standard mounting configurations to provide centerline, foot or pivot installations as explained below.

**Centerline Mounting**

The preferred cylinder installation method, centerline mounting places the mounting bolts in simple tension so that the mounting mechanism is protected from compound forces. Centerline mounting is a rigid mounting style and thus requires accurate cylinder alignment to prevent damage to cylinder working parts.

Miller Series H mounting configurations that provide centerline support are tie-rod mounts (51, 52, 53), flange mounts with square or rectangular flanges fastened to the cylinder head or cap (61, 62, 65, 66), rectangular head and cap cylinders (67 and 68), and centerline lug cylinders (73).

Centerline mounting is preferable since it prevents compound forces from acting on the mounting bolts (tie rod model shown).

**Foot Mounting**

Foot mounting allows the cylinder to be mounted and secured along its side, on both the head and cap end. When considering this style of mount, it should be noted that the mounting surface plane is not truly centered with the line of force plane. Therefore, the mounting bolts may be subjected to a significant amount of shear stress. Foot mounts are rigid in nature. Accurate cylinder alignment must be practiced when selecting this type of mount.

Lugs, either welded onto the sides of the head and cap (72) or attached to the ends of the cylinder (77), are the usual form of foot mounts. Centerline lugs are available as Model H 73. As an alternative to the use of lugs, flush mounting incorporates tapped mounting holes on the sides of the cylinder head and cap (74).

Foot mounting secures the cylinder on its side, but can subject the mounting bolts to compound stress (cylinder side lugs shown).

**Pivot Mounting**

Pivot mounting is used when the cylinder must pivot during piston motion. Clevis and trunnion mounts are the two methods used to allow this motion.

The clevis end and rear eye design locates the pivot point at the cap end of the cylinder (84, 86, 90, 94). Trunnion mounting uses trunnions on the head, cap or side of the cylinder to allow it to pivot at any of three locations (81, 82, 89). Both clevis and trunnion mounting configurations allow the cylinder to pivot in one plane only.

Pivot mounting allows the cylinder to pivot during piston motion (clevis method shown).
Miller H Series
Hydraulic Cylinders

Index
23 Mounting Styles Available

Centerline Mounts

- Tie Rod Models 50*, 51, (NFPA MX1), 52 (NFPA MX2), 53 (NFPA MX3), 54 (NFPA MX4)
- Rectangular Flange/Head End Model 61 (NFPA MF1)
- Rectangular Flange/Cap End Model 62 (NFPA MF2)
- Square Flange/Head End Model 65 (NFPA MF5)
- Square Flange/Cap End Model 66 (NFPA MF6)
- Rectangular Head Model 67 (NFPA ME5)
- Rectangular Cap Model 68 (NFPA ME6)
- Centerline Lug Model 73 (NFPA MS3)

Foot Mounts

- Side Lug Model 72 (NFPA MS2)
- Side Tapped Model 74 (NFPA MS4)
- End Lug Model 77 (NFPA MS7)
- End Angle Model 71 (NFPA MS1)

Pivot Mounts

- Trunnion/Head End Model 81 (NFPA MT1)
- Trunnion/Cap End Model 82 (NFPA MT2)
- Fixed Clevis Model 84 (NFPA MP1)
- Detachable Clevis Model 86 (NFPA MP2)
- Intermediate Trunnion Model 89 (NFPA MT4)
- Rear Eye Model 90 (NFPA MP3)
- Spherical Eye Model 94

* Model 50 - No tie rod extension
Model 51 - Tie rods extended head and cap
Model 52 - Tie rods extended cap end only
Model 53 - Tie rods extended head end only
Model 54 - Tie rods (2) extended head and cap at position No. 3
Miller H Series
Hydraulic Cylinders
1½" thru 20" Bore Cylinders

Bushing Retainer Style

While the standard Miller cylinder design utilizes a bolted bushing, on certain combinations of bore size, rod size and/or mounting style a bolted bushing would interfere with the tie rod nuts. In those cases, a square retainer-held bushing is used.

The selection chart below lists all the possible combinations, with a ● indicating bolted type bushing and a ■ indicating use of the full square retainer method.

Please note that dimensional information is provided on the appropriate catalog pages for the two different styles.

### Mounting Configuration Model No.

<table>
<thead>
<tr>
<th>BORE/ROD SIZE AVAILABILITY</th>
<th>1½&quot; Bore</th>
<th>2&quot; Bore</th>
<th>2½&quot; Bore</th>
<th>3¼&quot; Bore</th>
<th>4&quot; Bore</th>
<th>5&quot; Bore</th>
<th>6&quot; Bore</th>
<th>7&quot; Bore</th>
<th>8&quot; Bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD ROD</td>
<td>OS ROD</td>
<td>STD ROD</td>
<td>OS ROD</td>
<td>STD ROD</td>
<td>OS ROD</td>
<td>STD ROD</td>
<td>OS ROD</td>
<td>STD ROD</td>
<td>OS ROD</td>
</tr>
<tr>
<td>½&quot;</td>
<td>⅜&quot;</td>
<td>1&quot;</td>
<td>⅜&quot;</td>
<td>1½&quot;</td>
<td>⅜&quot;</td>
<td>1¾&quot;</td>
<td>⅜&quot;</td>
<td>2&quot;</td>
<td>⅜&quot;</td>
</tr>
<tr>
<td>●</td>
<td>■</td>
<td>●</td>
<td>■</td>
<td>●</td>
<td>■</td>
<td>●</td>
<td>■</td>
<td>●</td>
<td>■</td>
</tr>
</tbody>
</table>

- ● Bolted type bushing construction
- ■ Full Square retainer construction
- Mounting lugs at head end must be removed before bushing
- ♦ Cylinders furnished with metallic sealing rings and wear band in place of “U” cup seals.
- N/A Not Available

If rod eye is used on Style 2 rod end, it will interfere with Model 77 mounting lugs.

Reduced pressure ratings due to shallow tapped mounting holes.
## 1\(\frac{1}{2}\)" thru 8" Bore Size Reference Chart
SAE Ports Standard — NPTF Ports Optional

<table>
<thead>
<tr>
<th>Cylinder Bore Diam. (inches)</th>
<th>Standard SAE Port</th>
<th>Optional NPTF Port</th>
<th>4 Bolt SAE (Code 61)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NFPA Standard</td>
<td>First Oversize</td>
<td>** Maximum Oversize</td>
</tr>
<tr>
<td></td>
<td>Head</td>
<td>Cap</td>
<td></td>
</tr>
<tr>
<td>1(\frac{1}{2})</td>
<td>(-8)</td>
<td>(-10)</td>
<td>(\frac{1}{2}) - 14</td>
</tr>
<tr>
<td>2</td>
<td>(-8)</td>
<td>(-10)</td>
<td>(\frac{1}{2}) - 14</td>
</tr>
<tr>
<td>2(\frac{1}{2})</td>
<td>(-8)</td>
<td>**(-10)</td>
<td>(\frac{1}{2}) - 14</td>
</tr>
<tr>
<td>3(\frac{3}{4})</td>
<td>(-12)</td>
<td>**(-14)</td>
<td>¾ - 14</td>
</tr>
<tr>
<td>4</td>
<td>(-12)</td>
<td>**(-14)</td>
<td>¾ - 14</td>
</tr>
<tr>
<td>5</td>
<td>(-12)</td>
<td>**(-16)</td>
<td>¾ - 14</td>
</tr>
<tr>
<td>6</td>
<td>(-16)</td>
<td>**(-20)</td>
<td>1 - 11(\frac{1}{2})</td>
</tr>
<tr>
<td>7</td>
<td>(-20)</td>
<td>**(-24)</td>
<td>1(\frac{1}{4}) - 11(\frac{1}{2})</td>
</tr>
<tr>
<td>8</td>
<td>(-24)</td>
<td>**(-32)</td>
<td>1(\frac{1}{2}) - 11(\frac{1}{2})</td>
</tr>
<tr>
<td>10</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>2 - 11(\frac{1}{2})</td>
</tr>
<tr>
<td>12</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>2(\frac{1}{2}) - 8</td>
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<td>14</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>3 - 8</td>
</tr>
<tr>
<td>16</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>3(\frac{1}{2}) - 8</td>
</tr>
<tr>
<td>18</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>4 - 8</td>
</tr>
<tr>
<td>20</td>
<td>(-32)</td>
<td>**(-32)</td>
<td>5 - 8</td>
</tr>
</tbody>
</table>

** = Welded  ♦ = Consult Miller Engineering

Note: All Optional Maximum Oversize NPTF Ports are Welded.

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## 1\(\frac{1}{2}\)" thru 20" Bore Port Size Reference Chart

<table>
<thead>
<tr>
<th>DASH Number</th>
<th>Tube O.D. (in.)</th>
<th>Thread Size (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>.50</td>
<td>.75 - 16</td>
</tr>
<tr>
<td>10</td>
<td>.62</td>
<td>.88 - 14</td>
</tr>
<tr>
<td>12</td>
<td>.75</td>
<td>1.06 - 12</td>
</tr>
<tr>
<td>14</td>
<td>.88</td>
<td>1.18 - 12</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>1.31 - 12</td>
</tr>
<tr>
<td>20</td>
<td>1.25</td>
<td>1.62 - 12</td>
</tr>
<tr>
<td>24</td>
<td>1.50</td>
<td>1.88 - 12</td>
</tr>
<tr>
<td>32</td>
<td>2</td>
<td>2.50 - 12</td>
</tr>
</tbody>
</table>

Miller SAE O-Ring ports conform to SAE standard J514 (straight thread O-Ring boss).

Note: ISO 6149 ports are available as an option and should be identified as a cylinder modification in the cylinder number.
Miller H Series
Hydraulic Cylinders

Model 52-B (NFPA MX2)
Bolted Bushing
Tie Rods Extended Cap End

Also Available
Model 50-B No Tie Rods Extended, Model 51-B (NFPA MX1) Tie Rods Extended both ends, Model 53-B (NFPA MX3) Tie Rods Extended head end, Model 54-B (NFPA MX4) two Tie Rods Extended both ends at position #3. All of the above models can be dimensioned from Model 52-B shown.

Model 52-R (NFPA MX2)
Square Retainer Held Bushing
Tie Rods Extended Cap End

Also Available
Model 50-R No Tie Rods Extended, Model 51-R (NFPA MX1) Tie Rods Extended both ends, Model 53-R (NFPA MX3) Tie Rods Extended head end, Model 54-R (NFPA MX4) two Tie Rods Extended both ends at position #3. All of the above models can be dimensioned from Model 52-R shown.

Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.
**Miller H Series**
**Hydraulic Cylinders**

### Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>AA</th>
<th>BB</th>
<th>DD</th>
<th>*EE</th>
<th>SAE</th>
<th>NPTF</th>
<th>RB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>2 1/2</td>
<td>%</td>
<td>3</td>
<td>1/4</td>
<td>1 1/2</td>
<td>3/8</td>
<td>2.3</td>
<td>1/16</td>
<td>3/4-24</td>
<td>-8</td>
<td>1/2</td>
<td>1.63</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>%</td>
<td>3</td>
<td>1 1/2</td>
<td>1/4</td>
<td>3/8</td>
<td>2.9</td>
<td>1 1/16</td>
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<td>1/2</td>
<td>2.05</td>
</tr>
<tr>
<td>2 1/2</td>
<td>3 1/2</td>
<td>%</td>
<td>3</td>
<td>1/4</td>
<td>1 1/2</td>
<td>3/8</td>
<td>3.6</td>
<td>1 1/16</td>
<td>1/2-20</td>
<td>-8</td>
<td>1/2</td>
<td>2.55</td>
</tr>
<tr>
<td>3 1/4</td>
<td>4 1/4</td>
<td>%</td>
<td>4</td>
<td>2</td>
<td>1 1/2</td>
<td>9/16</td>
<td>4.6</td>
<td>2 1/16</td>
<td>9/16-18</td>
<td>-12</td>
<td>3/8</td>
<td>3.25</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>%</td>
<td>2</td>
<td>1 1/2</td>
<td>15/16</td>
<td>9/16</td>
<td>6.4</td>
<td>2 1/16</td>
<td>9/16-14</td>
<td>-12</td>
<td>3/8</td>
<td>3.82</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>%</td>
<td>2</td>
<td>1 1/2</td>
<td>15/16</td>
<td>7/16</td>
<td>10.6</td>
<td>7/8-14</td>
<td>-12</td>
<td>3/8</td>
<td>4.95</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7 1/2</td>
<td>2</td>
<td>2 1/2</td>
<td>2 1/2</td>
<td>3/8</td>
<td>1 1/4</td>
<td>8.1</td>
<td>1-14</td>
<td>-16</td>
<td>1</td>
<td>5.73</td>
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</tr>
<tr>
<td>7 8 1/2</td>
<td>2</td>
<td>3 1/2</td>
<td>3 1/2</td>
<td>5/8</td>
<td>1 3/8</td>
<td>10.8</td>
<td>1-1/4</td>
<td>-20</td>
<td>1 1/4</td>
<td>6.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 9 1/2</td>
<td>3</td>
<td>3 1/4</td>
<td>4 1/2</td>
<td>3/4</td>
<td>1 1/4</td>
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<td>7.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page.

### Add Stroke

<table>
<thead>
<tr>
<th>H</th>
<th>L</th>
<th>LD</th>
<th>LG</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>4%</td>
<td>4%</td>
<td>5</td>
<td>2%</td>
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<tr>
<td>1%</td>
<td>4%</td>
<td>4%</td>
<td>5 1/4</td>
<td>2%</td>
</tr>
<tr>
<td>1%</td>
<td>4%</td>
<td>5</td>
<td>5%</td>
<td>3</td>
</tr>
<tr>
<td>1 1/2%</td>
<td>5%</td>
<td>6%</td>
<td>3%</td>
<td></td>
</tr>
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<td>2%</td>
<td>5%</td>
<td>6%</td>
<td>7%</td>
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</tr>
<tr>
<td>2%</td>
<td>6%</td>
<td>6%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>3%</td>
<td>8%</td>
<td></td>
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### Rod End Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>Rod Dia (MM)</th>
<th>A</th>
<th>B</th>
<th>-.001 to -.003</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style 5</th>
<th>KK Styles 2 &amp; 4 &amp; 6</th>
<th>RD (Max.)</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>9/16</td>
<td>1/2</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
<td>1/4</td>
<td>10-32</td>
<td>1/2-20</td>
<td>3/16-20</td>
<td>1.972</td>
<td>.316</td>
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Miller H Series Hydraulic Cylinders

Model 61-B (NFPA MF1) Bolted Bushing Rectangular Flange/Head End

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2½” through 8” bore cylinders.

Model 61-R (NFPA MF1) Retainer Held Bushing Rectangular Flange/Head End (1½” - 6” Bores)

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2½” through 8” bore cylinders.

Mounting Dimensions (see tables on opposite page)

Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.
## Miller H Series

### Hydraulic Cylinders

#### Rectangular Flange/Head End

#### 1½”–8” Bore Cylinders

### Cylinder Body Dimensions

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<th>G</th>
<th>J</th>
<th>K</th>
<th>R</th>
<th><strong>EE</strong></th>
<th>FB</th>
<th>TF</th>
<th>UF</th>
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<td>½</td>
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<td>¾</td>
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### Rod End Dimensions

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<th>B - .001 to -.003</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style 5</th>
<th>KK Styles 2.446</th>
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<td>¼</td>
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<td>2.625</td>
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<td>¾-20</td>
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<td>¾-20</td>
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<td>¼</td>
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### Add Stroke

| ZB | 6 | 6 | 6½ | 6½ | 6½ | 6½ | 6½ | 6½ | 6½ | 6½ |

### Add Stroke

| ZB | 6 | 6 | 6½ | 6½ | 6½ | 6½ | 6½ | 6½ | 6½ |

### Pressure Limitations For Model 61-B

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<th>3⅛</th>
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### Pressure Limitations For Model 61-R

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For higher rated Head End Mounted Cylinders, see Model H-67.
Miller H Series
Hydraulic Cylinders

Rectangular Flange/Cap End
1½"—8" Bore Cylinders

Model 62-B (NFPA MF2)
Bolted Bushing
Rectangular Flange/Cap End

Mounting Dimensions
(see tables on opposite page)

Model 62-R (NFPA MF2)
Square Retainer Held Bushing
Rectangular Flange/Cap End
(1½" - 6" Bore)

Mounting Dimensions
(see tables on opposite page)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2—Standard
Threaded on Turndown Section

Style No. 4
Short Rod End—Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.

Pressure Limitations For Models 62-B and 62-R

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For higher rated cap end mounted cylinders, see Model H-68.
# Cylinder Body Dimensions

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<th>J</th>
<th>K</th>
<th>R</th>
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<th>EE</th>
<th>SAE</th>
<th>NPTF</th>
<th>FB</th>
<th>RB</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

Note: Mounting holes are 1/16" larger than bolt sizes (FB) shown.

# Rod End Dimensions

<table>
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<tr>
<th>Bore Size (MM)</th>
<th>Rod Dia</th>
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<th>B -0.001 to -0.003</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style</th>
<th>KK Styles 2.4.66</th>
<th>RD (Max.)</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
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Add Stroke

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</table>

Note: Mounting holes are 1/16" larger than bolt sizes (FB) shown.
Miller H Series
Hydraulic Cylinders

Model 65-B (NFPA MF5)
Bolted Bushing
Square Flange/Head End

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2 1/2" through 8" bore cylinders.

Model 65-R (NFPA MF5)
Retainer Held Bushing
Square Flange/Head End

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2 1/2" through 8" bore cylinders.

Mounting Dimensions
(See tables on opposite page)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.
### Miller H Series

#### Hydraulic Cylinders

#### Square Flange/Head End

#### 1½” – 8” Bore Cylinders

### Cylinder Body Dimensions

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<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>R</th>
<th>*EE</th>
<th>SAE</th>
<th>NPTF</th>
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<td>7.50</td>
<td>-24</td>
<td>-24</td>
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</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page.

Note: Mounting holes are 1/16” larger than bolt sizes (FB) shown.

### Rod End Dimensions

| Bore Size | Rod Dia. (MM) | A | B - .001 to -.003 | C | D | V | W | AB | IM | Style 5 | KK Styles 2.4&6 | RD (Max.) |
|-----------|-------------|---|-------------------|---|---|---|---|----|----|-------|--------------|-----------|----------|
| 1½        | ½           | ½ | 1.125            | ½ | ½ | ½ | ½ | —  | —  | ½-20 | ½-20         | —         | 6        |
| 1         | ½           | ½ | 1.500            | ½ | ½ | ½ | ½ | 1   | —  | ¾-14 | ¾-16        | —         | 6½       |
| 2         | ½           | ½ | 2.000            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 6⅛       |
| 2½        | ½           | ½ | 2.375            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 6⅛       |
| 3¼        | ½           | ½ | 2.625            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 8½       |
| 3½        | ½           | ½ | 3.125            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 8½       |
| 4         | ½           | ½ | 3.750            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 9½       |
| 5         | ½           | ½ | 4.250            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 9½       |
| 5½        | ½           | ½ | 4.750            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 10½      |
| 6         | ½           | ½ | 5.250            | ½ | ½ | ½ | ½ | 1   | —  | 1½-12| 1½-14       | —         | 10½      |

### Pressure Limitations For Model 65-B and 65-R

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<th>2½”</th>
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<th>3½”</th>
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**Note:** Mounting holes are 1/16” larger than bolt sizes (FB) shown.
**Miller H Series**

**Hydraulic Cylinders**

**Model 66-B (NFPA MF6)**

Bolted Bushing

Square Flange/Cap End

**Mounting Dimensions**

(See tables on opposite page)

**Note:** High tensile mounting bolts should be used. Hardened flat washers should be used on 2½" through 8" bore cylinders.

---

**Model 66-R (NFPA MF6)**

Square Retainer Held Bushing

Square Flange/Cap End

**Mounting Dimensions**

(See tables on opposite page)

**Note:** High tensile mounting bolts should be used. Hardened flat washers should be used on 2½" through 8" bore cylinders.

---

**Common Rod End Styles & Dimensions**

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

- **Style No. 2—Standard**
  - Threaded on Turndown Section

- **Style No. 4**
  - Short Rod End—Internal Threads

- **Style No. 5**
  - Threaded Intermediate Male

- **Style No. 6**
  - Studded Rod End (Available Thru 2" Rod Diameter)

  "Special" Thread Style X

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

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

---

**Pressure Limitations For Model 66-B and 66-R**

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### Cylinder Body Dimensions

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<th>F</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

Note: Mounting holes are 1/16" larger than bolt sizes (FB) shown.

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**Miller H Series**

**Hydraulic Cylinders**

**Square Flange/Cap End**

**1 1/2" – 8" Bore Cylinders**

### Rod End Dimensions

| Bore Size (" ) | Red Dia (MM) | A | B | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB | AB |
|---------------|-------------|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1 1/2        | 3 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2 3/8 | -8 1/2 | 1/2 | 1/2 | 2.05 | 4 1/2 | 5 1/2 | 6 |
| 2            | 3 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2.05 | 2.9 | -8 | 1/2 | 1/2 | 2.05 | 4 1/2 | 5 1/2 | 6 |
| 2 1/2        | 3 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2.05 | 2.9 | -8 | 1/2 | 1/2 | 2.05 | 4 1/2 | 5 1/2 | 6 |
| 3 1/2        | 4 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 2.55 | 4 1/4 | -8 | 1/2 | 1/2 | 2.55 | 4 1/2 | 5 1/2 | 6 |
| 4            | 5 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 3.82 | 5 1/4 | -8 | 1/2 | 1/2 | 3.82 | 5 1/2 | 6 1/2 | 7 |
| 5            | 7 | 2 | 1 1/2 | 1 1/2 | 1 1/2 | 1 1/2 | 4.95 | 6 1/2 | -8 | 1/2 | 1/2 | 4.95 | 6 1/2 | 7 1/2 | 8 |
| 6            | 8 | 2 1/2 | 2 1/2 | 2 1/2 | 2 1/2 | 6.58 | 8 1/2 | -8 | 1/2 | 1/2 | 6.58 | 8 1/2 | 8 1/2 | 9 1/2 |
| 8            | 9 | 3 | 3 | 3 | 3 | 3 | 7.50 | 10 1/2 | 1/2 | 1/2 | 7.50 | 11 1/2 | 14 | |

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**Notes:**

- SAE ports are standard, NPTF ports are available at no extra charge.
- Mounting holes are 1/16" larger than bolt sizes (FB) shown.
Miller H Series
Hydraulic Cylinders

Rectangular Head/Cap
1½"–8" Bore Cylinders

Model 67-B (NFPA ME5)
Bolted Bushing
Rectangular Head

Mounting Dimensions
(See tables on opposite page)

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2½" through 8" bore cylinders. Not available in Retainer Held Bushing construction.

Model 68-B (NFPA ME6)
Bolted Bushing
Rectangular Cap

Mounting Dimensions
(See tables on opposite page)

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2½" through 8" bore cylinders.

Model 68-R (NFPA ME6)
Square Retainer Held Bushing
Rectangular Cap End

Mounting Dimensions
(See tables on opposite page)

Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 2½" through 8" bore cylinders.

Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.
## Cylinder Body Dimensions

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### Notes:
- SAE ports are standard, NPTF ports are available at no extra charge.
- Rectangular Head/Cap 2 1/2"-8" Bore Cylinders
- See Double Rod End page.
- 1 1/2" Bore with 1" Rod Diameter and 2" Bore with 1 3/8" Rod Diameter. Not Available with Bolted Bushing on Model 68.
Miller H Series
Hydraulic Cylinders

Model 72-B (NFPA MS2)
Bolted Bushing
Side Lug

Mounting Dimensions
(See tables on opposite page)

Model 72-R (NFPA MS2)
Square Retainer Held Bushing
Side Lug

Mounting Dimensions
(See tables on opposite page)

Common Rod End Styles & Dimensions

Style No. 2 - Standard Threaded on Turndown Section

Style No. 4 - Short Rod End - Internal Threads

Style No. 5 - Threaded Intermediate Male

Style No. 6 - Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.

Pressure Limitations For Models 72-B & 72-R

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Model 72 cylinders have mounting lugs welded to the head and cap, and are considered to be a fixed mount that does not absorb force on its centerline.
The plane of the mounting surface is not through the centerline of the cylinder, and for this reason Model 72 cylinders produce a turning moment as the cylinder applies force to the load. This turning moment tends to rotate the cylinder about its mounting bolts. If the cylinder is not well secured to the machine member on which it is mounted or the load is not well-guided, this turning moment results in side load applied to rod bushing and piston bearings. To avoid this problem, Model 72 cylinders should be specified with a stroke length at least equal to the bore size.

Note: Lugs should be blocked, or a “K” retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load. See Keying and Pinning Cylinders page.
## Cylinder Body Dimensions

| Bore Size | Rod Dia (MM) | A | B -.001 to -.005 | C | D | V | W | AB | IM Style 5 | KK Styles 2,4,8 | RD (Max.) | RT | VB | WB | XS | ZB |
|-----------|-------------|---|----------------|---|---|---|---|----|----------|--------------|-----------|----|----|----|----|---|---|
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/4     | 1           | 1 1/2 | 1.500         | 5/8 | 1/2 | 1/2 | 1/2-20 | 9/16-14 | 9/16-16  | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1         | 1           | 1 1/2 | 1.500         | 5/8 | 1/2 | 1/2 | 1/2-20 | 9/16-14 | 9/16-16  | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/4     | 2           | 2 3/4 | 2.375         | 5/8 | 1 1/2 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/4     | 2           | 2 3/4 | 2.375         | 5/8 | 1 1/2 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 2 1/4     | 2 1/2       | 3 1/2 | 3 1/2         | 5/8 | 1 1/2 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 2 1/4     | 2 1/2       | 3 1/2 | 3 1/2         | 5/8 | 1 1/2 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 3 1/2     | 3 3/4       | 4 1/2 | 4.250         | 1 3 | 5/8 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 3 1/2     | 3 3/4       | 4 1/2 | 4.250         | 1 3 | 5/8 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 4 1/4     | 4 1/4       | 5 1/2 | 5 1/2         | 1 3 | 5/8 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 4 1/4     | 4 1/4       | 5 1/2 | 5 1/2         | 1 3 | 5/8 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 5 1/2     | 5 1/2       | 6 1/2 | 6 1/2         | 1 3 | 1 1/2 | 1/2 | 1 1/2-12 | 1 1/2-12 | 1 1/2-12 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |

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* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page. For end to end bolt centerlines on double rod-end cylinders, use common dimension “Stroke plus LD" instead of “Stroke Plus SS" and subtract dimension “SW" from each end.

**Note:** Mounting holes are 1/16" larger than bolt sizes (SB) shown.

### Rod End Dimensions

| Bore Size | Rod Dia (MM) | A | B -.001 to -.005 | C | D | V | W | AB | IM Style 5 | KK Styles 2,4,8 | RD (Max.) | RT | VB | WB | XS | ZB |
|-----------|-------------|---|----------------|---|---|---|---|----|----------|--------------|-----------|----|----|----|----|---|---|
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |
| 1 1/2     | 5/8         | 3/4 | 1.125         | 3/8 | 1/2 | 3/8 | 10-32 | 1/2-20 | 9/16-20 | 0.212     | 0.146 | 5   | 1 1/8 | 6  |

**Add Stroke**

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* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page. For end to end bolt centerlines on double rod-end cylinders, use common dimension “Stroke plus LD" instead of “Stroke Plus SS" and subtract dimension “SW" from each end.

**Note:** Mounting holes are 1/16" larger than bolt sizes (SB) shown.
**Miller H Series**  
**Hydraulic Cylinders**

**Model 73-B (NFPA MS3)**  
Bolted Bushing  
Centerline Lug

**Model 73-R (NFPA MS3)**  
Square Retainer Held Bushing  
Centerline Lug

---

**Mounting Dimensions**  
(See tables on opposite page)

Note: Lugs should be blocked, or pinned on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load. See Keying and Pinning Cylinders page.

---

**Common Rod End Styles & Dimensions**  
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

- **Style No. 2-Standard**  
  Threaded on Turndown Section  
- **Style No. 4**  
  Short Rod End-Internal Threads  
- **Style No. 5**  
  Threaded Intermediate Male  
- **Style No. 6**  
  Studded Rod End  
  (Available Through 2” Rod Diameter)  
- **“Special” Thread Style X**  
  Special thread, extension, rod eye, blank, etc., are also available.  
  To order, specify “Style X” and give desired dimensions for KK, A, WB or W.  
  If otherwise special, furnish dimensioned sketch.
# Cylinder Body Dimensions

| Bore Size | E | F | G | J | K | AA | **EE** | RB | SB | ST | SU | SW | TS | US | H | LB | $\$LD$ | LG | P | $\$SS$ |
|-----------|---|---|---|---|---|-----|-------|----|----|----|----|----|----|----|----|---|---|-----|-----|---|---|---|
| 1 1/2     | 2 1/2 | 3/4 | 1 1/4 | 1 1/2 | 3/8 | 2.3  | -8  | 1/2 | 1.63 | 3/8 | 1 1/2 | 13/16 | 3/8 | 3/4 | 4 | 1 1/4 | 4 5 | 2 3/8 | 3/8 |
| 2         | 1 1/4 | 1/2 | 1 1/2 | 1 3/8 | 5/8 | 2.9  | -8  | 1/2 | 2.05 | 7/8 | 1 3/4 | 1 3/4 | 1/4 | 3/8 | 5 | 1 1/4 | 4 5 | 2 3/8 | 3/8 |
| 3 1/4     | 3/4 | 1 1/2 | 1 3/8 | 5/8 | 2.3  | -12 | 3/4 | 3.25 | 5/8 | 1 1/8 | 1 3/8 | 1/4 | 13/16 | 5/8 | 3 | 1 1/4 | 4 5 | 2 3/8 | 3/8 |
| 4         | 5/8 | 1 3/8 | 5/8 | 2.3  | -12 | 3/4 | 3.25 | 5/8 | 1 1/8 | 1 3/8 | 1/4 | 13/16 | 5/8 | 3 | 1 1/4 | 4 5 | 2 3/8 | 3/8 |
| 5         | 5 1/8 | 1 3/8 | 5/8 | 2.3  | -12 | 3/4 | 3.25 | 5/8 | 1 1/8 | 1 3/8 | 1/4 | 13/16 | 5/8 | 3 | 1 1/4 | 4 5 | 2 3/8 | 3/8 |
| 6         | 1 1/4 | 3/4 | 1 1/2 | 1 3/8 | 5/8 | 2.9  | -12 | 3/4 | 4.95 | 1 1/2 | 1 1/4 | 2 1/4 | 8 1/16 | 10 |
| 7         | 3 1/4 | — | 2 1/2 | 2 1/4 | 3/8 | 3.3 | -20 | 1 1/4 | 6.58 | 1 1/4 | 1 1/4 | 2 1/4 | 1 1/4 | 14 |
| 8         | 3 1/4 | — | 2 1/2 | 2 1/4 | 3/8 | 3.3 | -20 | 1 1/4 | 6.58 | 1 1/4 | 1 1/4 | 2 1/4 | 1 1/4 | 14 |

* SAE ports are standard, NPTF ports are available at no extra charge.
† LD dimension is for double rod end models. See Double Rod End page. For end to end bolt centerlines on double rod end cylinders, use common dimension “Stroke plus LD” instead of “Stroke Plus SS” and subtract dimension “SW” from each end.

# Add Stroke

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<th>B - .001 to .000</th>
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# Rod End Dimensions

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Mounting holes are 1/16” larger than bolt sizes (SB) shown.
**Miller H Series**
**Hydraulic Cylinders**

**Model 74-B (NFPA MS4)**
*Bolted Bushing*
*Side Tapped*

**Mounting Dimensions**
*(See tables on opposite page)*

![Diagram of Model 74-B with dimensions]

**Note:** A "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load. See Keying and Pinning Cylinders page.

**Model 74-R (NFPA MS4)**
*Square Retainer Held Bushing*
*Side Tapped*

**Mounting Dimensions**
*(See tables on opposite page)*

![Diagram of Model 74-R with dimensions]

**Note:** A "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load. See Keying and Pinning Cylinders page.

---

**Common Rod End Styles & Dimensions**

For additional standard rod ends, see "Rod End Styles and Dimensions" page.

**Style No. 2-Standard**
Threaded on Turndown Section

**Style No. 4**
Short Rod End-Internal Threads

**Style No. 5**
Threaded Intermediate Male

**Style No. 6**
Studded Rod End
*(Available thru 2" Rod Diameter)*

**“Special” Thread Style X**
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

---

**Pressure Limitations For Model 74-B and 74-R**

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**Model 74 cylinders** have side tapped holes for flush mounting, and are considered to be a fixed mount that does not absorb force on its centerline. The plane of the mounting surface is not through the centerline of the cylinder, and for this reason Model 74 cylinders produce a turning moment as the cylinder applies force to the load. This turning moment tends to rotate the cylinder about its mounting bolts. If the cylinder is not well secured to the machine member on which it is mounted or the load is not well-guided, this turning moment results in side load applied to rod bushing and piston bearings. To avoid this problem, Model 74 cylinders should be specified with a stroke length at least equal to the bore size.
## Cylinder Body Dimensions

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<thead>
<tr>
<th>Bore Size</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

SN dimension on double rod end (Model DH-74): For 6” bore is 4 1/4”, 7” bore SN-5/16”, and 8” bore SN-6 1/4”. 1 1/2”-5” bores the SN dimension is the same for both single and double rod end cylinders.

## Rod End Dimensions

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**Add Stroke**

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* LD dimension is for double rod end models. See Double Rod End page.
Miller H Series
Hydraulic Cylinders

Model 77-B (NFPA MS7)
Bolted Bushing
End Lug

Model 77-R (NFPA MS7)
Square Retainer Held Bushing
End Lug

Mounting Dimensions
(See tables on opposite page)

Note: Mounting bolts should not carry shear load. Lugs should be blocked or a "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. See Keying and Pinning Cylinders page.

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Pressure Limitations For Models 77-B & 77-R

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Model 77 cylinders have lugs connected to the ends, and are considered to be a fixed mount that does not absorb force on its centerline. The plane of the mounting surface is not through the centerline of the cylinder, and for this reason Model 77 cylinders produce a turning moment as the cylinder applies force to the load. This turning moment tends to rotate the cylinder about its mounting bolts. If the cylinder is not well secured to the machine member on which it is mounted or the load is not well-guided, this turning moment results in side load applied to rod bushing and piston bearings. To avoid this problem, Model 77 cylinders should be specified with a stroke length at least equal to the bore size.
### Cylinder Body Dimensions

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<th>G</th>
<th>J</th>
<th>K</th>
<th>R</th>
<th>EB</th>
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<th>NPTF</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.
‡ LD dimension is for double rod end models. See Double Rod End page. For overall length on double rod-end cylinder, use common dimension “Stroke plus LD” instead of figures “ZE”, “XE”, “SF” and “SE”, and add end lug dimensions.

### Rod End Dimensions

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<th>D</th>
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<th>W</th>
<th>AB</th>
<th>IM Style</th>
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<table>
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<th>Add Stroke</th>
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‡ Mounting holes are 1/16” larger than bolt sizes (FB) shown.
Miller H Series
Hydraulic Cylinders

Model 71-R (NFPA MS1)
Square Retainer Held Bushing
End Angle

End Angle
1 1/2”–6” Bore Cylinders

Mounting Dimensions
(See tables on opposite page)

Note: Mounting bolts should not carry shear load. End angles should be blocked or an "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. See Keying and Pinning Cylinders page.

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

<table>
<thead>
<tr>
<th>Style No. 2 - Standard</th>
<th>Style No. 4 - Short Rod End - Internal Threads</th>
<th>Style No. 5 - Threaded Intermediate Male</th>
<th>Style No. 6 - Studded Rod End (Available Thru 2” Rod Diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threaded on Turndown Section</td>
<td>Across Flats WB &lt;KK Across Flats MM &lt;WB</td>
<td>Across Flats WB &lt;KK Across Flats IM</td>
<td>Across Flats WB &lt;KK Across Flats IM</td>
</tr>
</tbody>
</table>

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

Pressure Limitation For Model 71-R

<table>
<thead>
<tr>
<th>Bore (PSI)</th>
<th>ALL</th>
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</thead>
<tbody>
<tr>
<td>Pressure 500</td>
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</tbody>
</table>

Model 71 cylinders have mounting angles connected to the ends, and are the weakest of the side mount styles. Model 71 cylinders should be limited to a maximum operating pressure of 500 psi and minimum stroke length of twice the bore size. For pressure rating of shorter strokes, consult the factory.

28
### Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>S</th>
<th>AH</th>
<th>AO</th>
<th>AT</th>
<th>*EE</th>
<th>SAE</th>
<th>NPTF</th>
<th>NB</th>
<th>NE</th>
<th>NL</th>
<th>RB</th>
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</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page. For overall length on double rod-end cylinder, use common dimension "Stroke plus LD" instead of figures "XF", and "SA", and add end angle dimensions.

Note: Mounting holes are 1/16" larger than bolt sizes (NB) shown.

### Rod End Dimensions

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<tr>
<th>Bore Size</th>
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<th>A</th>
<th>B - .001 to -.003</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>IM Style 5</th>
<th>KK Styles 2.4.6</th>
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<td>13 1/2</td>
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</tbody>
</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page. For overall length on double rod-end cylinder, use common dimension "Stroke plus LD" instead of figures "XF", and "SA", and add end angle dimensions.

Note: Mounting holes are 1/16" larger than bolt sizes (NB) shown.

### Add Stroke

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* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page. For overall length on double rod-end cylinder, use common dimension "Stroke plus LD" instead of figures "XF", and "SA", and add end angle dimensions.

Note: Mounting holes are 1/16" larger than bolt sizes (NB) shown.
Miller H Series
Hydraulic Cylinders

Model 81-B (NFPA MT1)
Bolted Bushing
Trunnion Head End

Model 81-R (NFPA MT1)
Square Retainer Held Bushing
Trunnion Head End

Mounting Dimensions
(See tables on opposite page)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Pressure Limitations For Models 81-B & 81-R

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## Cylinder Body Dimensions

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<th>G</th>
<th>J</th>
<th>K</th>
<th>AA</th>
<th>*EE SAE</th>
<th>NPTF</th>
<th>RB</th>
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</table>

* SAE ports are standard, NPTF ports are available on extra charge.
† LD dimension is for double rod end models. See Double Rod End page.

## Add Stroke

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<th>LB</th>
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## Rod End Dimensions

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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>W</th>
<th>AB</th>
<th>IM Style 5</th>
<th>KK Styles 2, 4 &amp; 6</th>
<th>RD (Max.)</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
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Add Stroke

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<tr>
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<tr>
<td>6</td>
</tr>
</tbody>
</table>

31
Miller H Series
Hydraulic Cylinders

Model 82-B (NFPA MT2)
Bolted Bushing
Trunnion Cap End

Note: PInS designed for shear (not bending) loads.

Model 82-R (NFPA MT2)
Square Retainer Held Bushing
Trunnion Cap End

Note: Pins designed for shear (not bending) loads.

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

<table>
<thead>
<tr>
<th>Style No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>2</td>
<td>Standard Threaded on Turndown Section</td>
</tr>
<tr>
<td>4</td>
<td>Short Rod End-Internal Threads</td>
</tr>
<tr>
<td>5</td>
<td>Threaded Intermediate Male</td>
</tr>
<tr>
<td>6</td>
<td>Studded Rod End (Available Thru 2” Rod Diameter)</td>
</tr>
</tbody>
</table>

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.

Pressure Limitations For Models 82-B & 82-R

<table>
<thead>
<tr>
<th>Bore</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
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<td>2250</td>
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<td>1260</td>
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### Cylinder Body Dimensions

<table>
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<tr>
<th>Bore Size</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>AA</th>
<th>*EE</th>
<th>RB</th>
<th>TD</th>
<th>TL</th>
<th>UT</th>
<th>H</th>
<th>LB</th>
<th>LG</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td>2/3</td>
<td>3/8</td>
<td>1 1/4</td>
<td>1 1/2</td>
<td>3/8</td>
<td>2.3</td>
<td>-8</td>
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<td>1</td>
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<td>1%</td>
<td>4%</td>
<td>5</td>
</tr>
<tr>
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<td>3</td>
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<td>1%</td>
<td>5%</td>
<td>1%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>2 1/2</td>
<td>3/4</td>
<td>7/8</td>
<td>1 1/4</td>
<td>1 1/2</td>
<td>7/8</td>
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<td>1%</td>
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<td>1%</td>
<td>4%</td>
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<td>3/4</td>
<td>2</td>
<td>1 1/4</td>
<td>3/8</td>
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<td>-12</td>
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<td>1%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>4</td>
<td>5/8</td>
<td>1 1/4</td>
<td>1 1/2</td>
<td>1 1/3</td>
<td>7/8</td>
<td>5.4</td>
<td>-12</td>
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<td>3.82</td>
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<td>2%</td>
<td>5%</td>
<td>6%</td>
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<tr>
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<td>7/8</td>
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<td>7%</td>
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<td>7/8</td>
<td>1 2 1/4</td>
<td>1 1/2</td>
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<td>7/8</td>
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<td>4%</td>
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<td>7 1/2</td>
<td>8 1/2</td>
<td>—</td>
<td>2 1/2</td>
<td>1 1/4</td>
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<td>-20</td>
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<td>—</td>
<td>5%</td>
</tr>
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<td>8 9/16</td>
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<td>3</td>
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<td>3</td>
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<td>3 1/2</td>
<td>9%</td>
<td>—</td>
<td>6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

### Rod End Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>Rod Dia (MM)</th>
<th>A</th>
<th>B 0.001 to 0.003</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style 5</th>
<th>KK Styles 2 &amp; 6</th>
<th>RD (Max.)</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
<th>X</th>
<th>ZB</th>
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<tbody>
<tr>
<td>1 1/2</td>
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<td>3/4</td>
<td>1.125</td>
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<td>1/2</td>
<td>1/4</td>
<td>3/8</td>
<td>10-32</td>
<td>1/4-28</td>
<td>1/4-16</td>
<td>1.972</td>
<td>316</td>
<td>1/8</td>
<td>1%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>2</td>
<td>1 1/2</td>
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<td>1/4</td>
<td>1/8</td>
<td>1/4-28</td>
<td>1/4-12</td>
<td>1/4-12</td>
<td>3.470</td>
<td>313</td>
<td>1 1/8</td>
<td>1/8</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>2 1/2</td>
<td>3/4</td>
<td>3/4</td>
<td>2.375</td>
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<td>1/4</td>
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<td>1/14</td>
<td>2.972</td>
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<td>1/4</td>
<td>1/8</td>
<td>1/14</td>
<td>1/14</td>
<td>3.470</td>
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<td>1/4</td>
<td>1/8</td>
<td>1/14</td>
<td>1/14</td>
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<td>3/4</td>
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<td>4.625</td>
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<td>1/14</td>
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<td>5%</td>
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<td>5.125</td>
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### Add Stroke

#### Trunnion/Cap End

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<tr>
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<th>H</th>
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<th>LG</th>
<th>P</th>
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<tbody>
<tr>
<td>1 1/2</td>
<td>1%</td>
<td>4%</td>
<td>5</td>
<td>2%</td>
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</tr>
<tr>
<td>2 1/2</td>
<td>1%</td>
<td>4%</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>3 1/4</td>
<td>1%</td>
<td>5%</td>
<td>6%</td>
<td>3%</td>
</tr>
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<td>2%</td>
<td>5%</td>
<td>6%</td>
<td>3%</td>
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</tr>
<tr>
<td>6</td>
<td>2 1/2</td>
<td>6%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>7 1/2</td>
<td>3 8%</td>
<td>—</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>8 9/16</td>
<td>3 1/2</td>
<td>9%</td>
<td>—</td>
<td>6%</td>
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#### 1 1/2” to 8” Bore Cylinders

<table>
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<th>LG</th>
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<tbody>
<tr>
<td>3 1/4</td>
<td>1%</td>
<td>5%</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>4</td>
<td>4%</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4%</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5%</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 1/2</td>
<td>5%</td>
<td>6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 9/16</td>
<td>5%</td>
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Add Stroke

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<td>1 1/2</td>
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<td>5%</td>
</tr>
<tr>
<td>5</td>
<td>5%</td>
</tr>
<tr>
<td>6</td>
<td>5%</td>
</tr>
<tr>
<td>7 1/2</td>
<td>5%</td>
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<td>8 9/16</td>
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</table>
Miller H Series
Hydraulic Cylinders

Model 89-B (NFPA MT4)
Bolted Bushing
Intermediate Trunnion

Note: Pins designed for shear (not bending) loads. Specify dimension "XI" when ordering.

Model 89-R (NFPA MT4)
Square Retainer Held Bushing
Intermediate Trunnion

Note: Pins designed for shear (not bending) loads. Specify dimension "XI" when ordering.

Common Rod End Styles & Dimensions
For additional standard rod ends, see "Rod End Styles and Dimensions" page.

<table>
<thead>
<tr>
<th>Style No. 2-Standard</th>
<th>Style No. 4</th>
<th>Style No. 5</th>
<th>Style No. 6</th>
<th>“Special” Thread Style X</th>
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</thead>
<tbody>
<tr>
<td>Threaded on Turndown Section</td>
<td>Short Rod End-Internal Threads</td>
<td>Threaded Intermediate Male</td>
<td>Studded Rod End (Available Thru 2” Rod Diameter)</td>
<td>Special thread, extension, rod eye, blank, etc., are also available. To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.</td>
</tr>
</tbody>
</table>

Pressure Limitations, Minimum XI Dimension and Minimum Stroke For Models 89-B & 89-R

<table>
<thead>
<tr>
<th>Bore</th>
<th>1½</th>
<th>2</th>
<th>2½</th>
<th>3¼</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</thead>
<tbody>
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<td>3000</td>
<td>3000</td>
<td>2530</td>
<td>1660</td>
<td>1060</td>
<td>1090</td>
<td>1260</td>
<td>820</td>
</tr>
<tr>
<td>Min. XI</td>
<td>3¼</td>
<td>4½</td>
<td>4.5</td>
<td>5½</td>
<td>5¼</td>
<td>5¼</td>
<td>6¼</td>
<td>7</td>
<td>7½</td>
</tr>
<tr>
<td>Min. Stroke</td>
<td>0</td>
<td>.125</td>
<td>.25</td>
<td>.5</td>
<td>1</td>
<td>.5</td>
<td>.625</td>
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<td>1</td>
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### Cylinder Body Dimensions

<table>
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<tr>
<th>Bore Size</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>AA</th>
<th>BD</th>
<th>&quot;EE</th>
<th>RB</th>
<th>TD</th>
<th>TL</th>
<th>TM</th>
<th>UM</th>
<th>UW</th>
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<tbody>
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<td>1/4</td>
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<td>1/4</td>
<td>3/8</td>
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<td>1 1/2</td>
<td>2 1/2</td>
<td>1 1/4</td>
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<tr>
<td>3 1/4</td>
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<td>1/4</td>
<td>1 1/2</td>
<td>1/4</td>
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<td>1 1/2</td>
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<td>1/4</td>
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<td>1 1/4</td>
<td>1 1/2</td>
<td>1 1/4</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
</tbody>
</table>

* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page.

### Add Stroke

<table>
<thead>
<tr>
<th>H</th>
<th>LB</th>
<th>#LD</th>
<th>LG</th>
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### Rod End Dimensions

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* SAE ports are standard, NPTF ports are available at no extra charge.

‡ LD dimension is for double rod end models. See Double Rod End page.
Miller H Series
Hydraulic Cylinders

Model 84-B (NFPA MP1)
Bolted Bushing
Fixed Clevis
(Pivot Pin Included)

Model 84-R (NFPA MP1)
Square Retainer Held Bushing
Fixed Clevis
(Pivot Pin Included)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2” Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

Mounting Dimensions
(See tables on opposite page)
# Miller H Series
## Hydraulic Cylinders
### Fixed Clevis
#### 1½"–8" Bore Cylinders

**Cylinder Body Dimensions**

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Miller H Series
Hydraulic Cylinders

Model 86-B (NFPA MP2)
Bolted Bushing
Detachable Clevis
(Pivot Pin Included)

Mounting Dimensions
(See tables on opposite page)

Model 86-R (NFPA MP2)
Square Retainer Held Bushing
Detachable Clevis
(Pivot Pin Included)

Mounting Dimensions
(See tables on opposite page)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

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Short Rod End-Internal Threads

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Threaded Intermediate Male

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Studded Rod End
(Available Thru 2" Rod Diameter)

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Special thread, extension, rod eye, blank, etc., are also available.
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If otherwise special, furnish dimensioned sketch.
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<table>
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<th>Bore Size (MM)</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

## Rod End Dimensions

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<th>Bore Size (MM)</th>
<th>Rod Dia (MM)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style 5</th>
<th>KK Styles 2,486</th>
<th>RD</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
<th>XD</th>
<th>ZD</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

## Add Stroke

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* SAE ports are standard, NPTF ports are available at no extra charge.
Miller H Series
Hydraulic Cylinders

Model 90-B (NFPA MP3)
Bolted Bushing
Rear Eye
(Pivot Pin Included)

Model 90-R (NFPA MP3)
Square Retainer Held Bushing
Rear Eye
(Pivot Pin Included)

Mounting Dimensions
(See tables on opposite page)

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.
## Cylinder Body Dimensions

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<tr>
<th>Bore Size</th>
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<th>G</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>AA</th>
<th>CB</th>
<th>CD</th>
<th>CL</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

## Add Stroke

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## Rod End Dimensions

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<th>Rod Dia (MM)</th>
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<th>C</th>
<th>D</th>
<th>V</th>
<th>W</th>
<th>AB</th>
<th>IM Style</th>
<th>KK Styles</th>
<th>RD (Max.)</th>
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<th>VB</th>
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</tbody>
</table>

* SAE ports are standard, NPTF ports are available at no extra charge.
Miller H Series
Hydraulic Cylinders

Model 94-B
Bolted Bushing
Rear Eye Spherical Bearing
(Pivot Pin Included)

Mounting Dimensions
(See tables on opposite page)

Note: See next page for pivot pin dimensions.
Model 94 should use Spherical Rod Eye on Rod End. See below.
See Maximum Cylinder Pressure Rating below.

Model 94-R
Square Retainer Held Bushing
Rear Eye Spherical Bearing
(Pivot Pin Included)

Mounting Dimensions
(See tables on opposite page)

Note: See next page for pivot pin dimensions.
Model 94 should use Spherical Rod Eye on Rod End. See below.
See Maximum Cylinder Pressure Rating below.

Maximum Cylinder Pressure Rating

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<th>Max Press (psi)</th>
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Rod End Style
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 4
Short Rod End-Internal Threads

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.
### Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>E</th>
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* SAE ports are standard, NPTF ports are available at no extra charge.

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</table>

### Rod End Dimensions

| Bore Size (in) | Rod Dia (inch) | A | B | C | D | V | W | AB | KK Styles | RD | RT | VB | WB |
|----------------|----------------|---|---|---|---|----|----|----|----|-----|----|----|----|----|
| 1/2           | 5/32           | 3/8 | 1 1/2 | 1 1/2 | 3/8 | 1/2 | 1 1/2 | 0.5 | 35/64 | 1 1/4 | 32/64 | 3/4 | 1/2 |
| 2             | 5/32           | 3/8 | 1 1/2 | 1 1/2 | 3/8 | 1/2 | 1 1/2 | 0.5 | 35/64 | 1 1/4 | 32/64 | 3/4 | 1/2 |

### Add Stroke

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### Spherical Rod Eye

<table>
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<tr>
<th>Part No.</th>
<th>CD ±</th>
<th>A</th>
<th>CE</th>
<th>EX</th>
<th>ER</th>
<th>LE</th>
<th>JK</th>
<th>JL</th>
<th>MAX. LOAD CAPACITY (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>057-SRE02-44-20</td>
<td>.5000</td>
<td>1 1/16</td>
<td>7/8</td>
<td>3/16-20</td>
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<td>057-SRE02-75-16</td>
<td>.7500</td>
<td>1</td>
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<td>7/16-20</td>
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<td>16,860</td>
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<tr>
<td>057-SRE02-125-12</td>
<td>1.3750</td>
<td>2</td>
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<td>1 1/2</td>
<td>2</td>
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### Clevis Bracket for Spherical Eye

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<th>057-SMB01 50</th>
<th>057-SMB01 75</th>
<th>057-SMB01 100</th>
<th>057-SMB01 138</th>
<th>057-SMB01 175</th>
<th>057-SMB01 200</th>
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<td>CD</td>
<td>1/2</td>
<td>3/4</td>
<td>1</td>
<td>1 1/4</td>
<td>1 1/4</td>
<td>2</td>
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<tr>
<td>CF</td>
<td>3/16</td>
<td>1/4</td>
<td>3/8</td>
<td>1/4</td>
<td>1/4</td>
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<td>3/4</td>
<td>3/4</td>
<td>3/4</td>
<td>1 1/2</td>
<td>1 1/2</td>
</tr>
<tr>
<td>DD</td>
<td>1/16</td>
<td>1/4</td>
<td>9/32</td>
<td>1/4</td>
<td>9/32</td>
<td>9/32</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>3/4</td>
<td>5/8</td>
<td>6/8</td>
<td>8/8</td>
<td>10/8</td>
</tr>
<tr>
<td>F</td>
<td>1/2</td>
<td>3/4</td>
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<td>1/2</td>
</tr>
<tr>
<td>FL</td>
<td>1 1/2</td>
<td>5/8</td>
<td>5/8</td>
<td>1/2</td>
<td>1/2</td>
<td>1/2</td>
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<tr>
<td>LR</td>
<td>1 1/2</td>
<td>3/8</td>
<td>1 1/4</td>
<td>2 1/4</td>
<td>3/4</td>
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<tr>
<td>M</td>
<td>1/2</td>
<td>3/4</td>
<td>1</td>
<td>1 1/4</td>
<td>1 1/4</td>
<td>2</td>
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<tr>
<td>MR</td>
<td>5/8</td>
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<td>1 1/4</td>
<td>1 1/4</td>
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<tr>
<td>R</td>
<td>2.05</td>
<td>2.76</td>
<td>10 3/16</td>
<td>9 3/16</td>
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<td>7 1/16</td>
</tr>
<tr>
<td>Load Capacity</td>
<td>5,770</td>
<td>9,450</td>
<td>14,300</td>
<td>20,322</td>
<td>37,800</td>
<td>50,375</td>
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### Pivot Pin for Spherical Eye (Includes 2 Retainer Rings)

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<th>057-PP005 -050</th>
<th>057-PP005 -075</th>
<th>057-PP005 -100</th>
<th>057-PP005 -138</th>
<th>057-PP005 -175</th>
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<tbody>
<tr>
<td>CD</td>
<td>.4997 - .0004</td>
<td>.7497 - .0004</td>
<td>.9997 - .0004</td>
<td>1.3746 - .0004</td>
<td>1.7496 - .0004</td>
<td>1.9996 - .0007</td>
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<tr>
<td>CS</td>
<td>1 1/16</td>
<td>2 1/2</td>
<td>2 1/2</td>
<td>3 3/16</td>
<td>4 1/2</td>
<td>4 3/4</td>
</tr>
<tr>
<td>Load (lb) Capacity</td>
<td>8,600</td>
<td>19,300</td>
<td>34,300</td>
<td>65,000</td>
<td>105,200</td>
<td>137,400</td>
</tr>
</tbody>
</table>

Note: Maximum Cylinder Pressure Ratings for Model 94 Cylinders are shown on previous page. Load capacities of accessories or Model 94 cylinders at Maximum Pressure Ratings should not be exceeded.
Miller H Series
Hydraulic Cylinders

Double Rod End

Bolted Bushing
Double Rod End

Note: To determine the dimensions for your Double Rod End cylinder:
• Refer to the Single Rod mounting style you are selecting on the preceding pages.
• Select the necessary dimensions which pertain to your mounting style.
• Return to this page and use these dimensions to finish sizing your cylinder.

Square Retainer Held Bushing
Double Rod End

Note: To determine the dimensions for your Double Rod End cylinder:
• Refer to the Single Rod mounting style you are selecting on the preceding pages.
• Select the necessary dimensions which pertain to your mounting style.
• Return to this page and use these dimensions to finish sizing your cylinder.

Note: Double Rod End cylinders have head (G dimensions) at both ends and LD replaces the LB dimension. On Double Rod End cylinders where the rod end styles differ, be sure to clearly state which rod end is on which cylinder end. (port position 1 is standard).

Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard Threaded on Turndown Section
Style No. 4 Short Rod End-Internal Threads
Style No. 5 Threaded Intermediate Male
Style No. 6 Studded Rod End (Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.
To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.
Miller H Series
Hydraulic Cylinders

No Mounting
10”–20” Bore Cylinders

Model 50-B
Bolted Bushing

Mounting Dimensions
(see tables on opposite page)

Model 50-B No Tie Rods Extended.

Bolted Bushing
Double Rod End
Model DH-50B

Mounting Dimensions
(see tables on opposite page)

Tie Rod Construction For 10” - 20” Bore Cylinders

Bore Size
10
12
14
16
18
20

No. Tie Rods Per Corner
3
4
5
7
6
7

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Note: To determine the dimensions for your Double Rod End cylinder:
• Refer to the Single Rod mounting style you are selecting on the following pages.
• Select the necessary dimensions which pertain to your mounting style.
• Return to this page and use these dimensions to finish sizing your cylinder.

Note: Double Rod End cylinders have had (G dimensions) at both ends and LD replaces the LB dimension. On Double Rod End cylinders where the rod end styles differ, be sure to clearly state which rod is on which cylinder end. (port position 1 is standard).
### Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>AA</th>
<th>*EE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SAE</td>
<td>NPTF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10&quot;</td>
<td>12%</td>
<td>3(\text{\frac{3}{16}})</td>
<td>3(\text{\frac{1}{8}})</td>
<td>1(\text{\frac{1}{2}})</td>
<td>12.69</td>
<td>-32</td>
</tr>
<tr>
<td>12&quot;</td>
<td>15%</td>
<td>4(\text{\frac{3}{8}})</td>
<td>4(\text{\frac{1}{8}})</td>
<td>1(\text{\frac{1}{2}})</td>
<td>15.06</td>
<td>-32</td>
</tr>
<tr>
<td>14&quot;</td>
<td>17(\text{\frac{1}{2}})</td>
<td>4(\text{\frac{1}{8}})</td>
<td>4(\text{\frac{1}{8}})</td>
<td>1(\text{\frac{1}{2}})</td>
<td>17.31</td>
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</tr>
<tr>
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<td>5(\text{\frac{1}{8}})</td>
<td>1(\text{\frac{1}{2}})</td>
<td>19.75</td>
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<td>1(\text{\frac{7}{16}})</td>
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<td>24.50</td>
<td>-32</td>
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</table>

*=SAE ports are standard, NPTF ports are available at no extra charge.

### Add Stroke

<table>
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<th>H</th>
<th>LB</th>
<th>LD</th>
<th>P</th>
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<td>14(\text{\frac{1}{2}})</td>
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<tr>
<td>6(\text{\frac{1}{2}})</td>
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<td>18(\text{\frac{1}{8}})</td>
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<td>21</td>
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### Rod End Dimensions

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<th>Rod Dia</th>
<th>A</th>
<th>B - .001 to -.003</th>
<th>C</th>
<th>D</th>
<th>AB</th>
<th>KK</th>
<th>RD</th>
<th>RT MAX.</th>
<th>VB</th>
<th>WB</th>
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<td>4(\text{\frac{1}{2}})&quot;</td>
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<td>1(\text{\frac{3}{16}})</td>
<td>3(\frac{1}{16})</td>
<td>5(\frac{1}{16})-24</td>
<td>3(\frac{1}{16})</td>
<td>4-12</td>
<td>6.439</td>
<td>.610</td>
<td>1(\text{\frac{1}{4}})</td>
<td>2(\text{\frac{1}{2}})</td>
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<tr>
<td>5&quot;</td>
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<td>5.750</td>
<td>1(\text{\frac{3}{16}})</td>
<td>4(\frac{1}{16})</td>
<td>5(\frac{1}{16})-24</td>
<td>3(\frac{1}{16})</td>
<td>12</td>
<td>6.939</td>
<td>.610</td>
<td>1(\text{\frac{1}{4}})</td>
<td>3(\frac{1}{16})</td>
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<td>4(\frac{1}{16})</td>
<td>5(\frac{1}{16})-24</td>
<td>4-12</td>
<td>7.439</td>
<td>.610</td>
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<td>3(\frac{1}{16})</td>
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<tr>
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<td>.610</td>
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<td>5(\frac{1}{2})-8</td>
<td>9.939</td>
<td>.610</td>
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*Wrench flats are 1" long these sizes

### Add Stroke

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<td>29(\text{\frac{1}{4}})</td>
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</table>
Model 63-B
Bolted Bushing
Square Head

Mounting Dimensions
(see tables on opposite page)

Model 64-B
Bolted Bushing
Square Cap

Mounting Dimensions
(see tables on opposite page)

Model 63/64 Multiple Mounting Holes

Note: Mount on outside face with high tensile socket head cap screws. Hardened 1/4" thick bearing plates are furnished with cylinder and must be used under bolt head.
## Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore Size</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>*EE</th>
<th>SAE</th>
<th>NPTF</th>
<th>EX</th>
<th>H</th>
<th>LB</th>
<th>P</th>
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<td>-32</td>
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<td>17/8&quot;</td>
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*SAE ports are standard, NPTF ports are available at no extra charge.

## Add Stroke

<table>
<thead>
<tr>
<th>H</th>
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## Rod End Dimensions

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<th>A</th>
<th>B - .001 to -.003</th>
<th>C</th>
<th>D</th>
<th>AB</th>
<th>KK</th>
<th>RD</th>
<th>RT MAX.</th>
<th>VB</th>
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<td>5</td>
<td>5.750</td>
<td>11/16&quot;</td>
<td>.03&quot;</td>
<td>.03&quot;</td>
<td>11/16&quot;</td>
<td>3/16</td>
<td>11/16&quot;</td>
<td>.610</td>
<td>11/16&quot;</td>
<td>21/16&quot;</td>
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<td>3/16</td>
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<td>.610</td>
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<td>.06&quot;</td>
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<td>.610</td>
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<td>.06&quot;</td>
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<td>51/16</td>
<td>11/16&quot;</td>
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<td>.07&quot;</td>
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<td>.610</td>
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<td>.06&quot;</td>
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<td>51/16</td>
<td>11/16&quot;</td>
<td>.610</td>
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<td>31/8&quot;</td>
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<td>8</td>
<td>8.750</td>
<td>1</td>
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<td>.06&quot;</td>
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<td>51/16</td>
<td>11/16&quot;</td>
<td>.610</td>
<td>21/16&quot;</td>
<td>31/8&quot;</td>
</tr>
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<td></td>
<td>9&quot;</td>
<td>9</td>
<td>9.750</td>
<td>1</td>
<td>.07&quot;</td>
<td>.07&quot;</td>
<td>11/16&quot;</td>
<td>61/16</td>
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<td>.610</td>
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<td>.07&quot;</td>
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<td>11/16&quot;</td>
<td>.610</td>
<td>21/16&quot;</td>
<td>31/8&quot;</td>
</tr>
</tbody>
</table>

*Wrench flats are 1" long these sizes

## Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

### Style No. 2 - Standard
Threaded on Tumdown Section

### Style No. 4 - Short Rod End-Internal Threads

### Style No. 5 - Threaded Intermediate Male
Miller H Series
Hydraulic Cylinders

Model 72-B (NFPA MS2)
Bolted Bushing
Side Lug

Model 73-B (NFPA MS3)
Bolted Bushing
Centerline Lug

Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Note: Lugs should be blocked on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load. See Keying and Pinning Cylinders page.
## Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>*EE</th>
<th>SB</th>
<th>ST</th>
<th>SU</th>
<th>SW</th>
<th>TS</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>12%</td>
<td>3%</td>
<td>3%</td>
<td>1%</td>
<td>-32</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>12</td>
<td>15%</td>
<td>4%</td>
<td>4%</td>
<td>1%</td>
<td>-32</td>
<td>2%</td>
<td>1%</td>
<td>4</td>
<td>2</td>
<td>19%</td>
<td>23%</td>
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<tr>
<td>14</td>
<td>17%</td>
<td>4%</td>
<td>4%</td>
<td>1%</td>
<td>-32</td>
<td>3</td>
<td>1%</td>
<td>5</td>
<td>2%</td>
<td>22%</td>
<td>27%</td>
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</table>

*SAE ports are standard, NPTF ports are available at no extra charge.

## Rod End Dimensions

<table>
<thead>
<tr>
<th>Bore</th>
<th>Rod Dia Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>AB</th>
<th>KK</th>
<th>RD</th>
<th>RT</th>
<th>VB</th>
<th>WB</th>
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</thead>
<tbody>
<tr>
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<td>4\frac{1}{2}&quot;</td>
<td>4\frac{1}{2}</td>
<td>5.250</td>
<td>11%</td>
<td>3%</td>
<td>3%</td>
<td>6.439</td>
<td>.610</td>
<td>1%</td>
<td>2\frac{1}{2}</td>
<td></td>
</tr>
<tr>
<td>5&quot;</td>
<td>5</td>
<td>5.750</td>
<td>11%</td>
<td>4\frac{1}{2}</td>
<td>3%</td>
<td>6.939</td>
<td>.610</td>
<td>1%</td>
<td>1\frac{1}{2}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5\frac{1}{2}&quot;</td>
<td>5\frac{1}{2}</td>
<td>6.250</td>
<td>1\frac{1}{2}</td>
<td>4\frac{1}{2}</td>
<td>4\frac{1}{2}</td>
<td>7.439</td>
<td>.610</td>
<td>1%</td>
<td>3\frac{1}{2}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7&quot;</td>
<td>7</td>
<td>7.750</td>
<td>1\frac{1}{2}</td>
<td>6\frac{1}{2}</td>
<td>5\frac{1}{2}</td>
<td>8.939</td>
<td>.610</td>
<td>2\frac{1}{2}</td>
<td>3\frac{1}{2}</td>
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<tr>
<td>12&quot;</td>
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<td>1\frac{1}{2}</td>
<td>4\frac{1}{2}</td>
<td>4\frac{1}{2}</td>
<td>7.439</td>
<td>.610</td>
<td>1%</td>
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<td></td>
</tr>
<tr>
<td>8&quot;</td>
<td>8</td>
<td>8.750</td>
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<td>6\frac{1}{2}</td>
<td>5\frac{1}{2}</td>
<td>9.939</td>
<td>.610</td>
<td>2\frac{1}{2}</td>
<td>3\frac{1}{2}</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>9.750</td>
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<td>7\frac{1}{2}</td>
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<td>10.939</td>
<td>.610</td>
<td>2\frac{1}{2}</td>
<td>3\frac{1}{2}</td>
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</tr>
</tbody>
</table>

*Wrench flats are 1" long these sizes

## Pressure Limitations For Model 72-B

<table>
<thead>
<tr>
<th>Bore</th>
<th>Pressure (PSI)</th>
</tr>
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<tbody>
<tr>
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<td>1320</td>
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<td>14</td>
<td>1200</td>
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## Pressure Limitations For Model 73-B

<table>
<thead>
<tr>
<th>Bore</th>
<th>Pressure (PSI)</th>
</tr>
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<tbody>
<tr>
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<td>1320</td>
</tr>
<tr>
<td>12</td>
<td>1480</td>
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<tr>
<td>14</td>
<td>1620</td>
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</tbody>
</table>

Model 72 cylinders have mounting lugs welded to the head and cap, and are considered to be a fixed mount that does not absorb force on its centerline. The plane of the mounting surface is not through the centerline of the cylinder, and for this reason Model 72 cylinders produce a turning moment as the cylinder applies force to the load. This turning moment tends to rotate the cylinder about its mounting bolts. If the cylinder is not well secured to the machine member on which it is mounted or the load is not well-guided, this turning moment results in side load applied to rod bushing and piston bearings. To avoid this problem, Model 72 cylinders should be specified with a stroke length at least equal to the bore size.
Miller H Series
Hydraulic Cylinders

Model 81-B (NFPA MT1)
Bolted Bushing
Trunnion Head End

Note: Pins designed for shear, (not bending) loads.

Model 82-B (NFPA MT2)
Bolted Bushing
Trunnion Cap End

Note: Pins designed for shear, (not bending) loads.

Common Rod End Styles & Dimensions
For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Pressure Limitations For Models 81-B & 82-B

<table>
<thead>
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<th>12</th>
<th>14</th>
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<tbody>
<tr>
<td>Pressure (PSI)</td>
<td>900</td>
<td>760</td>
<td>870</td>
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## Cylinder Body Dimensions

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<th>Bore</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>*EE</th>
<th>TD</th>
<th>TL</th>
<th>UT</th>
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<td>SAE</td>
<td>NPTF</td>
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<tr>
<td>10&quot;</td>
<td>12½</td>
<td>3½</td>
<td>3½</td>
<td>1½</td>
<td>-32</td>
<td>2</td>
<td>3½</td>
<td>3½</td>
</tr>
<tr>
<td>12&quot;</td>
<td>15½</td>
<td>4½</td>
<td>4½</td>
<td>1½</td>
<td>-32</td>
<td>2½</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>14&quot;</td>
<td>17½</td>
<td>4½</td>
<td>4½</td>
<td>1½</td>
<td>-32</td>
<td>3</td>
<td>5</td>
<td>5</td>
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*SAE ports are standard, NPTF ports are available at no extra charge.

## Rod End Dimensions

### Add Stroke

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<tr>
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<th>LB</th>
<th>LD</th>
<th>P</th>
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<td>12½</td>
<td>12½</td>
<td>8</td>
</tr>
<tr>
<td>5½</td>
<td>14½</td>
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<td>9½</td>
</tr>
<tr>
<td>5½</td>
<td>15½</td>
<td>15½</td>
<td>10½</td>
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### Add Stroke

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<th>ZB</th>
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<tr>
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<td>19½</td>
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<tr>
<td>16½</td>
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</tr>
<tr>
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*Wrench flats are 1” long these sizes

## Bore Table

<table>
<thead>
<tr>
<th>Bore</th>
<th>Rod Dia Size</th>
<th>A</th>
<th>B -.001 to -.003</th>
<th>C</th>
<th>D</th>
<th>AB</th>
<th>KK</th>
<th>RD</th>
<th>RT MAX.</th>
<th>VB</th>
<th>WB</th>
<th>XG</th>
</tr>
</thead>
<tbody>
<tr>
<td>10&quot;</td>
<td>4½”</td>
<td>4½</td>
<td>5.250</td>
<td>13½</td>
<td>3½</td>
<td>¾</td>
<td>8-16-24</td>
<td>3½</td>
<td>12</td>
<td>6.439</td>
<td>.610</td>
<td>1¼</td>
</tr>
<tr>
<td>12&quot;</td>
<td>5½</td>
<td>4½</td>
<td>5.750</td>
<td>13½</td>
<td>3½</td>
<td>¾</td>
<td>8-16-24</td>
<td>3½</td>
<td>12</td>
<td>6.939</td>
<td>.610</td>
<td>1¼</td>
</tr>
<tr>
<td>14&quot;</td>
<td>7½</td>
<td>4½</td>
<td>6.250</td>
<td>13½</td>
<td>3½</td>
<td>¾</td>
<td>8-16-24</td>
<td>4-12</td>
<td>7.439</td>
<td>.610</td>
<td>1¼</td>
<td>3½</td>
</tr>
</tbody>
</table>

*SAE ports are standard, NPTF ports are available at no extra charge.
Note: Pins designed for shear (not bending) loads. Specify dimension “XI” when ordering.

Common Rod End Styles & Dimensions

Style No. 2-Standard Threaded on Turndown Section
Style No. 4 Short Rod End-Internal Threads
Style No. 5 Threaded Intermediate Male
Style No. 6 Studded Rod End

“For Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available. To order, specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

Pressure Limitations, Minimum XI and Minimum Stroke For Model 89-B

<table>
<thead>
<tr>
<th>Bore</th>
<th>10</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure (PSI)</td>
<td>624</td>
<td>546</td>
</tr>
<tr>
<td>Min. XI</td>
<td>9½</td>
<td>10½</td>
</tr>
<tr>
<td>Min. Stroke</td>
<td>.25</td>
<td>.375</td>
</tr>
</tbody>
</table>
### Cylinder Body Dimensions

<table>
<thead>
<tr>
<th>Bore</th>
<th>E</th>
<th>G</th>
<th>J</th>
<th>K</th>
<th>BD</th>
<th>*EE</th>
<th>TD</th>
<th>TL</th>
<th>TM</th>
<th>UM</th>
<th>UW</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>12½</td>
<td>3½</td>
<td>3½</td>
<td>1½</td>
<td>4½</td>
<td>.32</td>
<td>2</td>
<td>3½</td>
<td>14</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>15½</td>
<td>4½</td>
<td>4½</td>
<td>1½</td>
<td>5½</td>
<td>.32</td>
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*SAE ports are standard, NPTF ports are available at no extra charge.

### Rod End Dimensions

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<th>C</th>
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<th>RT MAX.</th>
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*Wrench flats are 1" long these sizes.

### Add Stroke

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55
Miller H Series
Hydraulic Cylinders

Fixed Clevis and Rear Eye
10"–20" Bore Cylinders

Model 84-B
Bolted Bushing
Fixed Clevis

Model 90-B
Bolted Bushing
Rear Eye

Mounting Dimensions
(See tables on opposite page)

Pressure Limitations For Models 84-B & 90-B

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<th>14</th>
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<th>18</th>
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Common Rod End Styles & Dimensions

For additional standard rod ends, see “Rod End Styles and Dimensions” page.

Style No. 2-Standard
Threaded on Turndown Section

Style No. 4
Short Rod End-Internal Threads

Style No. 5
Threaded Intermediate Male

Style No. 6
Studded Rod End
(Available Thru 2" Rod Diameter)

“Special” Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify “Style X” and give desired dimensions for KK, A, WB or W.
If otherwise special, furnish dimensioned sketch.
## Cylinder Body Dimensions

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<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>*EE</th>
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<th>CD</th>
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*SAE ports are standard, NPTF ports are available at no extra charge.

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## Rod End Dimensions

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</table>

*Wrench flats are 1" long these sizes
**Rod End Styles**

Rod End Style 2 is the standard rod end on Miller Fluid Power cylinders and will be furnished unless otherwise specified.

The rod end styles shown on this page represent most of the more commonly used rod end connections. If a rod end is required other than any of those shown, specify Style X. Give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

Rod end modifications to your specifications can be readily made and could include a radius, a spherical radius, special thread size or length or both, keyway, special drilled holes and many other variations too numerous to mention.

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<th>AF</th>
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<th>C</th>
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*For Style #1 Rod End “D” Dimension: 5⁄8 Rod D = 7⁄16
1" Rod D = 13⁄16*

** For 41⁄4" rod, the “C” dim. is 11⁄16 and the “A+C” dim. is 6⁄32 for 10 inch bore-H-series.
For 5" rod, the “C” dim. is 11⁄16 and the “A+C” dim. is 6⁄32 for 10 inch bore-H-series.
For 51⁄2" rod, the “C” dim. is 11⁄16 and the “A+C” dim. is 7⁄32 for 10 and 12 inch bore-H-series.
Wrench flats on these sizes are 1" long.

† In September 2003 most dimensions for the Style 9 end on 7-10 inch piston rods were revised. Customer orders for 7-10 inch Style 9 rod ends must specify required AC, AD, AE, AF, and AM dimensions.
Miller H Series
Hydraulic Cylinders

Rod End Couplers

Dimensions

Good machine design practice requires that proper alignment be maintained to avoid excessive bearing loads. The Miller linear alignment rod end coupler can reduce minor cylinder misalignment problems, within design limitations. These couplers can be used for both push and pull applications.

Note: Use jam nut to lock coupler to rod when used with full diameter threads.

Part Numbers and Sizes

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<thead>
<tr>
<th>Part Number</th>
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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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** 'E' thread is not deep enough to accept rod end style #2 standard 'A' thread length. Piston Rod style #2 thread for these sizes must be this 'E' dimension or shorter to permit torquing of Rod End Coupler to piston rod shoulder.

* Load in pounds. 4.1 safety factor.
† 10° Total Movement on 1 1/2"-12 thread and larger.

On Long Stroke Horizontally Mounted Cylinder, see Determining Stop Tube Requirements pages.
## Selecting Rod End Accessories

### Pivot Pin

<table>
<thead>
<tr>
<th>Pivot Pin</th>
<th>Eye Bracket</th>
<th>Clevis Bracket</th>
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### Eye Bracket

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<th>CZ</th>
<th>DB</th>
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<th>EA</th>
<th>FC</th>
<th>FE</th>
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### Clevis Bracket

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<td>1</td>
<td>1/2</td>
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</table>

† Dimensions apply to eye bracket only.  **Note:** Do not order clevis bracket to convert cylinders to 86 mounting. Contact factory.
# Miller H Series
## Hydraulic Cylinders

### Rod Eye

![Rod Eye Diagram]

### Rod Clevis

![Rod Clevis Diagram]

<table>
<thead>
<tr>
<th>Part No. + Load Capacity (lbs)</th>
<th>Thd Size KK</th>
<th>A</th>
<th>MC</th>
<th>ME</th>
<th>CA</th>
<th>CB</th>
<th>CE</th>
<th>CD</th>
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Cylinder Rod End Accessories

Cylinder Rod End Accessories are used to affix the piston rod to the load—most commonly when the cylinder pivots during operation.

Piston Rod Attachments

In attaching machinery components or rod clevises, rod eyes, etc. to Miller Styles 2 & 6 (Threaded on Turndown Section) or Styles 3 & 4 (Internally Threaded Piston Rods), the attachments should be tightened to the torques given in the Table at right. This torque or pre-stress triples the fatigue strength of the rod's threaded section and makes a stronger assembly than attaching the machinery component to a maximum diameter threaded rod (Style 5) and torquing it against a lock nut. Miller recommends the Style 2 (Threaded on Turndown Section) Rod for most applications. It's square shoulder design helps proper alignment of cylinder to mechanism, eliminates need for a jam nut, provides fixed point for more accurate cylinder positioning, and simplifies piloting of full rod diameter into mating part.

Flange Coupling (For Use with Style #9 Rod End)

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<th>Weld Plate Part No.</th>
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<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
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<td>.406</td>
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<td>.562</td>
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<td>.750</td>
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<td>.375</td>
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<td>30˚</td>
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<td>12</td>
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<td>.875</td>
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<td>5.000</td>
<td>2.375</td>
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<td>5.500</td>
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<td>30˚</td>
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<td>7.000</td>
<td>.375</td>
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<td>30˚</td>
<td>.666</td>
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<td>1.000</td>
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<td>7.000</td>
<td>.375</td>
<td>15˚</td>
<td>30˚</td>
<td>.666</td>
<td>¾-11</td>
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<td>5.188</td>
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<td>057-FC002-450</td>
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<td>30˚</td>
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<td>12</td>
<td>5.688</td>
<td>1.500</td>
<td>4.625</td>
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<tr>
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<td>057-BA003-500</td>
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<td>7.375</td>
<td>3.125</td>
<td>1.000</td>
<td>8.000</td>
<td>.375</td>
<td>15˚</td>
<td>30˚</td>
<td>.666</td>
<td>¾-11</td>
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<td>6.188</td>
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<td>057-FC002-700</td>
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<td>10.380</td>
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<td>1.750</td>
<td>11.000</td>
<td>.500</td>
<td>15˚</td>
<td>30˚</td>
<td>1.031</td>
<td>1-7</td>
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<td>12.000</td>
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<td>11.25˚</td>
<td>22.5˚</td>
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<td>1-8</td>
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<td>057-FC002-1000</td>
<td>057-BA003-1000</td>
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<td>8.250</td>
<td>14.120</td>
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<td>15.000</td>
<td>.500</td>
<td>11.25˚</td>
<td>22.5˚</td>
<td>1.281</td>
<td>1½-7</td>
<td>16</td>
<td>12.125</td>
<td>2.375</td>
<td>10.130</td>
</tr>
</tbody>
</table>

Note: Some dimensions for Flange Coupling and Weld Plate to fit 2 1/2 rod Style #9 machining changed in September 2003. Although the current and previous designs both fit Style #9 machining, the mounting bolt diameter has been reduced from 1/2 inch to 3/8 inch. There also has been a corresponding decrease in the Flange Coupling OD and bolt circle. For dimensional information on the older Flange Coupler and Mounting Plate, please consult the factory or previous editions of this catalog.
Adjustable on Retract Stroke
Available at additional cost. Screw is furnished in cap end of cylinder and is designed for infrequent* stroke adjustment. Turning it in or out limits the retract stroke to the precise length desired. **Note: Stroke adjustments should be made at Zero fluid pressure only.** PTFE Tru-Seal fitting provides positive seal against leakage, as well as providing adjustment lock. Cap end cushion not available with this option.

*Infrequent is defined by positioning the retract stroke in a couple of attempts at original machine set-up.

Adjustable on Extend Stroke
Available at additional cost. Using a double rod end cylinder, the extend stroke can be adjusted by repositioning the lock nuts on the threaded rod extension on the adjustment end.

Other Available Cylinder Modifications

**Rod End Modifications**
Miller can produce a wide variety of custom rod end styles such as special threads and non-standard size turndowns. For unusual modifications, involving more than just a change in dimensions, submit a sketch or drawing to Miller for a determination as to cost and feasibility.

**Special Ports**
Standard H cylinder ports are SAE. However, equivalent NPTF or oversize SAE or NPTF ports are available as options.

**Air Bleeds**
Miller cylinders can be ordered with optional self or manual air bleeds.

**Heavy Chromed Tubes and Piston Rods**
Miller can provide an optional 0.002 to 0.003 inch heavy chrome plating on cylinder tube I.D. and piston rods.

**Stainless Steel Piston Rods**
Miller can supply cylinders with 17-4 or other types of stainless steel piston rods. Contact Miller Fluid Power application engineering department regarding any special piston rod material.

**More Options**
- Fluorocarbon Seal Materials
- Designs to meet specialized requirements: Nuclear, ASME, ABS, AWWA, SUB SEA, and Various Automotive Industry and Military Specifications.
- Special Coatings and Painting
- Grease Fitted Rod Bushing
- External Drainback Bushing
End of Stroke Magnetic Principle Type Proximity Switch

Specify on Order:
Magnetic Principle Proximity Switch

Reliable: Proximity type sensor never contacts cylinder moving parts; eliminating wear and adjustments.

Positive Action: Multiple magnet design provides “snap action.” Eliminates creep and false signals.

Versatile: Sealed stainless steel switch body can be used with any operating fluid and is impervious to most environmental conditions.

As shown in the sketches above, these switches are magnetically operated. Dual magnets provide a dependable “snap action” for positive position sensing.

In the “unoperated” position, the magnet assembly is attracted in the direction of the arrow, causing a finely ground stainless steel connecting rod to hold the contacts open.

In the “operated” position a ferrous part (cushion or piston) enters the sensing area and attracts the magnet assembly which causes the rod to draw the contacts closed.

Specifications

Switch Type:
Magnetic Principle

Contacts:
Single Pole-Double Throw (SPDT)

Contact Rating*:
2 Amp at 110-240 VAC (UL & CSA) 100 MA at 12 VDC 50 MA at 24 VDC (CSA)

Note: Check current draw of solenoid valves.

Connection: 36" long, 3 wire, potted in cable. Can be wired Normally Open or Normally Closed. Leads are tagged (Com, N/O, N/C)

Pressure Rating: 3000 PSI Non Shock

Temperature Range:
– 20°F to + 200°F (UL 104°F. Max.)

Sensing Gap:
.030 to .060 inch

Trip Point: Factory Set with Piston Bottomed out

Release Point: Approximately ¾” Piston Travel Min. Cyl. stroke ½” on 1½” & 2” bore, ¾” stroke on 2½” and up.

*UL and CSA approved for industrial control, general purpose use. If Class I, Division 1 or 2 is required, please specify.
**Miller H Series**

**Hydraulic Cylinders**

Switch Extension for Standard Side Position or Optional End Cap Position

![Diagram of switch extension](image)

Standard location for switch mounting is any available side position. Please specify side location (1, 2, 3 or 4) desired. Cylinders are standardized as cushioned. Models 67/68 in positions #2 & #4 require special machining.

### Table Showing Extension of Switch from Endcap

<table>
<thead>
<tr>
<th>BORE</th>
<th>ROD</th>
<th>HEAD</th>
<th>CAP</th>
<th>HEAD</th>
<th>CAP</th>
</tr>
</thead>
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<td>2.39</td>
<td>1</td>
</tr>
<tr>
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<td>2.76</td>
<td>1</td>
<td>2.39</td>
<td>1</td>
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<tr>
<td>2</td>
<td>1.000</td>
<td>2.57</td>
<td>1</td>
<td>2.26</td>
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<tr>
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<td>1.375</td>
<td>2.70</td>
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<td>2.26</td>
<td>1</td>
</tr>
<tr>
<td>2 1/2</td>
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<td>3.25</td>
<td>2</td>
<td>2.94</td>
<td>2</td>
</tr>
<tr>
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<td>3.44</td>
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<td>2.94</td>
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<tr>
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<td>2.94</td>
<td>2</td>
</tr>
<tr>
<td>3 3/4</td>
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<td>2.38</td>
<td>2</td>
<td>2.13</td>
<td>2</td>
</tr>
</tbody>
</table>

*NOTE: The depth to which a switch is installed may vary and still be in sensing range. Therefore, the calculated extension of the switch is approximate.*

**How to order:**

To order switches, enter a '9' in the Modified field of the cylinder model code. Describe the modification in notes by specifying:

1. Magnetic end of stroke switch
2. Installation in head, cap, or both ends of the cylinder
3. Location in the head or cap (position #1, 2, 3, or 4) not occupied by a port or mounting
Series and Parallel Wiring

When Miller EPS-5 or PEP-1 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.

Miller EPS-5 or PEP-1 switches may be hard wired for series operation, but the voltage drop through the switches (see specifications) must not reduce the available voltage below what is needed to actuate the load.

Miller EPS-5 or PEP-1 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-5 or PEP-1 switches in parallel will require the use of a bypass (shunt) resistor.

---

**End of Stroke Inductive Type**

**Proximity Switch**

**All Switches are:**
- Non-Contacting
- Water Resistant
- Weld-Field Immune
- Shock and Vibration Resistant
- Flange-Mounted to Cylinder End Caps

**EPS-5**

**Automotive Applications**

(Meets some Automotive Manufacturer’s Specifications)

**PEP-1 Switches**

**Miller H Series**

**Hydraulic Cylinders**

**End of Stroke Inductive Type**

**Proximity Switch**

**All Switches are:**
- Non-Contacting
- Water Resistant
- Weld-Field Immune
- Shock and Vibration Resistant
- Flange-Mounted to Cylinder End Caps

**EPS-5**

**Automotive Applications**

(Meets some Automotive Manufacturer’s Specifications)

**PEP-1 Switches**

**Series and Parallel Wiring**

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**Connector Pin Numbering**

**3-Pin Mini**

<table>
<thead>
<tr>
<th>Male Receptacle End View</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Load Source</td>
</tr>
<tr>
<td>Black N.O. L2 or L1 or</td>
</tr>
<tr>
<td>Green</td>
</tr>
</tbody>
</table>

**5-Pin Mini**

<table>
<thead>
<tr>
<th>Male Receptacle End View</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Load Source</td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>White (+) Load Sinking</td>
</tr>
<tr>
<td>Orange (-) N.O.</td>
</tr>
</tbody>
</table>
# Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>PEP-1</th>
<th>EPS-5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Style:</strong></td>
<td><strong>PEP-1</strong></td>
<td><strong>EPS-5</strong></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td>Economical, General Purpose, 2 wire device, primarily for AC applications, not suitable for 24 VDC applications. Use EPS-5 only for automotive industry customers who specify them.</td>
<td></td>
</tr>
<tr>
<td><strong>Supply Voltage:</strong></td>
<td>20 to 250 VAC/DC</td>
<td>20 to 230 VAC/DC</td>
</tr>
<tr>
<td><strong>Load Current, min.:</strong></td>
<td>8 mA</td>
<td>5 mA</td>
</tr>
<tr>
<td><strong>Load Current, max.:</strong></td>
<td>300 mA</td>
<td>500 mA</td>
</tr>
<tr>
<td><strong>Leakage Current:</strong></td>
<td>1.7 mA, max.</td>
<td>1.7 mA, max.</td>
</tr>
<tr>
<td><strong>Voltage Drop:</strong></td>
<td>7 V, max.</td>
<td>10 V, max.</td>
</tr>
<tr>
<td><strong>Operating Temperature:</strong></td>
<td>-14° to +158° F</td>
<td>-4° to +158° F</td>
</tr>
<tr>
<td><strong>Sensor Type:</strong></td>
<td>Inductive proximity</td>
<td>Inductive proximity</td>
</tr>
<tr>
<td><strong>Connection:</strong></td>
<td>3 pin mini</td>
<td>3 pin mini</td>
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<tr>
<td><strong>Enclosure Rating:</strong></td>
<td>IEC IP67</td>
<td>NEMA 4, 6, 12, 13</td>
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<tr>
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<td>Yes</td>
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<tr>
<td><strong>Short Circuit Protection:</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Weld Field Immunity:</strong></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Output:</strong></td>
<td>2 wire, Normally Open with leakage current</td>
<td>2 wire, Normally Open with leakage current</td>
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<tr>
<td><strong>Approvals/Marks:</strong></td>
<td>CE, UL, CSA</td>
<td>UL</td>
</tr>
<tr>
<td><strong>Make/Break Location:</strong></td>
<td>0.125&quot; from end of stroke, typical tolerance is +0/-0.125&quot;</td>
<td></td>
</tr>
<tr>
<td><strong>Wiring Instructions:</strong></td>
<td>Pin 1: AC Ground (Green)</td>
<td>Pin 1: AC Ground (Green)</td>
</tr>
<tr>
<td></td>
<td>Pin 2: Output (Black)</td>
<td>Pin 2: Output (Black)</td>
</tr>
<tr>
<td></td>
<td>Pin 3: AC Line (White)</td>
<td>Pin 3: AC Line (White)</td>
</tr>
<tr>
<td><strong>Cable:</strong></td>
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<td>085355-0006</td>
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<tr>
<td><strong>Cable:</strong></td>
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<td>087547-0006</td>
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**Standard location for switch mounting is any available side location. Please specify side location (1, 2, 3, or 4) desired.**

<table>
<thead>
<tr>
<th>BORE</th>
<th>All Models Except 67/68 In Position 2 &amp; 4</th>
<th>Model 67/68 In Position 2 &amp; 4</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>ROD</td>
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<tr>
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<tr>
<td></td>
<td>1.000</td>
<td>1.425</td>
</tr>
<tr>
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<td>CAP</td>
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<td>0.175</td>
</tr>
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<td>0.836</td>
</tr>
<tr>
<td></td>
<td>2.500</td>
<td>0.336</td>
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<tr>
<td></td>
<td>CAP</td>
<td>0.275</td>
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<tr>
<td>6</td>
<td>2.500</td>
<td>0.649</td>
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<tr>
<td></td>
<td>3.000</td>
<td>0.154</td>
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<tr>
<td></td>
<td>CAP</td>
<td>0.674</td>
</tr>
<tr>
<td>7</td>
<td>3.000</td>
<td>0.462</td>
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<tr>
<td></td>
<td>3.500</td>
<td>0.649</td>
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<tr>
<td></td>
<td>CAP</td>
<td>0.363</td>
</tr>
<tr>
<td>8</td>
<td>3.500</td>
<td>0.154</td>
</tr>
<tr>
<td></td>
<td>4.000</td>
<td>0.400</td>
</tr>
<tr>
<td></td>
<td>CAP</td>
<td>0.836</td>
</tr>
</tbody>
</table>

** Check with Miller Engineering.

### How to order:

To order switches, enter a ‘9’ in the Modified field of the cylinder model code. Describe the modification in notes by specifying:

1. EPS-5 or PEP-1 switch
2. Installation in head, cap, or both ends of the cylinder
3. Location in the head or cap (position #1, 2, 3, or 4) not occupied by a port or mounting
To find the proper bore size for your cylinder, follow these simple steps:

1. In the table below, locate the column headed by the pressure at which you plan to operate the system.

2. Move down that column and find the force or thrust value which is the same as (or next higher value) that which the cylinder will be required to deliver.

3. On the same line, move across the table to the first column. The number shown there is most likely the bore size best suited to delivering the push stroke forces you require. Later checks can confirm whether this bore size is, in fact, the one which best serves your particular application needs.

### Bore Size Estimation Table

<table>
<thead>
<tr>
<th>Cylinder Bore Sizes in Inches</th>
<th>Piston Area Square Inches</th>
<th>THEORETICAL PUSH STROKE FORCES IN POUNDS Oil Consumption Per Inch of Stroke in One Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PRESSURES OF OPERATING MEDIUM (GPI) Gals. Displaced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50 PSI 60 PSI 80 PSI 100 PSI 200 PSI 250 PSI 500 PSI 750 PSI 1000 PSI 1500 PSI 2000 PSI 3000 PSI</td>
</tr>
<tr>
<td>1 1/2</td>
<td>1.767</td>
<td>88 106 141 177 353 442 864 1,325 1,767 2,651 3,534 5,301</td>
</tr>
<tr>
<td>2</td>
<td>3.147</td>
<td>157 189 251 314 628 786 1,571 2,357 3,142 4,713 6,283 9,426</td>
</tr>
<tr>
<td>2 1/2</td>
<td>4.909</td>
<td>245 295 393 491 982 1,227 2,455 3,682 4,909 7,364 9,818 14,727</td>
</tr>
<tr>
<td>3 1/4</td>
<td>6.296</td>
<td>415 498 664 830 1,659 2,074 4,148 6,222 8,296 12,444 16,592 24,888</td>
</tr>
<tr>
<td>4</td>
<td>12.566</td>
<td>628 754 1,005 1,257 2,513 3,141 6,283 9,425 12,566 18,849 25,132 37,698</td>
</tr>
<tr>
<td>5</td>
<td>19.635</td>
<td>982 1,178 1,571 1,964 3,927 4,909 9,818 14,726 19,635 29,453 39,270 56,905</td>
</tr>
<tr>
<td>6</td>
<td>28.274</td>
<td>1,414 1,886 2,262 2,849 5,657 7,021 14,137 21,206 28,274 42,412 56,546 84,822</td>
</tr>
<tr>
<td>7</td>
<td>38.485</td>
<td>2,153 2,039 2,079 2,849 5,679 9,621 19,242 28,864 38,485 57,728 76,970 115,455</td>
</tr>
<tr>
<td>8</td>
<td>50.265</td>
<td>2,513 3,016 4,021 5,027 10,053 12,566 25,132 37,698 50,265 75,398 100,530 150,795</td>
</tr>
<tr>
<td>9</td>
<td>78.54</td>
<td>3,927 4,712 6,283 7,854 15,710 19,635 39,270 58,905 78,540 117,810 157,080 235,620</td>
</tr>
<tr>
<td>10</td>
<td>154.93</td>
<td>7,697 9,236 12,315 15,394 30,790 38,485 76,970 115,455 153,940 230,910 307,880 461,820</td>
</tr>
<tr>
<td>11</td>
<td>201.06</td>
<td>10,053 12,064 16,085 20,106 40,201 50,265 100,530 150,796 201,060 301,590 402,120 603,180</td>
</tr>
</tbody>
</table>

Thrusts for operating pressures not shown in the table may be calculated by multiplying the operating pressures by the piston areas.

Miller cylinders have efficiencies greater than 98% at 80 or more PSI on 4" or larger bores. As a result, power losses due to friction are usually negligible and need not be allowed for.

### Pull Stroke Cylinder Bore Sizes and Forces

To find the force on the pull stroke, you need to know the area on the rod end of the cylinder is less than the cylinder bore by the area of the rod.

To find the force on the pull stroke, you need to know the area of the rod. Example: For a five inch bore cylinder, the standard rod diameter is two inches.

Find two inches in the left most column in the chart below, move along to the right until you find the column headed by the pressure you will be working at. The number shown, is the value you deduct from the push stroke thrust in the chart above. The resultant is the force available for the pull stroke.

Should your pressure be different from those shown in the table, then use the following formula to calculate the pull force.

\[
\text{Pull force} = (\text{Bore Area} - \text{Rod Area}) \times \text{Working Pressure}
\]
Operating Fluids and Temperature Range
Fluidpower cylinders are designed for use with pressurized air, hydraulic oil, and fire resistant fluids. In some cases special seals are required.

Standard Seals
Standard seals in a cylinder assembly are intended for use with fluids such as: air, nitrogen, mineral base hydraulic oil, water glycols, or MIL-H-5606 within the temperature range of -10°F (-23°C) to +180°F (+82°C). The individual seals may be nitrile (Buna-N), polyurethane, or PTFE.

High Temperature Seals
High temperature seals are intended for elevated temperature service or for some Phosphate Ester Fluids such as Houghto-Safe 1010, 1055, 1120; Fyrquel 150, 220, 300, 350; Mobil Pyrogard 42, 43, 53, and 55.

Note: In addition, high temperature seals can be used with fluids listed under Standard Seal service. However, they are not compatible with Phosphate Ester Fluids such as Skydrols.

High temperature seals can operate within a temperature range of -10°F (-23°C) to +250°F (+121°C). Fluorocarbon seals may be operated to +400°F (+204°C) with limited service life. For temperatures above +250°F (+121°C) the cylinder must be manufactured with non-studded piston rod thread. High temperature rod seals, rod wipers, and bushing O-rings are fluorocarbon. Piston seals and tube end seals are PTFE and piston seals are spring loaded. A spring loaded PTFE rod seal option is available for service to +450°F (+232°C).

PSCH (Position Sensing Cylinder H) Seals
PSCH seals consist of one filled PTFE dynamic piston seal with an elastomer expander underneath. PSCH piston arrangement normally consists of two wear rings mounted at the rear of the piston with the seal in front. This type of seal is virtually leak free under static conditions and can tolerate high pressure. The wear rings on the piston can also tolerate high side loads. The dynamic portion of the seal is bronze filled PTFE and is compatible with almost all types of fluids. However, carbon filled PTFE will provide better seal life when used with High Water Content Fluids. A nitrile expander will be provided unless high temperature seals are specified. In those cases the expander will be fluorocarbon. Note: It may be necessary to cycle the piston seals 40 or 50 times before achieving leakage free performance.

Warning
Optional studded piston rod end Style 6 has a threaded connection that is secured with temperature sensitive anaerobic adhesive. Cylinders specified with high temperature seals are assembled with anaerobic adhesive having a maximum temperature rating of +250°F (+121°C). Cylinders specified with all other seal compounds are assembled with anaerobic adhesive that has a maximum operating temperature rating +165°F (+74°C). These temperature limitations are necessary to prevent possible loosening of the threaded connections. Cylinders originally manufactured with standard seals (polyurethane, nitrile, & PTFE) that will be exposed to ambient temperatures above +165°F (+74°C) must be modified for higher temperature service. Contact the factory immediately and arrange for the stud to piston rod connection to be properly reassembled to withstand the higher temperature service.

Cast Iron Piston Rings
Cast iron rings are optional piston seals for H Series cylinders. They offer the widest operating conditions by tolerating high operating pressures, wide temperature range, and are compatible with most fluids. The only drawback of cast iron rings is that they allow a small amount of leakage. The leakage for a 4" bore cylinder, operating at 2000 psi, with mineral base hydraulic fluid will be less than 10 in.3/min. Leakage will increase as pressure, bore size and viscosity of the operating hydraulic fluid increases. For these reasons cast iron rings are not recommended when using water or High Water Content Fluids (HWCF).

Water Service
H Series hydraulic cylinders can be modified for water operation and are supplied with nickel-PTFE plated cylinder bore, head, cap, bushing, tie rods, tie rod nuts, cushion plungers, and piston; chrome-plated precipitation hardened stainless steel piston rod. When high water base fluids are the operating medium, hydraulic cylinders are usually supplied with high water base rod wiper and seals. Water and high water base fluid operated cylinders are best used on short stroke applications or where high pressure is applied only to clamp the load.

Warranty
Miller will warrant cylinders modified for water or high water content fluid service to be free of defects in materials or workmanship, but cannot accept responsibility for premature failure due to excessive wear caused by lack of lubricity or where failure is the result of corrosion, electrolysis or mineral deposits within the cylinder.
Description
Miller Fluid Power Position Sensing Cylinders (PSC) with LDT magnetostrictive transducers provide versatile, high-response, and non-contacting position sensing.

The LDT consists of a conducting wire element in a waveguide internal to the cylinder rod. As the permanent magnet moves with the piston, an interaction of magnetic fields creates a waveguide twist which is converted from a strain pulse to an electrical output signal. The time interval from the pulse generator input to the conducting wire and the waveguide strain return pulse is the linear displacement measure. Position sensing is then determined by the digital or analog output voltage produced in the transducer electronics proportional to the magnet (piston) position.

Transducer Performance Specifications

<table>
<thead>
<tr>
<th></th>
<th>L* Series</th>
<th>R* Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>Analog: Infinite</td>
<td>Analog: 16 Bit</td>
</tr>
<tr>
<td></td>
<td>Digital: Controller Dependent</td>
<td>Digital: Up to 0.00008&quot;</td>
</tr>
<tr>
<td>Non-Linearity</td>
<td>±0.02% or ±0.002&quot; whichever is greater</td>
<td>&lt; ±0.02% or ±0.0019&quot; whichever is greater</td>
</tr>
<tr>
<td>Repeatability</td>
<td>Equal to Resolution</td>
<td>&lt;±0.001% or ±0.000098&quot; whichever is greater</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>&lt;0.0008&quot;</td>
<td>&lt;0.0002&quot;</td>
</tr>
<tr>
<td>Update Time</td>
<td>≤1 ms (stroke dependent)</td>
<td>≤1 ms (stroke dependent)</td>
</tr>
<tr>
<td>Analog Adjustment</td>
<td>5%, Zero and Span</td>
<td>100%, Zero and Span</td>
</tr>
</tbody>
</table>

Design Features
Unique design and state-of-the-art electronics allows for the integration of non-contacting transducers in heavy duty hydraulic cylinders. Infinite resolution, superior linearity, excellent stability, and "wear-free" operation provides enhanced system performance, maximum application accuracy, and improved productivity.

Wide range of transducer output signals interface with electronic modules and motion controllers for versatile system capability, multiplexing control schemes, and special application requirements.

Robust transducer electronics head is sealed and hardened for high vibration and shock use. The waveguide and wire is protected from possible damage by a stainless steel tube enclosure. Integral transducer mounting design provides ease of maintenance and reduced down-time.

Absolute position measurement ensures output voltage dependent on magnet (piston) position, thus calibrations are not required for electrical power on/off start-ups.

Cost competitive position sensing in a NFPA hydraulic cylinder with excellent price to performance ratio.

Standard Specifications
Enclosure/Housing Rating.................................IP67
Maximum Pressure ...........................................3,000 psi
Operating Temperature – Oil .........................-40° to 221°F
Operating Temperature – Ambient ......................-40° to 185°F
Supply Voltage ..............................................24 VDC strokes >60";
13.5-26 VDC strokes to 60"
Power Consumption ........................................100 mA
Shock Rating ................................................100g Single Hit
Vibration Rating ...........................................5g 10-150 Hz
Maximum Stroke ..........................................120 inches
Minimum Bore Size .......................................1 1/2 inches
Minimum Rod Diameter .................................1 inch

Transducer Electrical Options

<table>
<thead>
<tr>
<th>Analog</th>
<th>Digital</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 10 VDC</td>
<td>PWM</td>
</tr>
<tr>
<td>-10 to +10 VDC</td>
<td>Start/Stop</td>
</tr>
<tr>
<td>10 to 0 VDC</td>
<td>SSI</td>
</tr>
<tr>
<td>4 to 20 mA</td>
<td>DeviceNet</td>
</tr>
<tr>
<td>20 to 4 mA</td>
<td>Canbus</td>
</tr>
<tr>
<td>Velocity</td>
<td>Quadrature</td>
</tr>
</tbody>
</table>
How It Works

The Miller LRT is a uniquely designed position sensor that uses a resistive element and wiper assembly to provide an analog output signal of a cylinder's position. The LRT is a dual element type linear potentiometer with two independent elements mounted on either side of an anodized aluminum extrusion. The LRT operates as a voltage divider. This is done by shorting through the extrusion with the wiper assembly. The position of the wiper changes the resistive load proportional to its position along the cylinder stroke. The LRT is energized by applying a voltage across the unit, typically 10 VDC. As the resistive load changes with the cylinder stroke, the output voltage changes proportionally. The output voltage at the end point of the cylinder stroke is dictated by the input voltage applied across the device. The probe is mounted into the cylinder cap and inserted into the gun drilled piston rod. The compactness of the design only adds to the envelope dimensions of cylinders with 1-3/4" rods and smaller. Envelope dimensions of cylinders with larger rods are unaffected.

Transducer Performance Specifications

Non-Linearity: Less than 0.1% of full scale up to 48" stroke. Less than 1.0% of full scale over 48" stroke.
Repeatability: .001 inch
Input Voltage: Nominal 5-50 Vdc
Operating Temperature Range: -40°F to +160°F
Cylinder Stroke Length: Up to 120"
Electrical Connector: Brad Harrison 3-pin micro connector interface at pos. #4 standard. (Unless occupied by a port or mount.)
Total Resistance: 800Ω per inch of stroke (±20%) + end resistance.
End Resistance: 800Ω
Maximum Velocity: 30 inches per second
Life Expectancy: Greater than 50 x 10^6 cycles
( Based on 1" stroke @ 10 ips)
Fluid Medium: Petroleum based hydraulic fluids
End Voltage Loss: (V source) x 400/stroke x 800
Power Dissipation: supply voltage squared, divided by the total resistance.
The LRT requires a high impedance interface greater than 100K ohms.
A maximum of 1 microamp should be required from the LRT.
The accuracy of a given feedback device is a composite of the following factors:
Temperature Coefficient: The shift in output due to temperature change.
This is a combination of the effect of temperature on the cylinder, the transducer and the electronics.
These factors which are normally additive refer to the feedback device itself. The performance achieved by a given system depends on the various factors such as system stiffness, valve performance, friction, temperature variation, and backlash in mechanical linkages to the cylinder.
In the case of front flange mounted cylinders, the stretch of the cylinder due to hydraulic pressure changes may affect position repeatability and system performance.
*A high temperature option is offered to 300°F (consult factory).

Design Features

- Available in strokes to 120".
- Unique, easy to apply cylinder position sensing system.
- Infinite resolution, high linearity and repeatability.
- Innovative, resistive element is made of conductive plastic.
- 3 pin Brad Harrison electrical connector available at any cap position not occupied by a port or mount.

Pin Chart

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>On Cable</th>
<th>On LRT</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green</td>
<td>White (wiper)</td>
<td>Output</td>
</tr>
<tr>
<td>2</td>
<td>Red w/Bk</td>
<td>Black (resistor base)</td>
<td>V-</td>
</tr>
<tr>
<td>3</td>
<td>Red w/White</td>
<td>Red (resistor to power)</td>
<td>V+</td>
</tr>
</tbody>
</table>
**LRT & LDT Mounting Configurations**

Various types of transducers will affect the overall length of the cylinder. The length to be added to the cylinder is shown in the charts below for each of the designs and bore sizes. Pressure limitations apply for the different bore and rod combinations as shown below. If the particular mounting style you are using on the cylinder also has a pressure limitation, the lower of the two pressure limitations should be considered as the maximum rating of the cylinder. Optional manifolds are available for various circuits with proportional valves, etc. Contact the factory for special circuit requirements.

**LRT** cylinders can be furnished with any of the mounting styles shown in this catalog that do not interfere with the electrical connector in the cap. Standard position of the electrical connection is position #2 in the cap. Optional positions are #1, #3, or #4 except where the pressure port is located.

**LDT** cylinders have the transducer attached to the center rear face of the cap. Any mounting that does not interfere with the center face of the cap can be used with this standard design. The actual transducer length depends upon the manufacturer and can range between 3" and 4".

**PRESSURE LIMITATIONS**

<table>
<thead>
<tr>
<th>BORE Size</th>
<th>Rod Size</th>
<th>Pressure Rate (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½</td>
<td>1</td>
<td>3000</td>
</tr>
<tr>
<td>2</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>2½</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>3½</td>
<td>1¼</td>
<td>3000</td>
</tr>
<tr>
<td>4</td>
<td>1¼</td>
<td>2000</td>
</tr>
<tr>
<td>4½</td>
<td>1½</td>
<td>2500</td>
</tr>
<tr>
<td>5</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>6</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>7</td>
<td>3½</td>
<td>2700</td>
</tr>
<tr>
<td>8</td>
<td>3½</td>
<td>3000</td>
</tr>
</tbody>
</table>

**LDT** cylinders used with cap clevis type mountings can be furnished with the intrinsic mounting design shown. This design can also be specified for purposes of protecting the transducer. Dimensions H and J can be found on the mounting pages of this catalog.

**PRESSURE LIMITATIONS**

<table>
<thead>
<tr>
<th>BORE Size</th>
<th>Rod Size</th>
<th>Pressure Rate (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1½</td>
<td>1</td>
<td>3000</td>
</tr>
<tr>
<td>2</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>2½</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>3½</td>
<td>1¼</td>
<td>3000</td>
</tr>
<tr>
<td>4</td>
<td>1¼</td>
<td>2000</td>
</tr>
<tr>
<td>4½</td>
<td>1½</td>
<td>2500</td>
</tr>
<tr>
<td>5</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>6</td>
<td>1½</td>
<td>3000</td>
</tr>
<tr>
<td>7</td>
<td>3½</td>
<td>2700</td>
</tr>
<tr>
<td>8</td>
<td>3½</td>
<td>3000</td>
</tr>
</tbody>
</table>

**NOTES:**

1. *Min stroke is required for piping installation. May use stop tube to achieve this stroke.
2. Manifold block will extend beyond cap rear face in some bore sizes. Contact the factory for those sizes.
Bolt-on Manifolds
Miller H Series cylinders are available with Bolt-on Manifolds. Manifolds can be mounted on the head or cap end of a Miller H Series cylinder.

Available Bolt-on MANifold Valve Patterns

<table>
<thead>
<tr>
<th>Group A – Servo Manifold Height = 2.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group A Servo Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group D – Servo Manifold Height = 2.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group D Servo Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group G – NFPA D03 Manifold Height = 2.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group G NFPA D03 Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group H – NFPA D05 Manifold Height = 2.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group H NFPA D05 Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group J – NFPA D06 Manifold Height = 2.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group J NFPA D06 Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group K – NFPA D07 Manifold Height = 3.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group K NFPA D07 Manifold]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group M – NFPA D08 Manifold Height = 3.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram of Group M NFPA D08 Manifold]</td>
</tr>
</tbody>
</table>

Note: On NFPA D05 “X” and “Y” ports are not standard. If required, please contact the Miller Fluid Power.
Miller H Series
Hydraulic Cylinders
Feedback Device Dimensions
LD and RD Housings

<table>
<thead>
<tr>
<th>Bore Sizes</th>
<th>Dimension “JA”</th>
<th>Dimension “JB”</th>
<th>Dimension “JC”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50”</td>
<td>0.13’</td>
<td>N/A</td>
<td>2.53’</td>
</tr>
<tr>
<td>2.00”</td>
<td>0.13’</td>
<td>N/A</td>
<td>2.53’</td>
</tr>
<tr>
<td>2.50”</td>
<td>0.13’</td>
<td>N/A</td>
<td>2.53’</td>
</tr>
<tr>
<td>3.25”</td>
<td>0.06’</td>
<td>N/A</td>
<td>2.53’</td>
</tr>
<tr>
<td>4.00”</td>
<td>0.06’</td>
<td>0.52”</td>
<td>2.53’</td>
</tr>
<tr>
<td>5.00”</td>
<td>0.06’</td>
<td>0.52”</td>
<td>2.53’</td>
</tr>
<tr>
<td>6.00”</td>
<td>0.03’</td>
<td>0.52”</td>
<td>2.53’</td>
</tr>
<tr>
<td>7.00”</td>
<td>0.03’</td>
<td>0.52”</td>
<td>2.53’</td>
</tr>
<tr>
<td>8.00”</td>
<td>0.03’</td>
<td>0.52”</td>
<td>2.53’</td>
</tr>
</tbody>
</table>

Notes:
1. Enclosure position number 5 available with tie rods threaded into cap on 1-1/2” to 3-1/4” bore sizes.
2. Enclosure position number 6 available with tie rods threaded into cap on 1-1/2” to 6” bore sizes.
The proper application of a fluid power cylinder requires consideration of the operating pressure, the fluid medium, the mounting style, the length of stroke, the type of piston rod connection to the load, thrust or tension loading on the rod, mounting attitude, the speed of stroke, and how the load in motion will be stopped. Information given here provides pressure rating data for H Series hydraulic cylinders.

**Hydraulic Cylinders (Heavy-Duty)**

Standard operating fluid – clean filtered hydraulic oil. Pressure ratings for H Series heavy-duty cylinders are shown in the following table.

### Pressure ratings

H Series hydraulic cylinders are recommended for pressures to 3000 psi for heavy-duty service with hydraulic oil. The 4:1 design factor ratings shown are based on tensile strength of pressure envelope material and are for standard and first oversize rod diameter only. The pressure envelope components are the tube, piston and rod connection, and tie rod and nut connection. Additional oversize rods for a given bore will have the same rating as the first oversize rod. The rating is conservative for continuous severe applications. Design factors at other pressures can be calculated from this rating. In addition, mounting styles, stroke, etc., should be considered because of the limiting effect they may have on these ratings.

### H Series Hydraulic Cylinders

#### Maximum Pressure Ratings

<table>
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<tr>
<th>Bore Size (inches)</th>
<th>Rod Diameter (inches)</th>
<th>4:1 Design Factor (Tensile) (PSI)</th>
<th>Heavy-Duty Service (PSI)</th>
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*See individual mounting pages for reduced heavy-duty service ratings.

**Welded Oversize Ports**

To accommodate large pump volumes and minimize pressure drops, Miller hydraulic cylinders are available in most models with oversize ports that are welded half pipe couplings.
The use of a stop tube is a generally accepted and preferred method for reducing piston and bearing loads on long push stroke cylinders and, additionally, for preventing jack-knifing or buckling of horizontally mounted, long stroke cylinders on push stroke. Stop tubes are more effective, less costly, and lighter in weight than oversize piston rods.

Positioned between the piston and cylinder head, a stop tube restricts the extended position of the rod so that the added distance between the piston and bushing results in less strain, wear, and bearing load.

Determining the Length and Need For Stop Tube

Follow these simple steps to determine whether your cylinder requires a stop tube, and, if so, how long it should be.

1. Examine the groups of cylinders illustrated on Page 75 and determine which, if any, of the mounting configurations corresponds to your cylinder application and model number.

2. If your cylinder mounting style corresponds to any of those in Group A, then no stop tube is required. But, if cylinder operates on push stroke, an oversize rod may be required and you should check the following page. If your cylinder is like one of those in Group B, then a stop tube is recommended and you should proceed to Step 3. If your cylinder is similar to one of the Group C illustrations, then you should calculate the turning moments and loads between piston and rod bushing to insure that they are not excessive. Weight of fluid must be included on large dia. or long stroke cylinders. For assistance on this, contact Miller Fluid Power Application Engineering Dept. Next, continue on to Step 3 to determine the length of stop tube needed.
Miller H Series
Hydraulic Cylinders

3. Referring to the illustration which corresponds to your cylinder application, determine the value of “L”. Be certain to include the thickness of the cylinder head, cap and piston assembly plus twice the length of the cylinder stroke. Then go down the first column of the Stop Tube Table and find the range which encompasses that value of “L”. The number shown to the right in the second column is the length of stop tube your cylinder requires.

4. Add the stop tube length to your “L” dimension to obtain an “Adjusted L Dimension”. This dimension will be used in the procedures on the following page to determine whether your cylinder requires an oversize piston rod in addition to the stop tube except models 53, 61, 63, 65, 67, 81 & 89.

### Group A
With piston rod extended. To be checked for rod diameter only. Stop tube not required.

### Group B
To avoid rod buckling or cylinder jackknifing, check for stop tube and rod diameter requirements with piston rod extended. Use cylinder dimensional charts. No stop tube required if cylinder operates on pull stroke only.

### Group C
To be checked for Stop tube length and piston rod diameter to eliminate buckling or jackknifing with piston rod extended.

### Stop Tube Table

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<th>“L” (inches)</th>
<th>Stop Tube Length (inches)</th>
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<td>161-170</td>
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</table>

Note: ‘L’ or ‘D’ are calculated from mounting point with rod extended.

For longer strokes consult factory.
Cylinder applications requiring column strength or long cylinder push strokes may need oversize piston rods. However, Miller Fluid Power cautions against depending upon the higher rigidity of oversize rods to absorb or reduce side loading. Actually, the greater flexibility of a smaller standard diameter rod transmits less side loading back to the piston rod bushing. It is important to use the correct rod diameter based on the various factors involved in your application. Oversize rods, when not needed, merely add to the cylinder price and require longer delivery.

Standard rod diameters are recommended for all pull stroke cylinders. To determine the correct rod diameter for a push stroke application, follow these simple steps.

1. Referring to the Group A through C illustrations on the previous page, determine the value of “L” for your cylinder, or use the “Adjusted L Dimension” calculated in Step 4 on that page.

2. In the Oversize Piston Rod Table, find in the first column your cylinder thrust value which was previously determined.

3. Move across the table to the right end and in the same row locate your “L” or “Adjusted L Dimension”. If the exact value is not shown, continue to the next larger number.

4. Go to the top of the column and you will find the correct rod diameter for your cylinder application.

### Oversize Piston Rod Table

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Values of (L) for slenderness ratios (slenderness ratio = length ÷ radius of gyration = 4 x length ÷ piston rod diameter) greater than 50 have a safety factor of 5 to 1. Values of (L) for slenderness ratios less than 50 are based on compressive strength only (S = thrust ÷ rod area) and have safety factors between 2.4-1 and 5-1 which are directly proportional to (L). (i.e. the greater the value of (L) the greater the safety factor).
Determining If Your Cylinder Requires A Non-Sag Rod

Miller cylinders have a commercial straightness of 0.002 inches per foot of length. The gravity-induced rod sag for horizontally mounted cylinders is given in the Rod Deflection Table. To determine if this sag is excessive, follow these simple directions.

1. After having checked the rod for column strength on the previous page, find your rod diameter in the first column of the table.

2. Read across the table to the column headed by the length of the rod between supports when rod is fully extended, and find the sag in inches which can be expected with a standard rod.

3. If this figure lies within the shaded area of the table, you should specify a non-sag rod.

**Rod Deflection Table**

This table shows the deflections in inches of ordinary piston rods at center of span. Length of piston rod between supports is in feet. Rod diameter and sag are in inches.

<table>
<thead>
<tr>
<th>Dia. Piston Rod</th>
<th>Weight In Lbs. PER FT.</th>
<th>LENGTH OF PISTON RODS (IN FEET) BETWEEN SUPPORTS WITH RODS EITHER EXTENDED OR RETRACTED</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>5/8</td>
<td>1.043</td>
<td>.065</td>
</tr>
<tr>
<td>2</td>
<td>2.670</td>
<td>.030</td>
</tr>
<tr>
<td>1 1/2</td>
<td>5.049</td>
<td>.0128</td>
</tr>
<tr>
<td>3/4</td>
<td>8.178</td>
<td>.008</td>
</tr>
<tr>
<td>2 1/2</td>
<td>16.690</td>
<td>.004</td>
</tr>
<tr>
<td>3</td>
<td>24.030</td>
<td>.006</td>
</tr>
<tr>
<td>3 1/2</td>
<td>32.710</td>
<td>.0043</td>
</tr>
<tr>
<td>4</td>
<td>42.730</td>
<td>.006</td>
</tr>
<tr>
<td>4 1/2</td>
<td>54.070</td>
<td>.005</td>
</tr>
<tr>
<td>5</td>
<td>66.760</td>
<td>.0066</td>
</tr>
<tr>
<td>5 1/2</td>
<td>80.780</td>
<td>.0055</td>
</tr>
<tr>
<td>7</td>
<td>130.8</td>
<td>.0054</td>
</tr>
<tr>
<td>8</td>
<td>170.9</td>
<td>.0063</td>
</tr>
<tr>
<td>9</td>
<td>216.3</td>
<td>.0050</td>
</tr>
<tr>
<td>10</td>
<td>267.0</td>
<td>.0059</td>
</tr>
</tbody>
</table>
Foot mount cylinders should be keyed or pinned on the appropriate end to eliminate shearing loads on mounting bolts.

Cylinders with integral key mounts may be used where keyways can be cut in a machine member. This type of mounting accommodates shear loads, provides accurate alignment of the cylinder, and simplifies installation and servicing.

Only one end of a cylinder should be keyed to the machine. If both ends are keyed, there will be no cylinder elasticity to assist in absorbing shocks.

Locating pins may be used instead of shear keys to help take shear loads and to assure proper cylinder alignment. As with keys, cylinders should be pinned at either end (but not both ends). Contrary to common die design practices, cylinders should never be pinned across corners. To do so can result in severe warping under operating pressures and temperatures.

Pivoted mounts should have the same type of pivots at both the cylinder body and rod end. If a simple pivot pin mount is used, the pivot pin axes at each end should be parallel. Trunnion mounts are generally designed to resist only shear loads. Therefore, self-aligning mounts should not be used to support the trunnions, otherwise bending forces can also be set up.

---

**Keying a Cylinder**

**RIGHT**

![Keying Diagram]

**WRONG**

![Keying Diagram]

**Pinning a Cylinder**

**RIGHT**

![Pinning Diagram]

**WRONG**

![Pinning Diagram]

---

**“K” Retainer-Key Extension**

Provides Models 71, 72, 74, and 77 with Max. Mounting Rigidity Without Pins or Welded Keys

For a rugged mounting that cannot shift under maximum loads, the “K” retainer-key extension extends the rod retainer plate so that it slips into a slot milled in the machine’s mounting surface. “K” retainer thickness is dimension “F” \( \pm 0.014 \) - 0.0145. Extension = ½. Available as option at additional cost.

![“K” Retainer-Key Extension Diagram]
## Miller H Series Hydraulic Cylinders

### Parts List and Seal Kits

**Rod Diameter** | **Bolted Bushing Rod Seal Kit Part # 11, 12, 13, 14, 18** | **Retainer Bushing Rod Seal Kit Part # 11, 12, 14, 18**
--- | --- | ---
1 | 051-KR075-100 | 051-KR074-100
11/16 | 051-KR075-175 | 051-KR074-175
2 | 051-KR075-200 | 051-KR074-200
21/2 | 051-KR075-250 | 051-KR074-250
3 | 051-KR075-300 | 051-KR074-300
4 | 051-KR075-400 | 051-KR074-400
41/2 | 051-KR075-450 | 051-KR074-450
5 | 051-KR075-500 | 051-KR074-500
6 | 051-KR075-600 | 051-KR074-600
7 | 051-KR075-700 | 051-KR074-700
8 | 051-KR075-800 | 051-KR074-800
10 | 051-KR075-1000 | 051-KR074-1000

**Bore** | **Bore Kit Part # 5, 7, 10**
--- | ---
11/2 | 171-KB001-0150
2 | 171-KB001-0200
21/2 | 171-KB001-0250
31/4 | 171-KB001-0325
4 | 171-KB001-0400
5 | 171-KB001-0500
6 | 171-KB001-0600
7 | 171-KB001-0700
8 | 171-KB001-0800
10 | 171-KB001-1000
12 | 171-KB001-1200
14 | 171-KB001-1400
16 | 171-KB001-1600
18 | 171-KB001-1800
20 | 171-KB001-2000

**IMPORTANT:** When ordering parts, specify the 8 digit serial number and part name as shown. Serial number can be found on the cylinder name tag or stamped on the head and cap near the ports.

**Note:** The most popular sizes are shown. The larger bore and rod sizes are in stock, please call. For complete installation & maintenance request File No. 8535.

**PISTON RINGS**

<table>
<thead>
<tr>
<th>Bore</th>
<th>#19 (4 Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/2</td>
<td>052-PS027-150</td>
</tr>
<tr>
<td>2</td>
<td>052-PS027-200</td>
</tr>
<tr>
<td>21/2</td>
<td>052-PS027-250</td>
</tr>
</tbody>
</table>

Spring Loaded Teflon Cup Seals required for temperatures in excess of 160°F or below -20°F.

Piston ring construction is standard on the following small bore, max. oversize rod cylinders: 11/2" bore 1" rod, 2" bore 13/8" rod & 21/2" bore 13/4" rod.
**Storage and Installation**

**Mounting Recommendations / Cylinder Troubleshooting**

**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.

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.
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.
3. Port protector plugs should be left in the cylinder until the time of installation.
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.

**Installation**

1. Cleanliness is an important consideration, and Miller 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.
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. 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 bushing and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

**Mounting Recommendations**

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.
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. 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.
4. Flange Mount Cylinders – The controlled diameter of the rod bushing 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.
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.
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.

**Cylinder Trouble Shooting**

**External Leakage**

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 bushing 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.
2. Cylinder tube 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 tube 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 tube 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 tube seal will also result in a leak. Replace cylinder tube seal and retorque as in paragraph above.

**Internal Leakage**

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 lip seal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

   With lip seal 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.

   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.

**Cylinder Fails to Move the Load**

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

   Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

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.

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

4. Piston rod broken. Bring the operating conditions of the cylinder to the attention of our engineering department and have our factory repair the cylinder.

**Erratic or Chatter Operation**

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

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

   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.
Piston Rod Attachment & Rod Accessories

When connecting machinery components or rod clevises, rod eyes, etc. to Miller Style 2 (Threaded on Turndown Section) or Style 4 (Internally Threaded) Piston Rods, the attachments should be tightened to the torques given in chart 1. This torque or prestress triples the fatigue strength of the rod’s threaded section and makes a stronger assembly than attaching the machinery component to a full diameter threaded rod (Style 1) and torquing it against a lock nut. Miller recommends the Style 2 (Threaded on Turndown Section) Rod for most applications. Its square shoulder design helps assure proper alignment of cylinder to mechanism, eliminates need for a jam nut, provides fixed point for more accurate cylinder positioning, and simplifies piloting full rod diameter into mating part.

Cylinder Component Torque Values

<table>
<thead>
<tr>
<th>Chart 1</th>
<th>Chart 2</th>
<th>Chart 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston Rod Torque (ft./lbs.)</td>
<td>Tie Rod Torque (ft./lbs.)</td>
<td>Bolted Bushing Mounting Screw Torque</td>
</tr>
<tr>
<td>1 1/2</td>
<td>5/16-20</td>
<td>36</td>
</tr>
<tr>
<td>2, 2 1/2</td>
<td>7/16-16</td>
<td>125</td>
</tr>
<tr>
<td>3/4</td>
<td>1-14</td>
<td>250</td>
</tr>
<tr>
<td>4</td>
<td>1 1/2-12</td>
<td>460</td>
</tr>
<tr>
<td>5</td>
<td>1 1/2-12</td>
<td>663</td>
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<td>6</td>
<td>1 3/4-12</td>
<td>944</td>
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<td>7</td>
<td>2 1/4-12</td>
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<td>8</td>
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<td>-</td>
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<td>7940</td>
</tr>
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<td>12</td>
<td>4&quot;-12</td>
<td>12560</td>
</tr>
<tr>
<td>14</td>
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</tr>
<tr>
<td>16</td>
<td>6&quot;-8</td>
<td>21600</td>
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<td>18</td>
<td>7&quot;-8</td>
<td>30850</td>
</tr>
<tr>
<td>20</td>
<td>8&quot;-6</td>
<td>37700</td>
</tr>
</tbody>
</table>

* Recommended Torques (ft. lbs) with MoS2 lubricant or equivalent.
Selecting a Miller Hydraulic Cylinder

Miller hydraulic cylinders are selected and sized primarily based on force requirements and available operating pressure. The H Series is a heavy-duty design intended for normal industrial service at internal operating pressures up to 3,000 PSI. It is available in 23 mounting styles and bore sizes from 1 1/2" to 20".

H Series Pressure Rating
Nominal Pressure — 3,000 PSI

Notes:
1. If hydraulic operating pressure exceeds 3,000 PSI, send application data for engineering evaluation and recommendation.
2. Certain mounting styles and over-sized rod combinations have pressure rating limitations due to their inherent design. See mounting style catalog page for details.

Other Miller Hydraulic Cylinder Models
When evaluating your application, please review our other hydraulic cylinder models to be sure that you are selecting the model most appropriate to your requirements.

Certified Dimensions
Miller Fluid Power guarantees that all cylinders ordered from this catalog will have the dimensions as specified in this catalog — no waiting for special drawings to be prepared and sent. When required however, certified drawings are available at no extra cost.

Steps in Selecting the Correct Cylinder
Detailed engineering information on bore size selection, oversize and non-sag rods, stop tubes, determining port and pipe size, etc. is located in this catalog. See Table of Contents.

Step 1 — Determine the correct cylinder bore size required based upon operating pressure and thrust required.

Step 2 — Select the mounting style which is required for your application.

Step 3 — On the appropriate catalog page for the mounting style selected, review bore and rod sizes available and pressure rating limitations, if any.

Step 4 — Choose a rod end style and, if desired, rod end accessories, and optional cushions.

Step 5 — Consider the conditions listed below which may require further modifications to the cylinder you have selected. Application Engineering assistance is readily available by contacting any of the Miller locations listed on the back cover of this catalog.

Step 6 — Refer to “How to Order” section to develop the part number and place your order.

Application Condition | Check the following | Application Condition | Check the following
--- | --- | --- | ---
Rapid Starts or Stops | Use severe service pressure rating only. Confirm that sufficient thrust is available to accelerate or decelerate cylinder and load within prescribed distances. If optional cushions are selected and will be used to reduce shock during deceleration, check that peak pressures will be within acceptable limits. | Long Horizontal Stroke | Check to see if a non-sag piston rod is required to prevent excess sagging and resultant premature bushing and piston wear.
Long Stroke | Check whether stop tube may be required to prevent excess bearing loads and wear. | Operating Temperatures | The standard operating temperature range of the Urethane rod seal used in the H Series is -20°F to +160°F. For temperatures in excess of that range, optional spring-loaded PTFE seals will be required.
High Column Loading-Long Push Stroke | Determine if standard size piston rod is strong enough to accommodate intended load without buckling. | Sufficient Speed | Confirm that standard port size permits sufficient flow to accommodate speed requirements. Fluid flow velocity should not exceed 15 feet per sec.
 Loads | When high side loads and similar severe or unusual operating conditions are anticipated, please consult a Miller application engineer for recommendations concerning optional bushing material and design. | Fluid Compatibility | The standard H Urethane rod seal is compatible with petroleum based fluids. PTFE seals are available for use with water glycol, water/oil emulsions and phosphate ester fluids up to 150°F. For cylinders using these fluids in excess of 150°F the Miller Series H cylinders with spring-loaded PTFE seals are recommended.

Fluid power cylinders are designed to be linear actuators. They are intended to provide motion and force along the centerline of the rod. Since they have limited capacity to withstand eccentric or radial loads, they should not be employed as linear bearings. Good machine design practice requires that proper alignment be maintained to avoid excessive bearing loads. Any premature failure resulting from side loading is not considered a warranty failure. If your design involves the possibility of side loading, please contact the Miller Fluid Power engineering department.
Miller H Series
Hydraulic Cylinders

How To Order

Example: H-72B2N-00400-00800-0175-S119

<table>
<thead>
<tr>
<th>Series</th>
<th>Mounting Style</th>
<th>Bushing</th>
<th>Rod End Style</th>
<th>Cushions</th>
<th>Bore Dia.</th>
<th>Stroke</th>
<th>Rod Dia.</th>
<th>Port Type</th>
<th>Port Location</th>
<th>Modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td></td>
<td>B=</td>
<td></td>
<td>R=</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0=</td>
</tr>
<tr>
<td>DH</td>
<td>(D= Dbl. Rod End)</td>
<td>B=</td>
<td></td>
<td>R=</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9=</td>
</tr>
</tbody>
</table>

**Note:** The Standard (#1) port location is at the top of the cylinder in relation to the mountings as shown on the mounting dimensional pages in this catalog. These numbered locations are shown within the end views of the cylinders for each of the mountings indicated.

* The number 9 refers to any modifications from standard design. Non-Standard Modifications and options not identified in the part number identification above must be included on all orders.

▲ Mounting styles 72, 74, and 77 should have a minimum stroke equal to or longer than their bore size. Mounting Style 71 stroke should be twice the bore size.

† Customer must specify required AC, AD, AE, AF, and AM dimensions when ordering cylinders with Style #9 rod ends on 7-10 inch diameter piston rods.

‡ Special thread, extension, rod eye is available. To order specify “Style X” and give desired dimensions for KK, A, WB or W. If otherwise special, furnish dimensioned sketch.

**Examples of Other Modifications and Options Include:**

- Tie Rod Extensions
- Air Bleeds
- Rod End Modifications
- Special or Oversize Ports
- Keyways
- Key Retainers
- Stainless Steel Piston Rods
- Extra Heavy Chrome Plated Piston Rods
- Chrome Plated Tube I.D.
- Stop Tube
- External Drainback Rod Bushing
- Grease Fitted Rod Bushing
- Bronze Bushings
- Position Sensing Cylinder
- Special Materials
- Fluorocarbon Seals
- Non-Sag Piston Rods
- Adjustable Retract Stroke
- Adjustable Advance Stroke
- Metallic Rod Scrapers
- Drilling and Tapping Modifications
- Flush Tie Rod Nuts
- Heavy Duty Rod Bushing
- Epoxy or Special Paint
- Mixed Mounting Styles
- Piston Ring Construction
- Proximity Switches
- Modifications for Special Environments
- Close Stroke Tolerances
- Port in Rear Face of Cap

For other Non-Standard Modifications, contact Miller Fluid Power Engineering Dept.
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 the following Terms and Conditions. Buyer's offer of purchase 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 Buyer 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 and neither Seller shall have any 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 COMPRIZES 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 PURCHASED. NO REFUND 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 ITS CONTRACT 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 future 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 purpose 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 against 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 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 upon 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 refund the purchase price therefor. In the event of infringement 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 judgments 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.
Before selecting or using Miller (The Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information.

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 guidelines 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 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.

Seals
Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult “How to Select a Miller Cylinder” opposite the “How to Order” page, or contact our engineering department.

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.

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.

Following the recommendation of the “Piston Rod Selection Chart and Data” found in this catalog. 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. Cylinder 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.

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

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

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 flange 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.

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:

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

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

Cylinder Modifications or Repairs
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. 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.