**Major Benefits**

- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation

---

**SERIES AV**

- zinc-plated alloy steel heads and caps for robust construction
- anodized aluminum tube for long seal life and smooth motion
- pressure and wear compensating long life Nitrile piston seals (AV, HV)
- aluminum alloy piston
- pressure and wear compensating long life Nitrile rod seal
- PTFE rod wiper for durability
- corrosion resistant stainless steel rod
- long life bronze rod bushings

**SERIES HV**

Hydraulic Service

**SERIES A**

Shortest Length

Cleanroom option available on Series AV and A Cylinders. See page 1-69.
ORDERING DATA: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

TO ORDER SPECIFY:
Spring Return/Double Rod End, Series, Mounting Style, Bore Size, Stroke, Port Control®, and any Options. Also specify rod diameter if non-standard. Rod couplings and mounting attachments must be ordered separately.

OPTIONS
- Stroke Adjustment, 1/2" of adjustment standard (not available on Series HV)
- Magnetic Piston for PHD Hall Effect Switches (not available on Series A)
- #2 Rod End (see page 1-67 for dimensions) (see note 1)
- #4 Rod End, Female thread on rod (see page 1-67 for dimensions) (see note 1)
- Rodlok (Rod clamping device installed. Not available with Z1 or on HV. See option page.)
- #2X Rod End, twice as long as standard thread (see page 1-67 for dimensions)
- Extra Rod Extension, in 1/8" increments (see page 1-65) (see note 2)
- Coarse Thread Rod End (see page 1-67 for dimensions) (see note 1)
- Magnetic Piston for PHD Reed Switches (not applicable on Series A)
- Plain Rod End (see page 1-67 for dimensions) (see note 1)
- Port in Position #1, must be specified if required with mounting style "F" (see page 1-67 for dimensions) (see note 1)
- Ports in Position #2
- Ports in Position #3 ("F" mounting tab on cap end)
- Flow control on both ends
- Flow control on head end
- Pivot Mount, pivot on cap
- Tierod Mount, tierods extend out rod end
- Tierod Mount, tierods extend out cap end
- Tierod Mount, tierods extend out both ends
- Sink or Source Type 10-30 VDC
- AC Type 110-120 VAC with Current Limit
- Sink or Source Type 10-30 VDC, Quick Connect
- AC Type 110-120 VAC, Quick Connect with Current Limit

COMPACT REED SWITCHES

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<th>DESCRIPTION</th>
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<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
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<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
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<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
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</table>

Switches are ordered separately

CUSHION OR SHOCK PAD

- D - Cushions on both ends
- DR - Cushion on rod end
- DC - Cushion on cap end
- B - Shock Pads on both ends
- BR - Shock Pad on rod end
- BC - Shock Pad on cap end

(Options available on Series HV)

OVERSIZE ROD

To be specified only when using a non-standard diameter. Rod diameters available are shown on page 1-67.

CUSHION OR SHOCK PAD

- D - Cushions on both ends
- DR - Cushion on rod end
- DC - Cushion on cap end
- B - Shock Pads on both ends
- BR - Shock Pad on rod end
- BC - Shock Pad on cap end

(Options available on Series HV)

NOTES:
1) For double rod cylinders, rod end options will be applied to both ends of cylinder.
2) For double rod cylinders, _K_ extension will be applied to one end only (head end/primary mounting end).
3) Marked options provide additional cylinder flexibility, but may alter the dimensions.

PHDV3

www.phdinc.com/av • (800) 624-8511
**ENGINEERING DATA: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE**

### CYLINDER FORCE CALCULATIONS

**Imperial**

\[ F = P \times A \]

- **F** = Cylinder Force (lbs)
- **P** = Operating Pressure (psi)
- **A** = Effective Area (in²)

**Effective Area Force**

\[ F = P \times A \]

- **F** = Cylinder Force (lbs)
- **P** = Operating Pressure (psi)
- **A** = Effective Area (in²)

**AIR CONSUMPTION at 80 psi**

<table>
<thead>
<tr>
<th>CYLINDER FORCE (lb)</th>
<th>100</th>
<th>200</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>3000</th>
<th>5000</th>
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<td>0.0016</td>
<td>0.0019</td>
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<td></td>
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</tr>
<tr>
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<td>0.0017</td>
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<td>5/16 EXTEND</td>
<td>0.442</td>
<td>0.0016</td>
<td>0.0019</td>
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<td></td>
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<tr>
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<td>0.0034</td>
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<tr>
<td>3/8 RETRACT</td>
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<td>0.0026</td>
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### UNIT WEIGHTS (lb)

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<th>ZERO STROKE</th>
<th>ADDER PER INCH OF STROKE</th>
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<td>1</td>
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</tr>
<tr>
<td>1-1/8</td>
<td>0.95</td>
<td>0.10</td>
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**MAXIMUM ALLOWABLE EXTEND STROKE**

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<tr>
<th>SERIES</th>
<th>CYLINDER DIAMETER</th>
<th>100</th>
<th>200</th>
<th>500</th>
<th>1000</th>
<th>1500</th>
<th>2000</th>
<th>3000</th>
<th>5000</th>
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<tbody>
<tr>
<td>3/4&quot;, 1&quot;, 1-1/8&quot;</td>
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<td>12&quot;</td>
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<td>6&quot;</td>
<td>4&quot;</td>
<td>3&quot;</td>
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<td>3&quot;</td>
<td></td>
</tr>
<tr>
<td>AV, HV, A</td>
<td>1/4</td>
<td>18&quot;</td>
<td>13&quot;</td>
<td>8&quot;</td>
<td>6&quot;</td>
<td>5&quot;</td>
<td>5&quot;</td>
<td>5&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
<td>26&quot;</td>
<td>18&quot;</td>
<td>12&quot;</td>
<td>9&quot;</td>
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<tr>
<td></td>
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<td>32&quot;</td>
<td>21&quot;</td>
<td>15&quot;</td>
<td>12&quot;</td>
<td>12&quot;</td>
<td>12&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>46&quot;</td>
<td>32&quot;</td>
<td>21&quot;</td>
<td>15&quot;</td>
<td>12&quot;</td>
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<td></td>
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**APPLICATION & SIZING ASSISTANCE**

Use PHD's free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)
**DIMENSIONS:** SERIES AV CYLINDERS; 3/4", 1", 1-1/8" BORE

### BASIC CYLINDER DIMENSIONS

#### B (MS9)

![Diagram of B (MS9)](image1)

#### R (MR1)

![Diagram of R (MR1)](image2)

#### CF (MF2)

![Diagram of CF (MF2)](image3)

#### RF (MF1)

![Diagram of RF (MF1)](image4)

#### F (MS8) SEE NOTE

![Diagram of F (MS8)](image5)

#### F (MS8) - WITH PORT CONTROL® ON CAP END (-Q or -T without Port Control)

![Diagram of F (MS8) - With Port Control](image6)

#### L (MNR1)

![Diagram of L (MNR1)](image7)

#### T (MN1)

![Diagram of T (MN1)](image8)

#### P (MP3)

![Diagram of P (MP3)](image9)

#### RC, RR, RRC (Includes RR & RC)

![Diagram of RC, RR, RRC](image10)

All standard rod ends have four wrench flats (two wrench flats with "I" option).

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>AA AM BD CD DB DN E EW FT KM RM RM1 RT SD SD1 SN</td>
<td>1</td>
<td>AA AM BD CD DB DN E EW FT KM RM RM1 RT SD SD1 SN</td>
</tr>
<tr>
<td>1</td>
<td>#8-32 0.625 0.750 0.250 3/16 #8 0.625 1.000 0.250 1/4-28 8-32 x 0.18 DP 0.500 0.625 0.687 8-32 x 0.25 DP 1.812 2.212 1.812</td>
<td>1-1/8</td>
<td>#10-32 0.875 1.125 0.375 5/16 #10 1.000 1.500 0.375 3/8-24 10-32 x 0.25 DP 1.000 0.750 1.062 10-32 x 0.25 DP 1.750 2.250 1.750</td>
</tr>
<tr>
<td>1-1/8</td>
<td>#10-32 0.875 1.125 0.375 5/16 #10 1.000 1.500 0.375 3/8-24 10-32 x 0.25 DP 1.000 0.750 1.062 10-32 x 0.25 DP 1.750 2.250 1.750</td>
<td></td>
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<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
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</thead>
<tbody>
<tr>
<td>3/4</td>
<td>TF TN UF WA W1 XB XT ZG XY</td>
<td>1</td>
<td>TF TN UF WA W1 XB XT ZG XY</td>
</tr>
<tr>
<td>1</td>
<td>1.500 0.625 2.000 0.156 0.875 0.652 0.562 3.125 0.750</td>
<td>1-1/8</td>
<td>2.000 1.000 2.500 0.219 1.125 0.625 0.625 3.375 1.125</td>
</tr>
<tr>
<td>1-1/8</td>
<td>2.000 1.000 2.500 0.219 1.125 0.625 0.625 3.375 1.125</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.

---

Port Positions: Indicated by circled numbers.

Cushions: Add 0.500 in to all (+ stroke) dimensions for each cushion.

Shock Pads: Add 0.250 in to all (+ stroke) dimensions for each shock pad.

Spring Return: Add an additional stroke length to (+ stroke) dimensions (2 x stroke).

F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.

Oversize Rods: See page 1-67 for oversize rod specifications.

---

All standard rod ends have four wrench flats (two wrench flats with "I" option).
DIMENSIONS: SERIES HV CYLINDERS; 3/4", 1", 1-1/8" BORE

BASIC CYLINDER DIMENSIONS

B (MS9)

R (MR1)

CF (MF2)

RF (MF1)

F (MS8) SEE NOTE

F (MS8) - WITH PORT CONTROL ON CAP END

L (MNR1)

T (MN1)

P (MP3)

RC, RR, RRC (Includes RR & RC)

All standard rod ends have four wrench flats (two wrench flats with "I" option).

<table>
<thead>
<tr>
<th>BORE</th>
<th>LETTER DIMENSION</th>
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<tbody>
<tr>
<td>SIZE</td>
<td>SIZE</td>
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<tr>
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<td>#8-32</td>
</tr>
<tr>
<td>1-1/8</td>
<td>#10-32</td>
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</table>

<table>
<thead>
<tr>
<th>BORE</th>
<th>LETTER DIMENSION</th>
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</thead>
<tbody>
<tr>
<td>SIZE</td>
<td>SIZE</td>
</tr>
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<td>1.500</td>
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<tr>
<td>1</td>
<td>1.875</td>
</tr>
<tr>
<td>1-1/8</td>
<td>2.000</td>
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PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO (+ STROKE) DIMENSIONS (2 x STROKE)
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG.
TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.
OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

All dimensions are reference only unless specifically tolerated.

www.phdinc.com/av • (800) 624-8511
**DIMENSIONS:** SERIES A CYLINDERS; 3/4", 1", 1-1/8" BORE

**BASIC CYLINDER DIMENSIONS**

- **B (MS9)**
  - 3X NT THREAD
  - 2.375 + STROKE

- **CF (MF2)**
  - 4X 0.219 DIA THRU

- **F (MS8) SEE NOTES**
  - 3X C’BORED HOLES FOR DB SHCS

- **F (MS8) - WITH PORT CONTROL ON CAP END**
  - 2.625 + STROKE

- **L (MNR1)**
  - KM THREAD

- **P (MP3)**
  - 0.250 DIA THRU

- **R (MR1)**
  - 4X RT THREAD

- **RF (MF1)**
  - 4X 0.219 DIA THRU

- **T (MN1)**
  - KM THREAD

- **RC, RR, RRC (Includes RR & RC)**
  - 0.500 RR & RRC

All standard rod ends have four wrench flats (two wrench flats with “I” option).

**BORE SIZE**

| x | AA | BD | D | DB | DN | E | EW | FT | KM | NT | R | RM | RM1 | RT | SD | SD1 | SN | TF | TN |
| 3/4 | #6-32 | 0.750 | 0.250 | 0.250 | 1.000 | 0.625 | 0.250 | 1/4-28 | 5/8-18 | 8-32 x 0.18 DP | 0.500 | 0.625 | 0.687 | 8-32 x 0.25 DP | 1.312 | 1.812 | 1.312 | 1.500 | 0.625 |
| 1 | #8-32 | 1.000 | 0.250 | 0.250 | 1.000 | 0.875 | 0.375 | 5/16-24 | 5/8-16 | 10-32 x 0.25 DP | 0.750 | 0.875 | 0.812 | 10-32 x 0.25 DP | 1.250 | 1.750 | 1.750 | 2.000 | 1.000 |
| 1-1/8 | #10-32 | 1.125 | 0.250 | 0.250 | 1.000 | 1.000 | 0.250 | 3/8-24 | 3/4-16 | 10-32 x 0.25 DP | 1.000 | 0.750 | 0.812 | 10-32 x 0.25 DP | 1.250 | 1.750 | 1.750 | 2.000 | 1.000 |

**LETTER DIMENSION**

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<th>x</th>
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<th>WA</th>
<th>XB</th>
<th>XT</th>
<th>XY</th>
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<td>0.562</td>
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<td>0.750</td>
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<td>1-1/8</td>
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<td>1.125</td>
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PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: ADD 0.250 in TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO (+ STROKE) DIMENSIONS (2 x STROKE)
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.
OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

All dimensions are reference only unless specifically tolerated.

www.phdinc.com/av • (800) 624-8511
DIMENSIONS: SERIES DAV, DHV, DA DOUBLE ROD; 3/4", 1", 1-1/8" BORE

BASIC CYLINDER DIMENSIONS

B (MS9) 3X NT THREAD

R (MR1) 4X RT THREAD

F (MS8) SEE NOTE

L (MNR1) KM THREAD

T (MN1) KM THREAD

RC, RR, RRC (Includes RR & RC)

All standard rod ends have four wrench flats (two wrench flats with "I" option).

DIMENSIONS COMMON TO ALL SERIES

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<tbody>
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<td>#8-32</td>
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<td>1-1/8</td>
<td>#10-32</td>
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SERIES DA CYLINDERS

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<td>1</td>
<td>0.625</td>
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<tr>
<td>1-1/8</td>
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SERIES DHV CYLINDERS

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<td>SIZE</td>
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<tr>
<td>1-1/8</td>
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PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: ADD 0.250 in TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.
OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

All dimensions are reference only unless specifically tolerated.
OPTIONS: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

PORT CONTROL®

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

ADJUSTABLE CUSHION

PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.

Effective cushion length 1/2”

STANDARD PORT CONTROL® AND CUSHION NEEDLE POSITIONS

Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A, AV, and HV.

PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

Cushion and Port Control® combination arranged in series provides a compact efficient control system for maximum space weight and cost savings. The cushion is activated when the piston extension enters a seal in the cushion block. The remaining volume in the cylinder exhausts past an adjustable needle. A check seal in the adjusting needle is closed during deceleration, but opens to permit full flow for immediate reversing. The cushion seal in the block is an O-ring for air units.
OPTIONS: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

H47

RODLOK CYLINDER & RODLOK
Available on single rod Series A and AV units only. (Preassembled) 🍒

PHD's Rodlok is ideal for locking the piston rod while in a static/stationary position. When the pressure is removed from the port of the Rodlok, the mechanism will grip the rod and prevent it from moving. The loads are held indefinitely without power. Rodlok performance is application and environment sensitive (cleanliness of rod or Rodlok will also affect performance). THE RODLOK IS NOT DESIGNED TO BE USED AS A PERSONAL SAFETY DEVICE.

Option -H47 provides a cylinder and Rodlok pre-assembled. The port for the Rodlok will be assembled in the same position as the port on the extend end of the cylinder.

Replacement Rodlok kits can be purchased separately. See chart at right. The locking device and adaptor are not available with the -Z1 corrosion resistant finish.

-H47 available on B, R, P, and RC only.

🍒 This option does not dimensionally comply with the NFPA standard specifications.

<table>
<thead>
<tr>
<th>BORE \ in</th>
<th>STATIC LOCKING FORCE* \ lb</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>40</td>
<td>180</td>
</tr>
<tr>
<td>1</td>
<td>56</td>
<td>250</td>
</tr>
<tr>
<td>1-1/8</td>
<td>79</td>
<td>350</td>
</tr>
</tbody>
</table>

**NOTE:** *LOCKING FORCE GIVEN IS THE ACTUAL LOCKING FORCE WITH A DRY, CLEAN ROD AND DOES NOT INCLUDE ANY SAFETY FACTOR.

REPLACEMENT RODLOK KITS

<table>
<thead>
<tr>
<th>BORE \ in</th>
<th>LOCKING DEVICE KIT</th>
<th>ADAPTOR KIT</th>
<th>COMPLETE RODLOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>63932-01</td>
<td>63931-01</td>
<td>63935-01</td>
</tr>
<tr>
<td>1</td>
<td>63932-02</td>
<td>63931-02</td>
<td>63935-02</td>
</tr>
<tr>
<td>1-1/8</td>
<td>63932-03</td>
<td>63931-03</td>
<td>63935-03</td>
</tr>
</tbody>
</table>

PART NUMBERS LISTED ABOVE ARE INTENDED FOR REPLACEMENT PURPOSES ONLY.

Bore Dimensions

- **4X L THREAD DP 0.25**
- **3X M THREAD x DP T**
- **4X M THREAD x DP T**

**NOTES:**
1) Breakaway force on cylinders with Rodlok approximately 30 psi.
2) For Series A 3/4", 1", and 1-1/8" bores, subtract 0.500 (K = 1.750, C : 3/4 = 2.563, 1, 1-1/8 = 2.500)

All dimensions are reference only unless specifically toleranced.

www.phdinc.com/av • (800) 624-8511
OPTIONS: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

SHOCK PADS

B  BC  BR

Polyurethane pads for absorption of shock and noise (not available on HV hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available with all options EXCEPT:
• Same end as Cushion (-D, -DC, or -DR)
• Spring end of Spring Return cylinder (-SC or -SR)
• Same end as Stroke Adjustment (-A)

SPRING RETURN

SR  SC

Available in 1/4" increments

All standard A, AV and HV Cylinders from 1/4" to 6’ of stroke can be built with internal springs to return or extend the piston rod in single acting applications. The standard spring provides a preload and a spring rate per chart below. Other spring combinations will be quoted on request.

PORT POSITIONS

Port position 1 is standard on all cylinders except mounting style -F without port controls. The cap end port will be in position 4 standard.

If port position 1 (-Q) or 3 (-T) is desired, add -Q or -T to unit description and -F mounting tab will be added to unit to accommodate units.

STROKE PRELOAD RATE

<table>
<thead>
<tr>
<th>STROKE</th>
<th>PRELOAD</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 - 3’</td>
<td>4 lb</td>
<td>7 lb/in</td>
</tr>
<tr>
<td>3-1/4 - 6’</td>
<td>2 lb</td>
<td>3-1/2 lb/in</td>
</tr>
</tbody>
</table>

CYLINDER STROKE ADJUSTMENT

A

Stroke adjustment screws are available to decrease the retraction stroke of any Series AV or A cylinders. The standard adjusting range is 1/2 inch. Longer adjusting lengths are available on request.

PORT POSITION 1

STANDARD PORT POSITION 1

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>H</th>
<th>ZA</th>
<th>ZE STANDARD</th>
<th>ZE WITH - P OR - PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>0.370</td>
<td>1.031</td>
<td>3/8-24</td>
<td>5/16-24</td>
</tr>
<tr>
<td>1</td>
<td>0.462</td>
<td>1.156</td>
<td>1/2-20</td>
<td>3/8-24</td>
</tr>
<tr>
<td>1-1/8</td>
<td>0.462</td>
<td>1.156</td>
<td>1/2-20</td>
<td>1/2-20</td>
</tr>
</tbody>
</table>

ZAE THREAD 3/16 HEX BLACK OXIDE OR ZINC PLATED ALLOY STEEL SCREW AND NUT

All dimensions are reference only unless specifically tolerated.
**OPTIONS:** SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

**MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES**

**E  HALL EFFECT SWITCHES**

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

### COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 18-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

**M  REED SWITCHES**

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

### COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

**V  FLUOROElastomer SEALS**

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

**Z1  ELECTROLESS NICKEL PLATING**

Electroless nickel plating is done on all externally exposed ferrous parts except rods and rod end, or parts made of stainless steel or aluminum. This optional plating treatment gives an alternative method of protecting the cylinder from severe environments.

**Y  SAE PORTS FOR SERIES HV**

SAE Ports are available on most Tom Thumb Hydraulic Cylinders. Series HV Cylinders require a boss which is brazed to the head and cap.

Dimensions for this boss are shown below. This option is not available on cylinders with an “F” mounting style. Consult PHD for optional port position or units with Port Controls®. Oversize rods are available except on T and L mounting styles on 3/4" bore cylinders.

**_K  EXTRA ROD EXTENSION**

This option may be specified when extra plain rod extension between rod flats and cylinder snout is desired. Length is specified in 1/8" increments.

Length code example (for imperial units)
-4K = 1/2" of extra rod extension
-8K = 1", etc.

**W  CLOSE TOLERANCE STROKE**

This option may be specified when a precise stroke length is required and stroke adjustment is not acceptable. By specifying this option, a stroke length with a tolerance of ±0.005 will be supplied. Standard stroke tolerance is ±0.032.

Maximum stroke for cylinders with close tolerance is 18".

**NOTE:** This option is not available with shock pads (-B, -BC, or -BR).

All dimensions are reference only unless specifically tolerated.

www.phdinc.com/av  •  (800) 624-8511
SELF-ALIGNING PISTON ROD COUPLERS
Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.

MINIATURE COUPLERS
Couplers provide greater reliability and reduce cylinder and component wear, simplifying alignment problems in the field.

Rod Couplers are manufactured from high tensile and hardened steel components.

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>250</td>
<td>1/4-28</td>
</tr>
<tr>
<td>312</td>
<td>5/16-24</td>
</tr>
<tr>
<td>375</td>
<td>3/8-24</td>
</tr>
<tr>
<td>437</td>
<td>7/16-20</td>
</tr>
<tr>
<td>500</td>
<td>1/2-20</td>
</tr>
<tr>
<td>625</td>
<td>5/8-18</td>
</tr>
<tr>
<td>750</td>
<td>3/4-16</td>
</tr>
</tbody>
</table>

To order, specify the model number.

All dimensions are reference only unless specifically tolerated.
**ACCESSORIES: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE**

### STANDARD (#1 ROD END)

![Diagram of STANDARD ROD END]

### L COARSE THREAD ROD END

![Diagram of L COARSE THREAD ROD END]

### G ROD END STYLE #2

![Diagram of G ROD END STYLE #2]

### I ROD END STYLE #4

![Diagram of I ROD END STYLE #4]

### J ROD END STYLE #2X

![Diagram of J ROD END STYLE #2X]

### N PLAIN ROD END

![Diagram of N PLAIN ROD END]

All standard rod ends have four wrench flats (two wrench flats with “I” option).

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>ROD TYPE</th>
<th>ROD DIAMETER</th>
<th>A</th>
<th>AC</th>
<th>CT</th>
<th>D</th>
<th>FT</th>
<th>FT2</th>
<th>RM DIA</th>
<th>T</th>
<th>WA</th>
<th>WA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>STANDARD</td>
<td>0.250</td>
<td>0.625</td>
<td>1.250</td>
<td>1/4-20</td>
<td>7/32</td>
<td>1/4-28</td>
<td>10-32</td>
<td>0.625</td>
<td>6-32 x 0.437 DP</td>
<td>0.156</td>
<td>0.130</td>
</tr>
<tr>
<td></td>
<td>OVERSIZED</td>
<td>0.312</td>
<td>0.625</td>
<td>1.250</td>
<td>5/16-18</td>
<td>1/4</td>
<td>5/16-24</td>
<td>1/4-28</td>
<td>0.625</td>
<td>10-32 x 0.625 DP</td>
<td>0.187</td>
<td>0.156</td>
</tr>
<tr>
<td>1</td>
<td>STANDARD</td>
<td>0.375</td>
<td>0.625</td>
<td>1.250</td>
<td>3/8-16</td>
<td>1/8</td>
<td>3/8-24</td>
<td>5/16-24</td>
<td>0.750</td>
<td>1/4-28 x 0.625 DP</td>
<td>0.219</td>
<td>0.187</td>
</tr>
<tr>
<td></td>
<td>OVERSIZED</td>
<td>0.500</td>
<td>0.750</td>
<td>1.500</td>
<td>1/2-13</td>
<td>7/16</td>
<td>1/2-20</td>
<td>7/16-20</td>
<td>A: 0.750, AV-HV: 1.000</td>
<td>3/8-24 x 0.625 DP</td>
<td>0.312</td>
<td>0.250</td>
</tr>
</tbody>
</table>

**NOTE:** On double rod cylinders, both rod ends will be the same on both ends of the cylinder.

All dimensions are reference only unless specifically tolerated.

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www.phdinc.com/av • (800) 624-8511
ACCESSORIES: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

EYE BRACKET KIT

ROD EYE KIT

CLEVIS BRACKET KIT - PIN INCLUDED

ROD CLEVIS KIT - PIN INCLUDED

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>CYLINDER SERIES</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>A, AV, HV</td>
<td>1077-01</td>
<td>0.750 0.248 0.500 0.250 0.250 1/4-28 x 0.375 DP</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>1077-02</td>
<td>0.875 0.373 0.750 0.250 0.375 5/16-24 x 0.375 DP</td>
</tr>
<tr>
<td>1-1/8</td>
<td>AV, HV</td>
<td>1077-03</td>
<td>0.875 0.373 0.750 0.250 0.375 5/16-24 x 0.375 DP</td>
</tr>
</tbody>
</table>

*For 3/4 bore thru hole only.

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>CYLINDER SERIES</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>A, AV, HV</td>
<td>12901</td>
<td>0.750 0.254 0.500 0.250 0.250 1/4-28 TO SLOT</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>12902</td>
<td>1.000 0.379 0.875 0.250 0.375 3/8-24 TO SLOT</td>
</tr>
<tr>
<td>1-1/8</td>
<td>AV, HV</td>
<td>12903</td>
<td>1.000 0.379 0.875 0.375 0.375 3/8-24 TO SLOT</td>
</tr>
</tbody>
</table>

*For 3/4 bore thru hole only.

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>CYLINDER SERIES</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>A, AV, HV</td>
<td>12904</td>
<td>0.812 0.254 0.750 0.437 0.250 0.250 1/4-28 TO SLOT</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td>12905</td>
<td>0.875 0.379 0.875 0.562 0.250 0.250 5/16-24 TO SLOT</td>
</tr>
<tr>
<td>1-1/8</td>
<td>AV, HV</td>
<td>12906</td>
<td>0.875 0.379 0.875 0.562 0.375 0.375 5/16-24 TO SLOT</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.
SERIES A, AV 3/4", 1", 1-1/8" BORE CLASS 100 CLEANROOM CYLINDERS (REQUIRES -O)

Major Benefits

- This option allows PHD Tom Thumb® Cylinders to be used in Class 100 cleanroom applications
- Vacuum port and special bushing minimize particles from rod gland area
- Wide range of mounting styles for easy installation
**ORDERING DATA:** CLEANROOM CYLINDERS

TO ORDER SPECIFY:
- Series, Mounting Style, Bore Size, Stroke, and Options.

**Bore Size**
- 3/4” BORE
  - 1/4” Rod Dia.
  - 1/4-28 Thread
- 1” BORE
  - 5/16” Rod Dia.
  - 5/16-24 Thread
- 1-1/8” BORE
  - 3/8” Rod Dia.
  - 3/8-24 Thread

**Series**
- AV - 150 psi Air
- A - 150 psi Air

**Required Option**
- O - Cleanroom Vacuum Port

**OPTION**
- Z1 - Electroless Nickel Plate all ferrous parts excluding Rod Ends.

**Mounting Style**
- F - Foot Mount, C'bored through holes
- B - Bottom Mount, Tapped holes in head and cap
- R - Rod Mount, Tapped holes on front face of head
- T - Thread Mount, Threaded snout on head (shipped with mounting nut)
- RF - Rod End Flange
- CF - Cap End Flange
- L - Pilot Mount, Threaded snout and pilot diameter on head (shipped with mounting nut)
- P - Pivot Mount, Pivot on cap

**NOTES:**
1) Some cleanroom applications may require -Z1 electroless nickel plating of all ferrous parts.
2) Consult PHD for any special lubrication requirements.
3) PHD Tom Thumb® Cylinders with vacuum ports have been tested and comply with class 100 cleanroom requirements for particle count and size.

**ENGINEERING DATA & DIMENSIONS:** CLEANROOM CYLINDERS

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Series AV</th>
<th>Series A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Pressure</strong></td>
<td>20 to 150 psi air</td>
<td>20 to 150 psi air</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-20° to 180°F [-29° to 82°C]</td>
<td>-20° to 180°F [-29° to 82°C]</td>
</tr>
<tr>
<td><strong>Stroke Tolerance</strong></td>
<td>±0.032</td>
<td>±0.032</td>
</tr>
<tr>
<td><strong>Lubrication</strong></td>
<td>Permanently lubricated</td>
<td>Permanently lubricated</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>Field repairable</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

**Cylinder Force Table**

<table>
<thead>
<tr>
<th>Series</th>
<th>Cylinder Bore</th>
<th>Rod Diameter</th>
<th>Rod Direction</th>
<th>Effective Area Force in lbs/psi</th>
<th>Air Consumption at 80 psi Cubic ft/in of Stroke</th>
<th>Displacement Gal./in of Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV, A</td>
<td>3/4</td>
<td>1/4</td>
<td>Extend</td>
<td>0.442</td>
<td>0.0016</td>
<td>0.0019</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Retract</td>
<td>0.393</td>
<td>0.0014</td>
<td>0.0017</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5/16</td>
<td>Extend</td>
<td>0.785</td>
<td>0.0029</td>
<td>0.0034</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Retract</td>
<td>0.709</td>
<td>0.0026</td>
<td>0.0031</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>3/8</td>
<td>Extend</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Retract</td>
<td>0.883</td>
<td>0.0032</td>
<td>0.0038</td>
</tr>
</tbody>
</table>

**Vacuum Rating**
- Vacuum Port - up to 25 In. Hg.

**Vacuum Connections**
Manufacturer fittings differ. Due to close proximity of vacuum port to cylinder head port, the 10-32 vacuum port may require the use of a 10-32 barb fitting depending on fitting manufacturer used.

**Max. Allowable Extend Stroke**

<table>
<thead>
<tr>
<th>Series</th>
<th>Rod Diameter</th>
<th>Cylinder Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV, A</td>
<td>3/4, 1, 1-1/8’</td>
<td>12’</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
<td>18’</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>26’</td>
</tr>
</tbody>
</table>

**Cylinder Force Calculations**

Imperial:  
\[ F = \frac{P \times A}{10} \]

Where:
- \( F \) = Cylinder Force in lbs
- \( P \) = Operating Pressure in psi
- \( A \) = Effective Area in square inches (Extend or Retract)

All dimensions are reference only unless specifically tolerated.
1-3/8" BORE TIE ROD
HYDRAULIC & PNEUMATIC
NFPA CYLINDERS

Major Benefits

- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation

SERIES AV
1-3/8"

SERIES HV
1-3/8"

- chrome-plated alloy steel rod for long rod seal life
- pressure and wear compensating long life nitrile rod seal
- anodized aluminum tube for long seal life and smooth motion
- removable long life bronze rod bushing
- black oxide or zinc-plated alloy steel threaded bushing retainer
- zinc-plated alloy steel heads and caps for durability
- aluminum alloy piston
- pressure and wear compensating long life nitrile rod seal
- long life double lip urethane rod wiper
- black oxide or zinc-plated alloy steel tierod and nut
**ORDERING DATA: SERIES AV, HV CYLINDERS; 1-3/8" BORE**

**TO ORDER SPECIFY:**
- Series, Mounting Style, Bore Size, Stroke, Port Control®, and any Options. Also specify rod diameter if non-standard. Rod couplings and mounting attachments must be ordered separately.

**SERIES**
- **AV** - 150 psi Air
- **HV** - 1500 psi Hyd.

**BORE SIZE**
- **1-3/8" BORE**

**STANDARD STROKE LENGTHS**
- 1-3/8" BORE
- 1/2" to 24" in 1/2" increments
- Consult PHD for longer lengths.

**MOUNTING STYLE**
- **F** - Foot Mount
- **B** - Bottom Mount, tapped holes in head and cap
- **R** - Rod Mount, tapped holes on front face of head
- **T** - Thread Mount, threaded snout on head ( shipped with mounting nut)
- **RF** - Rod End Flange
- **CF** - Cap End Flange
- **K** - Clevis Mount, clevis on cap
- **TR** - Trunnion Mount
- **RR** - Tierod Mount, tierods extend out rod end
- **RC** - Tierod Mount, tierods extend out cap end
- **RRC** - Tierod Mount, tierods extend out both ends

**CUSHION OR SHOCK PAD**
- **D** - Cushions on both ends
- **DR** - Cushion on rod end
- **DC** - Cushion on cap end
- **B** - Shock Pads on both ends
- **BR** - Shock Pad on rod end
- **BC** - Shock Pad on cap end

**OVERSIZE ROD**
- To be specified only when using a non-standard diameter. Rod diameters available are shown on page 1-80.

**PORT CONTROL®**

**OPTIONS**
- **A** - Stroke Adjustment, 1/2" of adjustment standard (not available on Series HV)
- **E** - Magnetic Piston for PHD Hall Effect Switches
- **F** - #1 Rod End (see page 1-80 for dimensions) (see note 1)
- **I** - #4 Rod End, Female thread on rod (see page 1-80 for dimensions) (see note 1)
- **H47** - Rodlok ( Rod clamping device installed. Not available with Z1 or on HV. See option page.)
- **J** - #2X Rod End, twice as long as standard thread (see page 1-80 for dimensions)
- **K** - Extra Rod Extension, in 1/8" increments (see page 1-80 for dimensions)
- **L** - Coarse Thread Rod End (see page 1-80 for dimensions) (see note 1)
- **M** - Magnetic Piston for PHD Reed Switches
- **N** - Plain Rod End (see page 1-80 for dimensions) (see note 1)
- **R** - Ports in Position #2
- **T** - Ports in Position #3
- **U** - Ports in Position #4
- **V** - Fluoroelastomer Seals
- **W** - Close Tolerance Stroke, ±0.005" stroke length
- **Z1** - Electroless Nickel Plate all ferrous parts excluding Rod Ends

**SPRING RETURN**
- SC - Spring on cap end
- SR - Spring on rod end (Strokes available in 1/4" increments up to 6")

**DOUBLE ROD END**
- D - Double Rod End Cylinders
  - Leave blank if not needed.

**CUSHION OR SHOCK PAD**

**NOTES:**
1. For double rod cylinders, rod end options will be applied to both ends of cylinder.
2. For double rod cylinders, _K_ extension will be applied to one end only (head end/primary mounting end).
3. Marked options provide additional cylinder flexibility, but may alter the dimensions.

**COMPACT HALL EFFECT SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

**COMPACT REED SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches are ordered separately

**PROXIMITY SWITCH MOUNTING BRACKETS**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>BORE</th>
<th>SIZE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV, HV</td>
<td>1-3/8&quot;</td>
<td>-34</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete ordering information.

**NOTE:**
Options may affect unit length. See dimensional pages and option information details.

**CAD & Sizing Assistance**
Use PHD’s free online Product Sizing and CAD Configurator at [www.phdinc.com/myphd](http://www.phdinc.com/myphd)
### ENGINEERING DATA: SERIES AV, HV CYLINDERS; 1-3/8" BORE

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>SERIES AV</th>
<th>SERIES HV</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING PRESSURE</td>
<td>20 to 150 psi air</td>
<td>40 to 1500 psi hyd*</td>
</tr>
<tr>
<td>STANDARD CYLINDER (NO RODLOK) CYLINDER WITH RODLOK</td>
<td>30 to 150 psi air</td>
<td>—</td>
</tr>
<tr>
<td>OPERATING TEMPERATURE</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
</tr>
<tr>
<td>STROKE TOLERANCE</td>
<td>±0.032</td>
<td>±0.032</td>
</tr>
<tr>
<td>LUBRICATION</td>
<td>Permanently lubricated</td>
<td>—</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Field repairable</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

*Hydraulic rating is based on non-shock hydraulic service.

### CYLINDER FORCE TABLE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIAMETER</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE lb/psi</th>
<th>AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE*</th>
<th>DISPLACEMENT gal/in OF STROKE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV HV</td>
<td>1-3/8</td>
<td>1/2</td>
<td>EXTEND</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0064</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.289</td>
<td>0.0048</td>
<td>0.0056</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5/8</td>
<td>EXTEND</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0064</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.178</td>
<td>0.0044</td>
<td>0.0051</td>
</tr>
</tbody>
</table>

**NOTE:** Use the RETRACT figures for calculating double rod cylinder forces in both directions.

### MAXIMUM ALLOWABLE EXTEND STROKE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER FORCE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
</tr>
<tr>
<td>1-3/8 AV, HV</td>
<td>48&quot;</td>
</tr>
<tr>
<td>5/8</td>
<td>74&quot;</td>
</tr>
</tbody>
</table>

### UNIT WEIGHTS (lb)

<table>
<thead>
<tr>
<th>SERIES</th>
<th>UNIT WEIGHTS (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ZERO STROKE</td>
</tr>
<tr>
<td>PLAIN UNIT</td>
<td>2.56</td>
</tr>
</tbody>
</table>

### CYLINDER FORCE CALCULATIONS

**Imperial**

\[F = P \times A\]

- **F** = Cylinder Force (lbs)
- **P** = Operating Pressure (psi)
- **A** = Effective Area (in²) (Extend or Retract)

---

**Application & Sizing Assistance**

Use PHD’s free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)
### BASIC CYLINDER DIMENSIONS

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.875 SQ</td>
<td>1-3/8” BORE</td>
</tr>
<tr>
<td>1.250 DIA</td>
<td>2X 1/4 NPT</td>
</tr>
<tr>
<td>0.750</td>
<td>3/8-24 THREAD</td>
</tr>
<tr>
<td>0.219</td>
<td>7/16 WRENCH FLAT</td>
</tr>
<tr>
<td>0.250</td>
<td>1.031</td>
</tr>
<tr>
<td>0.438</td>
<td>2.438 + STROKE</td>
</tr>
<tr>
<td>0.688</td>
<td>0.265</td>
</tr>
<tr>
<td>0.030</td>
<td>2X 1/4 NPT</td>
</tr>
</tbody>
</table>

### PORT POSITIONS

- **B (MS4)**: Indicated by circled numbers.
- **CF (MF2)**: 4X 1/4-28 THREAD x 0.375 DP
- **R (MR1)**: 4X 1/4-28 THREAD
- **F (MS2)**: 4X 1/4-28 THREAD, with port control & cushion on cap end
- **K (MP1)**: 4X 1/4-28, 4X W/R (MX) MTG, 4X W/R (MX) MTG, 4X 1/4-28, 4X W/R (MX) MTG, 4X 1/4-28, 4X W/R (MX) MTG
- **TR (MT4)**: SEE NOTE BELOW

### CUSHIONS

- Cylinder length is not affected by addition of cushions.

### SHOCK PADS

- Add 0.250 in to all (+ stroke) dimensions for each shock pad.

### SPRING RETURN

- Add an additional stroke length to all (+ stroke) dimensions (2 x STROKE).

### OVERSIZE RODS

- See page 1-80 for oversize rod specifications.

### TR MOUNTING NOTE

- Sensing in the extend direction will be affected on units with -E or -M option because of the trunnion mounting block.

All standard rod ends have four wrench flats (two wrench flats with “I” option).

All dimensions are reference only unless specifically tolerated.
BASIC CYLINDER DIMENSIONS

B (MS4)

B (MS2)

T (MN1)

RF (MF1)

RR (MX3)

RRC (MX1) THREADED TIEROD ON BOTH ENDS

All standard rod ends have four wrench flats (two wrench flats with “I” option)

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS
SHOCK PADS: ADD 0.250 IN TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)
OVERSIZE RODS: SEE PAGE 1-80 FOR OVERSIZE ROD SPECIFICATIONS.
TR MOUNTING NOTE: SENSING IN THE EXTEND DIRECTION WILL BE AFFECTED ON UNITS WITH -E OR -M OPTION BECAUSE OF THE TRUNNION MOUNTING BLOCK.

All dimensions are reference only unless specifically tolerated.
OPTIONS: SERIES AV, HV CYLINDERS; 1-3/8" BORE

PORT CONTROL®

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

ADJUSTABLE CUSHION

PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

Effective cushion length 1/2”

STANDARD PORT CONTROL® AND CUSHION NEEDLE POSITIONS

Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.

Location may vary depending on mounting and option combinations.

PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

The cushion and Port Control® combination is available on the 1-3/8" bore. This cushion is activated when a seal, which is traveling with the piston, seals against the cylinder end cap. This causes the remaining volume in the cylinder to exhaust past an adjustable needle which controls the amount of deceleration. The spring, which extends the seal from the piston, permits the seal to act as a check valve to allow full flow back into the cylinder for immediate reversing. The cushion seal for air units is made of urethane while seals for oil units are close tolerance metal.
**OPTIONS:**  SERIES AV, HV CYLINDERS; 1-3/8" BORE

**SHOCK PADS**

Polyurethane pads for absorption of shock and noise (not available on HV hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available with all options EXCEPT:
- Same end as Cushion (-D, -DC, or -DR)
- Spring end of Spring Return cylinder (-SC or -SR)
- Same end as Stroke Adjustment (-A)

**SPRING RETURN**

Available in 1/4" increments

All standard A, AV and HV Cylinders from 1/4" to 6" of stroke can be built with internal springs to return or extend the piston rod in single acting applications. The standard spring provides a preload and a spring rate per chart below. Other spring combinations will be quoted on request.

<table>
<thead>
<tr>
<th>STROKE</th>
<th>PRELOAD</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot; - 3&quot;</td>
<td>4 lb</td>
<td>7 lb/in</td>
</tr>
<tr>
<td>3-1/4&quot; - 6&quot;</td>
<td>2 lb</td>
<td>3-1/2 lb/in</td>
</tr>
</tbody>
</table>

Available with all options EXCEPT:
- Cushion on the spring end (-D, -DC, or -DR)
- Shock pad on the spring end (-B, -BC, or -BR)
- Stroke adjustment on the spring end (-A)

**CYLINDER STROKE ADJUSTMENT**

(SERIES AV)

Stroke adjustment screws are available to decrease the retraction stroke of any Series AV. The standard adjusting range is 1/2 inch. Longer adjusting lengths are available on request.

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>H</th>
<th>ZA</th>
<th>ZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/8</td>
<td>0.462</td>
<td>1.000</td>
<td>1/2-20</td>
</tr>
</tbody>
</table>

Available with all options EXCEPT:
- Same end as Cushion (-D, -DC, or -DR)
- Spring end of Spring Return cylinder (-SC or -SR)
- Same end as Stroke Adjustment (-A)

**PORT POSITIONS**

- **STANDARD PORT POSITION 1**
  - T PORT POSITION 3
  - U PORT POSITION 4

**PORT POSITION 2**

**PORT POSITION 4**

- B, BC, BR

Polyurethane pads for absorption of shock and noise (not available on HV hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.
OPTIONS: SERIES AV, HV CYLINDERS; 1-3/8” BORE

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

HALL EFFECT SWITCHES

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

REED SWITCHES

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

FLUOROELASTOMER SEALS

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

ELECTROLESS NICKEL PLATING

Electroless nickel plating is done on all externally exposed ferrous parts except rods and rod end, or parts made of stainless steel or aluminum. This optional plating treatment gives an alternative method of protecting the cylinder from severe environments.

NOTE: Standard plating is Brite Zinc.

CLOSE TOLERANCE STROKE

This option may be specified when a precise stroke length is required and stroke adjustment is not acceptable. By specifying this option, a stroke length with a tolerance of ±0.005 will be supplied. Standard stroke tolerance is ±0.032.

Maximum stroke for cylinders with close tolerance is 18”.

NOTE: This option is not available with shock pads (-B, -BC, or -BR).

EXTRA ROD EXTENSION

This option may be specified when extra plain rod extension between rod flats and cylinder snout is desired. Length is specified in 1/8” [1 mm] increments.

Length code example (for imperial units)
-4K = 1/2 of extra rod extension
-8K = 1, etc.

Length code example (for metric units)
-4K = 4 mm of extra rod extension
-12K = 12 mm, etc.

NOTE: On double rod end cylinders with -_K specified will be applied to one end of cylinder only (head end/primary mounting end).

All dimensions are reference only unless specifically tolerated.
OPTIONS: SERIES AV, HV CYLINDERS; 1-3/8" BORE

H47 RODLOK CYLINDER & RODLOK
Available on single rod Series AV units only.

PHD’s Rodlok is ideal for locking the piston rod while in a static/stationary position. When the pressure is removed from the port of the Rodlok, the mechanism will grip the rod and prevent it from moving. The loads are held indefinitely without power. Rodlok performance is application and environment sensitive (cleanliness of rod or Rodlok will also affect performance). THE RODLOK IS NOT DESIGNED TO BE USED AS A PERSONAL SAFETY DEVICE.

Option H47 provides a cylinder and Rodlok pre-assembled. The port for the Rodlok will be assembled in the same position as the port on the extend end of the cylinder.

Replacement Rodlok kits can be purchased separately. See chart at right. The locking device and adaptor are not available with the -Z1 corrosion resistant finish.

-H47 available on B, R, and RC mounting only.

This option does not dimensionally comply with the NFPA standard specifications.

RODLOK CYLINDER & RODLOK
(-H47) Cylinder with rod locking device and adaptor preassembled

<table>
<thead>
<tr>
<th>MODEL</th>
<th>BORE C D E F G</th>
</tr>
</thead>
<tbody>
<tr>
<td>375</td>
<td>3/8-24 1.000 0.625 1.875 0.500 0.875 0.219</td>
</tr>
<tr>
<td>437</td>
<td>7/16-20 1.125 0.650 2.187 0.500 1.000 0.250</td>
</tr>
<tr>
<td>500</td>
<td>1/2-20 1.125 0.650 2.187 0.500 1.000 0.312</td>
</tr>
</tbody>
</table>

To order, specify the model number.

-REPLACEMENT RODLOK KITS

RODLOK CYLINDER & RODLOK
-RODLOK CYLINDER AND ADAPTOR

ACCESSORIES: SERIES AV, HV CYLINDERS; 1-3/8" BORE

SELF-ALIGNING PISTON ROD COUPLERS

Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>375</td>
<td>3/8-24 1.000 0.625 1.875 0.500 0.875 0.219</td>
</tr>
<tr>
<td>437</td>
<td>7/16-20 1.125 0.650 2.187 0.500 1.000 0.250</td>
</tr>
<tr>
<td>500</td>
<td>1/2-20 1.125 0.650 2.187 0.500 1.000 0.312</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.


**ACCESSORIES: SERIES AV, HV CYLINDERS; 1-3/8" BORE**

### 1-3/8" BORE CYLINDERS

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>G</strong></td>
<td>ROD END STYLE #2</td>
<td>STANDARD ON: (1-3/8&quot; BORE)</td>
<td><strong>L</strong></td>
<td>COARSE THREAD ROD END</td>
<td></td>
</tr>
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<tr>
<td><strong>F</strong></td>
<td>ROD END STYLE #1</td>
<td></td>
<td><strong>I</strong></td>
<td>ROD END STYLE #4</td>
<td></td>
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</tr>
<tr>
<td><strong>J</strong></td>
<td>ROD END STYLE #2X</td>
<td></td>
<td><strong>N</strong></td>
<td>PLAIN ROD END</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

All standard rod ends have four wrench flats (two wrench flats with “I” option).

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>ROD TYPE</th>
<th>ROD DIAMETER</th>
<th>CT</th>
<th>D</th>
<th>FT</th>
<th>FT2</th>
<th>T</th>
<th>WA</th>
<th>WA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/8</td>
<td>STANDARD</td>
<td>0.500</td>
<td>3/8-16</td>
<td>7/16</td>
<td>3/8-24</td>
<td>7/16-20</td>
<td>3/8-24 x 0.625 DP</td>
<td>0.219</td>
<td>0.250</td>
</tr>
<tr>
<td>OVERSIZE</td>
<td>0.625</td>
<td>7/16-14</td>
<td>9/16</td>
<td>7/16-20</td>
<td>1/2-20</td>
<td>7/16-20 x 0.625 DP</td>
<td>0.250</td>
<td>0.312</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** On double rod cylinders, both rod ends will be the same on both ends of the cylinder.

**EYE BRACKET KIT**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/8</td>
<td>1330</td>
<td></td>
</tr>
</tbody>
</table>

**ROD EYE KIT**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/8</td>
<td>1375-01</td>
<td>3/8-24 x 0.750 DP</td>
</tr>
<tr>
<td></td>
<td>1375-02</td>
<td>7/16-20 x 0.750 DP</td>
</tr>
<tr>
<td></td>
<td>1375-03</td>
<td>1/2-20 x 0.750 DP</td>
</tr>
</tbody>
</table>

**ROD CLEVIS KIT - PIN INCLUDED**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>KIT NO.</th>
<th>LETTER DIMENSION FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3/8</td>
<td>12909</td>
<td>3/8-24 TO SLOT</td>
</tr>
<tr>
<td></td>
<td>12910</td>
<td>7/16-20 TO SLOT</td>
</tr>
<tr>
<td></td>
<td>12911</td>
<td>1/2-20 TO SLOT</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.
Major Benefits

- Precise speed control and smooth operation at low velocities with -C option
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation

SERIES TD
Cutaway depicts a 1-1/8" bore with -C option.

TO ORDER SPECIFY:
Series, Mounting Style, Bore Size, Stroke, and Options.

CYLINDER SERIES
TD - 150 psi air

BORE SIZE
3/4" BORE
1/4" Rod Dia.
1/4-28 Thread

1" BORE
5/16" Rod Dia.
5/16-24 Thread

1-1/8" BORE
3/8" Rod Dia.
3/8-24 Thread

1-3/8" BORE
1/2" Rod Dia.
3/8-24 Thread

OPTIONS
E - Magnetic Piston for PHD Hall Effect Switches
M - Magnetic Piston for PHD Reed Switches
V - Fluoroelastomer Seals

MOUNTING STYLE
F - Foot Mount, c'bored thru holes
B - Bottom Mount, tapped holes in head and cap
R - Rod Mount, tapped holes on front face of head
T - Thread Mount, threaded snout on head (shipped with mounting nut)
RF - Rod End Flange
CF - Cap End Flange
*L - Mount, Threaded snout and pilot diameter on head (shipped with mounting nut)
*P - Pivot Mount, pivot on cap
**K - Clevis Mount, clevis on cap

*Available on 3/4", 1", and 1-1/8" bore only
**Available on 1-3/8" bore only

STANDARD STROKE LENGTHS
3/4" BORE SIZE
1/4" to 6"
1" to 9"
in 1/4" increments
1-3/8" BORE SIZE
1/2" to 12"
in 1/2" increments

For longer strokes, consult PHD.

TANDEM OPTION
X - Crossover Tube must be specified to receive the unit with Crossover Tube and Fittings filled with oil for use as Air/Oil Tandem (crossover tube only)
C - Includes -X above with the reservoir plumbed to the head end. For use as Air/Oil crossover with reservoir

PROXIMITY SWITCH MOUNTING BRACKETS

<table>
<thead>
<tr>
<th>SERIES</th>
<th>BORE</th>
<th>SIZE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD</td>
<td>3/4&quot;</td>
<td>-31</td>
</tr>
<tr>
<td></td>
<td>1&quot;</td>
<td>-32</td>
</tr>
<tr>
<td></td>
<td>1-1/8&quot;</td>
<td>-33</td>
</tr>
<tr>
<td></td>
<td>1-3/8&quot;</td>
<td>-34</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete ordering information.

Compact Hall Effect Switches

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Compact Reed Switches

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches are ordered separately

CAD & Sizing Assistance

Use PHD's free online Product Sizing and CAD Configurator at www.phdinc.com/myphd

CAD & Sizing Assistance

www.phdinc.com/td • (800) 624-8511
# ENGINEERING DATA: SERIES TD AIR/OIL TANDEM; 3/4", 1", 1-1/8", 1-3/8" BORE

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>SERIES AV</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING PRESSURE</td>
<td>20 to 150 psi air</td>
</tr>
<tr>
<td>STANDARD WITH -X OR -C</td>
<td>30 to 150 psi air</td>
</tr>
<tr>
<td>RESERVOIR PRESSURE</td>
<td>20 psi recommended</td>
</tr>
<tr>
<td>OPERATING TEMPERATURE</td>
<td>-20° to +180°F [-29° to +82°C]</td>
</tr>
<tr>
<td>STROKE TOLERANCE</td>
<td>±0.032</td>
</tr>
<tr>
<td>LUBRICATION</td>
<td>Permanently lubricated</td>
</tr>
<tr>
<td>TANDEM FLUID</td>
<td>SAE 32 weight oil (viscosity at 100°F is 158. SSU at 250° is 45.1)</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

## CYLINDER FORCE TABLE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIAMETER</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE WITH -C OR -X</th>
<th>W/OUT -C OR -X</th>
<th>AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE</th>
<th>DISPLACEMENT gal/in OF STROKE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>lb/psi</td>
<td>lb/psi</td>
<td>WITH -C OR -X</td>
<td>WITH -C OR -X</td>
</tr>
<tr>
<td>TD</td>
<td>3/4</td>
<td>1/4</td>
<td>EXTEND</td>
<td>0.442</td>
<td>0.835</td>
<td>0.0016</td>
<td>0.0030</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.393</td>
<td>0.786</td>
<td>0.0014</td>
<td>0.0028</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>5/16</td>
<td>EXTEND</td>
<td>0.785</td>
<td>1.494</td>
<td>0.0029</td>
<td>0.0055</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.709</td>
<td>1.418</td>
<td>0.0026</td>
<td>0.0052</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>3/8</td>
<td>EXTEND</td>
<td>0.994</td>
<td>1.877</td>
<td>0.0037</td>
<td>0.0069</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.883</td>
<td>1.766</td>
<td>0.0032</td>
<td>0.0064</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>1/2</td>
<td>EXTEND</td>
<td>1.485</td>
<td>2.774</td>
<td>0.0055</td>
<td>0.0103</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.289</td>
<td>2.578</td>
<td>0.0048</td>
<td>0.0096</td>
</tr>
</tbody>
</table>

## MAXIMUM ALLOWABLE EXTEND STROKE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER FORCE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;, 1&quot;, 1-1/8&quot; TD</td>
<td>12&quot; 9&quot; 6&quot; — — — — —</td>
</tr>
<tr>
<td>5/16</td>
<td>18&quot; 13&quot; 8&quot; — — — — —</td>
</tr>
<tr>
<td>3/8</td>
<td>26&quot; 18&quot; 12&quot; — — — — —</td>
</tr>
<tr>
<td>1-3/8&quot; TD</td>
<td>48&quot; 34&quot; 21&quot; — — — — —</td>
</tr>
</tbody>
</table>

## MAXIMUM AIR/OIL TANDEM CYLINDER VELOCITY (in/sec)

<table>
<thead>
<tr>
<th>PRESSURE (psi)</th>
<th>BORE</th>
<th>3/4&quot;</th>
<th>1&quot;</th>
<th>1-1/8&quot;</th>
<th>1-3/8&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>EXTEND</td>
<td>0.68</td>
<td>2.26</td>
<td>2.66</td>
<td>3.07</td>
</tr>
<tr>
<td></td>
<td>RETRACT</td>
<td>1.00</td>
<td>2.26</td>
<td>2.30</td>
<td>2.60</td>
</tr>
<tr>
<td>60</td>
<td>EXTEND</td>
<td>1.26</td>
<td>3.07</td>
<td>3.33</td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td>RETRACT</td>
<td>1.50</td>
<td>3.00</td>
<td>3.24</td>
<td>3.52</td>
</tr>
<tr>
<td>80</td>
<td>EXTEND</td>
<td>1.71</td>
<td>3.42</td>
<td>3.48</td>
<td>4.80</td>
</tr>
<tr>
<td></td>
<td>RETRACT</td>
<td>2.00</td>
<td>3.42</td>
<td>3.87</td>
<td>4.44</td>
</tr>
<tr>
<td>100</td>
<td>EXTEND</td>
<td>2.06</td>
<td>4.28</td>
<td>5.00</td>
<td>5.21</td>
</tr>
<tr>
<td></td>
<td>RETRACT</td>
<td>2.44</td>
<td>4.44</td>
<td>4.61</td>
<td>4.80</td>
</tr>
</tbody>
</table>

Field Maintenance Videos on filling and bleeding Air/Oil Tandem Actuators are available. Contact your local PHD distributor or call our toll free number: 1-800-624-8511. Or go online to www.phdinc.com to view working cutaways and applications.

**CYLINDER FORCE CALCULATIONS**

Imperial

\[ F = P \times A \]

- **F** = Cylinder Force lbs
- **P** = Operating Pressure psi
- **A** = Effective Area in²

Minimum recommended velocity for all bore sizes at pressures from 40 to 150 psi is 0.133 in/sec.

### Application & Sizing Assistance

Use PHD’s free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)
DIMENSIONS: SERIES TD AIR/OIL TANDEM; 3/4", 1", 1-1/8", BORE

BASIC CYLINDER DIMENSIONS
For -C reservoir dimensions and operation notes, see next page (1-3/8").

<table>
<thead>
<tr>
<th>LETTER DIMENSION</th>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LETTER DIMENSION</th>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td></td>
</tr>
</tbody>
</table>

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
NOTE: *FOR -X AND -C OPTIONS WITH STROKES OF 0.250 in OR LESS, THE CROSSOVER TUBE WILL BE COILED AROUND CYLINDERS FOR ALL NON B OR F MOUNTING UNITS. F & B MOUNTING UNITS WILL HAVE TUBE COILED ABOVE CYLINDER DUE TO DISTANCE BETWEEN FITTINGS. SEE DETAIL ABOVE.

All dimensions are reference only unless specifically tolerated.

www.phdinc.com/td  •  (800) 624-8511
DIMENSIONS: SERIES TD AIR/OIL TANDEM; 1-3/8" BORE

BASIC CYLINDER DIMENSIONS

-C Option Air/Oil Tandem Mounting and Operation Notes:
1. Mount reservoir vertically above hydraulic section. Excess tubing may be coiled or cut off. Shortening of tubing should be done in a fashion as to keep oil loss to a minimum. Tubing and crossover below cut must be kept full of oil at all times.
2. A constant air supply of 20 psi to be on inlet port of reservoir during operation. Use of E-stop or other applications with pressure lost to reservoir may cause rod seal seepage. PHD recommends use of check valve in circuit on reservoir port.
3. Oil level in reservoir should be kept at level indicated on label of tube.

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

All standard rod ends have four wrench flats (two wrench flats with "I" option).

All dimensions are reference only unless specifically toleranced.

www.phdinc.com/td  •  (800) 624-8511

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

M REED SWITCHES
The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

V FLUOROElastoMER SeALS
Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

C RESERVOIR ASSEMBLY PLUMBED
Air/Oil Tandem models only (Series TD)
See previous page for dimensions.

Available on Series TD tandem models only. The reservoir assembly is plumbed to the unit and is bled of air for easy installation. (Includes -X option).

1) Mount reservoir vertically above hydraulic section. Extra tubing may be coiled or cut off. Shorten tubing in a manner that minimizes oil loss. Tubing and crossover should be kept full at all times.

2) Keep a constant 20 psi on inlet port of reservoir during operation.

3) Oil level in reservoir should be kept at levels indicated on tube label.

X CROSSOVER TUBE
Air/Oil Tandem models only (Series TD)
Available on Series TD tandem models only. These tandem models provide the smooth control of hydraulics with the simplicity of pneumatics. The -X option must be specified to receive the air/oil tandem units filled with oil and bled of air. (It is recommended that these units be used with reservoir and 20 psi oil pressure.)

STANDARD PORT CONTROL®
The exclusive PhD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.
### ACCESSORIES: SERIES TD AIR/OIL TANDEM; 3/4", 1", 1-1/8" BORE

#### EYE BRACKET KIT

![Eye Bracket Kit Diagram]

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>1077-01</td>
<td>0.750 0.248 0.250 #6 1.000 0.577</td>
</tr>
<tr>
<td>1 &amp; 1-1/8</td>
<td>1077-03</td>
<td>1.000 0.373 0.375 #10 1.375 0.437</td>
</tr>
</tbody>
</table>

*For 3/4 bore thru hole only.

#### ROD EYE KIT

![Rod Eye Kit Diagram]

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>12901</td>
<td>0.750 0.254 0.750 0.250 0.250 1/4-28 x 0.375 DP</td>
</tr>
<tr>
<td>1</td>
<td>12905</td>
<td>0.875 0.373 0.750 0.375 0.375 5/16-24 x 0.375 DP</td>
</tr>
<tr>
<td>1-1/8</td>
<td>12908</td>
<td>0.875 0.373 0.750 0.375 0.375 3/8-24 x 0.312 DP</td>
</tr>
</tbody>
</table>

*For 3/4 bore thru hole only.

#### CLEVIS BRACKET KIT - PIN INCLUDED

![Clevis Bracket Kit Diagram]

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>12904</td>
<td>0.812 0.254 0.750 0.437 0.250 0.250 1/4-28 TO SLOT</td>
</tr>
<tr>
<td>1</td>
<td>12906</td>
<td>0.875 0.379 0.875 0.562 0.375 0.375 5/16-24 TO SLOT</td>
</tr>
<tr>
<td>1-1/8</td>
<td>12908</td>
<td>0.875 0.379 0.875 0.562 0.375 0.375 3/8-24 TO SLOT</td>
</tr>
</tbody>
</table>

#### ROD CLEVIS KIT - PIN INCLUDED

![Rod Clevis Kit Diagram]

All dimensions are reference only unless specifically toleranced.
**ACCESSORIES:** SERIES TD AIR/OIL TANDEM; 1-3/8" BORE

### EYE BRACKET KIT

- **Dimensions:**
  - 0.500 DIA THRU
  - 1.000 DIA
  - 1.375 SQ
  - 1.875 SQ
  - 4X 0.281 DIA THRU

- **Part No.:** 1330

### ROD EYE KIT

- **Dimensions:**
  - 0.875
  - 0.625
  - 1.570
  - 0.438

- **Letter Dimension:**
  - 3/8-24 x 0.750 DP
  - 7/16-20 x 0.750 DP

- **Part Numbers:**
  - 1-3/8 1375-01
  - 1-3/8 1375-02

### ROD CLEVIS KIT - PIN INCLUDED

- **Dimensions:**
  - 0.875
  - 0.625
  - 1.375

- **Letter Dimension:**
  - 3/8-24 TO SLOT
  - 7/16-20 TO SLOT

- **Part Numbers:**
  - 1-3/8 12909
  - 1-3/8 12910
AV2, HV2, A2

3/4”, 1”, 1-1/8”, 1-3/8” BORE BACK-TO-BACK FOUR-POSITION CYLINDERS

Major Benefits

- Four linear positions with double rod
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation
- Simple four position operation

Series AV2

Cutaway depicts a 1-1/8” bore AV2 unit.
**ORDERING DATA:** AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

**TO ORDER SPECIFY:**
Series, Type, Mounting Style, Bore Size, Cylinder 1 Stroke, Cylinder 2 Stroke, and Options.

**CYLINDER SERIES**
AV - 150 psi Air  
HV - 1500 psi Hyd.  
*A - 150 psi Air  
*Not available in 1-3/8" bore

**BORE SIZE**
3/4" BORE  
1/4" Rod Dia.  
1/4-28 Thread  
1" BORE  
5/16" Rod Dia.  
5/16-24 Thread  
1-1/8" BORE  
3/8" Rod Dia.  
3/8-24 Thread  
1-3/8" BORE  
1/2" Rod Dia.  
3/8-24 Thread

**STANDARD STROKE CYLINDER 1**
**BORE**  
3/4"  
1" & 1-1/8"  
1-3/8"

**STROKE**
1/4" to 6"  
1/4" to 9"  
1/2" to 12"

Consult PHD for longer lengths.

**STANDARD STROKE CYLINDER 2**
**BORE**  
3/4"  
1" & 1-1/8"  
1-3/8"

**STROKE**
1/4" to 6"  
1/4" to 9"  
1/2" to 12"

Consult PHD for longer lengths.

**TYPE**
2 - Back-to-Back Cylinder

**MOUNTING STYLE**
F - Foot Mount, c'bored through holes  
B - Bottom Mount, tapped holes in head and cap  
R - Rod Mount, tapped holes on front face of head  
T - Thread Mount, threaded snout on head (shipped with mounting nut)  
RF - Rod end flange  
*L - Pilot Mount, threaded snout and pilot diameter on head (shipped with mounting nut)  
*Available on 3/4", 1", and 1-1/8" bore only

**OPTIONS**
B - Shock Pads on both ends of each cylinder (not available on Series HV2)  
D - Cushion on both ends of each cylinder (not available on Series HV2 3/4", 1", and 1-1/8" sizes)  
E - Magnetic Pistons on both cylinders for PHD Hall Effect Switches (not available on Series A)  
M - Magnetic Pistons on both cylinders for PHD Reed Switches (not available on Series A)  
P - Port Controls® on both ends of each cylinder  
V - Fluoroelastomer Seals

**COMPACT HALL EFFECT SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

**COMPACT REED SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches are ordered separately

**Cad & Sizing Assistance**
Use PHD’s free online Product Sizing and CAD Configurator at www.phdinc.com/myphd
## ENGINEERING DATA: AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

### SPECIFICATIONS

<table>
<thead>
<tr>
<th>SERIES</th>
<th>AV2</th>
<th>HV2</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING PRESSURE</td>
<td>20 to 150 psi air</td>
<td>40 to 1500 psi hyd*</td>
<td>20 to 150 psi air</td>
</tr>
<tr>
<td>OPERATING TEMPERATURE</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
</tr>
<tr>
<td>STROKE TOLERANCE</td>
<td>±0.032</td>
<td>±0.032</td>
<td>±0.032</td>
</tr>
<tr>
<td>LUBRICATION</td>
<td>Plain</td>
<td>—</td>
<td>Permanently lubricated</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Field repairable</td>
<td>Field repairable</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

*Hydraulic rating is based on non-shock hydraulic service.

### CYLINDER FORCE TABLE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIA</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE lb/psi</th>
<th>AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE*</th>
<th>DISPLACEMENT gal/in OF STROKE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV2</td>
<td>3/4</td>
<td>1/4</td>
<td>EXTEND</td>
<td>0.442</td>
<td>0.0016</td>
<td>0.0019</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.393</td>
<td>0.0014</td>
<td>0.0017</td>
</tr>
<tr>
<td>HV2</td>
<td>1</td>
<td>5/16</td>
<td>EXTEND</td>
<td>0.785</td>
<td>0.0029</td>
<td>0.0034</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.709</td>
<td>0.0026</td>
<td>0.0031</td>
</tr>
<tr>
<td>A2</td>
<td>1-1/8</td>
<td>3/8</td>
<td>EXTEND</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.883</td>
<td>0.0032</td>
<td>0.0038</td>
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<tr>
<td></td>
<td>1-3/8</td>
<td>1/2</td>
<td>EXTEND</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0064</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.289</td>
<td>0.0048</td>
<td>0.0056</td>
</tr>
</tbody>
</table>

*Value per cylinder (Cyl 1 or Cyl 2). Total = 2X value.

### MAXIMUM ALLOWABLE EXTEND STROKE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER FORCE (lb)</th>
<th>ROD DIAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 200 500 1000 2000 5000</td>
<td></td>
</tr>
<tr>
<td>3/4&quot;, 1&quot;, 1-1/8&quot; AV2, HV2, A2</td>
<td>1/4</td>
<td>12&quot; 9&quot; 6&quot; 4&quot; 3&quot;  —  —  —</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
<td>18&quot; 13&quot; 8&quot; 6&quot; 5&quot;  —  —  —</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>26&quot; 18&quot; 12&quot; 9&quot; 7&quot;  —  —  —</td>
</tr>
<tr>
<td>1-3/8&quot; AV2, HV2</td>
<td>1/2</td>
<td>48&quot; 34&quot; 21&quot; 15&quot; 12&quot;  —  —  —</td>
</tr>
</tbody>
</table>

### UNIT WEIGHTS (lb)

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ZERO STROKE</th>
<th>ADDER PER INCH OF STROKE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV2</td>
<td>3/4</td>
<td>0.84</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.74</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>1.90</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>5.12</td>
<td>0.12</td>
</tr>
</tbody>
</table>

*Total Stroke = Stroke Cylinder 1 + Stroke Cylinder 2

### CYLINDER FORCE CALCULATIONS

\[ F = P \times A \]

- **F** = Cylinder Force (lbf)
- **P** = Operating Pressure (psi)
- **A** = Effective Area (in²)

**Application & Sizing Assistance**

Use PHD’s free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

www.phdinc.com/av2 • (800) 624-8511
DIMENSIONS: SERIES AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8" BORE

BASIC CYLINDER DIMENSIONS

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: ADD 1.000 in TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (2' TOTAL TO OVERALL)
SHOCK PADS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (1' TOTAL TO OVERALL)

All standard rod ends have four wrench flats (two wrench flats with “I” option).

DIMENSIONS COMMON TO ALL SERIES

SERIES AV2 CYLINDERS

SERIES HV2 CYLINDERS

All dimensions are reference only unless specifically tolerated.
DIMENSIONS: SERIES AV2, HV2 BACK-TO-BACK; 1-3/8" BORE

BASIC CYLINDER DIMENSIONS

All standard rod ends have four wrench flats (two wrench flats with “I” option).

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS
SHOCK PADS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (1" TOTAL TO OVERALL)

All dimensions are reference only unless specifically tolerated.
**OPTIONS:** SERIES AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

---

**PORT CONTROL®**

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

---

**ADJUSTABLE CUSHION**

PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.

3/4", 1", 1-1/8" Series A2, A2V, H2V = Cushion Block
1-3/8" Series A2V, H2V = Poppet Style

Effective cushion length 1/2”

---

**STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS**

(3/4", 1", 1-1/8" Bore Series A2, AV2, and HV2 Cylinders)

Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A2, AV2, and HV2. Consult PHD for special Port Control® or cushion needle positions.

---

**PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION**

(3/4", 1", 1-1/8" Bore Series A2, AV2, and HV2 Cylinders)

Cushion and Port Control® combination arranged in series provides a compact efficient control system for maximum space weight and cost savings. The cushion is activated when the piston extension enters a seal in the cushion block. The remaining volume in the cylinder exhausts past an adjustable needle. A check seal in the adjusting needle is closed during deceleration, but opens to permit full flow for immediate reversing. The cushion seal in the block is an o-ring for air units.

---

**STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS**

(1-3/8" Bore Series AV and HV Cylinders)

Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.

---

**PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION**

(1-3/8" Bore Series AV2 and HV2 Cylinders)

The cushion and Port Control® combination is also available on the 1-3/8" Bore. This cushion is activated when a seal, which is traveling with the piston, seals against the cylinder end cap. This causes the remaining volume in the cylinder to exhaust past an adjustable needle which controls the amount of deceleration. The spring, which extends the seal from the piston, permits the seal to act as a check valve to allow full flow back into the cylinder for immediate reversing. The cushion seal for air units is made of urethane while seals for oil units are close tolerance metal.
**OPTIONS:** SERIES AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

---

**SHOCK PADS**

Polyurethane pads for absorption of shock and noise (not available on hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available together with all options EXCEPT:
- Same end as Cushion (-D)
- Both ends of both cylinders

---

**PORT POSITIONS**

Port position 1 is standard on all cylinders.

**PORT POSITION 1 (STANDARD)**

**PORT POSITION 2**

**PORT POSITION 3**

**PORT POSITION 4**

---

**MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES**

**HALL EFFECT SWITCHES**

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

**COMPACT HALL EFFECT SWITCHES**

<table>
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<th>PART NO.</th>
<th>DESCRIPTION</th>
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<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

**REED SWITCHES**

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches.

**COMPACT REED SWITCHES**

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<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

---

**FLUOROELASTOMER SEALS**

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.
SELF-ALIGNING PISTON ROD COUPLERS

Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32” lateral misalignment on push and pull stroke.

MODEL | LETTER DIMENSION
<table>
<thead>
<tr>
<th>NO.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>1/4-28</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.156</td>
</tr>
<tr>
<td>312</td>
<td>5/16-24</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.187</td>
</tr>
<tr>
<td>375</td>
<td>3/8-24</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.219</td>
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<tr>
<td>437</td>
<td>7/16-20</td>
<td>1.125</td>
<td>0.650</td>
<td>2.187</td>
<td>0.500</td>
<td>1.000</td>
<td>0.250</td>
</tr>
</tbody>
</table>

To order, specify the model number.

**EYE BRACKET KIT**

**ROD EYE KIT**

**CLEVIS BRACKET KIT - PIN INCLUDED**

**ROD CLEVIS KIT - PIN INCLUDED**

**EYE BRACKET KIT**

**ROD EYE KIT**

**ROD CLEVIS KIT - PIN INCLUDED**

All dimensions are reference only unless specifically tolerated.
A3V, H3V, A3

3/4", 1", 1-1/8", 1-3/8" BORE
THREE-POSITION HYDRAULIC & PNEUMATIC CYLINDERS

Major Benefits

• Four linear positions from piston rod
• Long life design for low maintenance
• NFPA repairable for extended life providing long term savings
• Wide range of options for easy application and reduced design time
• Wide range of mounting styles for easy installation
• Simple three position operation

SERIES A3V
Cutaway depicts a 1-1/8" bore A3V unit.

- Zinc-plated alloy steel heads and caps for durability
- Aluminum alloy piston
- Anodized aluminum tube for long seal life and smooth motion
- Pressure and wear compensating long life Nitrile piston seals
- Corrosion resistant alloy steel rod for long rod seal life
- Optional magnetic piston for use with PHD switches
- Long life bronze bushing
- PTFE rod wiper for durability
**ORDERING DATA:** SERIES A3, A3V, H3V; 3/4", 1", 1-1/8", 1-3/8" BORE

**TO ORDER SPECIFY:**
Series, Type, Mounting Style, Bore Size, Cylinder 1 Stroke, Cylinder 2 Stroke, and Options.

**CAUTION:** HYDRAULIC THREE POSITION CYLINDER (H3V) MUST BE VALVED PROPERLY TO PREVENT BLOCKING OF FLOW FROM THE CENTER PORT WHEN PRESSURIZING THE REAR (CAP) PORT. FAILURE TO DO SO MAY RESULT IN AN INTENSIFICATION OF PRESSURE IN CYLINDER NUMBER 1 CAUSING TIEROD FAILURE.

**CYLINDER SERIES**
- AV - 150 psi Air
- HV - 1500 psi Hyd.
- *A - 150 psi Air
  *Not available in 1-3/8" bore

**BORE SIZE**
- 3/4" BORE
  - 1/4" Rod Dia. 1/4-28 Thread
  - 1 BORE 5/16" Rod Dia. 5/16-24 Thread
  - 1-1/8" BORE 3/8" Rod Dia. 3/8-24 Thread
  - 1-3/8" BORE 1/2" Rod Dia. 3/8-24 Thread

**STANDARD STROKE CYLINDER 1**
- 3/4" BORE SIZE
  - 1/4" to 6" in 1/4" increments
  - 1" and 1-1/8" BORE SIZES
  - 1/4" to 9" in 1/4" increments
  - 1-3/8" BORE SIZE
  - 1/2" to 12" in 1/2" increments
  - For longer strokes, consult PHD.

**STANDARD STROKE CYLINDER 2**
- 3/4" BORE SIZE
  - 1/4" to 6" in 1/4" increments
  - 1" and 1-1/8" BORE SIZES
  - 1/4" to 9" in 1/4" increments
  - 1-3/8" BORE SIZE
  - 1/2" to 12" in 1/2" increments
  - For longer strokes, consult PHD.

**TYPE**
- 3 - Three Position Cylinder

**MOUNTING STYLE**
- F - Foot Mount, c'bored through holes
- B - Bottom Mount, tapped holes in head and cap
- R - Rod Mount, tapped holes on front face of head
- T - Thread Mount, threaded snout on head (shipped with mounting nut)
- RF - Rod End Flange
- CF - Cap End Flange
- *L - Pilot Mount, threaded snout and pilot diameter on head (shipped with mounting nut)
- RF - Rod End Flange
- CF - Cap End Flange
- *L - Pilot Mount, threaded snout and pilot diameter on head (shipped with mounting nut)
- *P - Pivot Mount, pivot on cap
- *K - Clevis Mount, clevis on cap
  *Available on 3/4", 1", and 1-1/8" bore only
  **Available on 1-3/8" bore only

**OPTIONS**
- B - Shock Pads on full extension and retraction only (not available on Series HV)
- D - Cushion on full extension and retraction only (not available on Series HV 3/4", 1", or 1-1/8" sizes)
- E - Magnetic Pistons on both cylinders for PHD Hall Effect Switches (not available on Series A)
- M - Magnetic Pistons on both cylinders for PHD Reed Switches (not available on Series A)
- P - Port Controls® on all heads and cap, full extension and retraction only, not on mid-position extension
- V - Fluoroelastomer Seals

**PROXIMITY SWITCH MOUNTING BRACKETS**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>BORE</th>
<th>SIZE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV, HV</td>
<td>3/4&quot;</td>
<td>-31</td>
</tr>
<tr>
<td></td>
<td>1&quot;</td>
<td>-32</td>
</tr>
<tr>
<td></td>
<td>1-1/8&quot;</td>
<td>-33</td>
</tr>
<tr>
<td></td>
<td>1-3/8&quot;</td>
<td>-34</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete ordering information.

**COMPACT HALL EFFECT SWITCHES**

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<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches are ordered separately.

**CAUTION:** OPTIONS MAY AFFECT UNIT LENGTH. SEE DIMENSIONAL PAGES AND OPTION INFORMATION DETAILS.

**CAD & Sizing Assistance**

Use PHD’s free online Product Sizing and CAD Configurator at www.phdinc.com/aphd

### SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>SERIES AV3</th>
<th>SERIES HV3</th>
<th>SERIES A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING PRESSURE</td>
<td>20 to 150 psi air</td>
<td>40 to 1500 psi hyd*</td>
<td>20 to 150 psi air</td>
</tr>
<tr>
<td>OPERATING TEMPERATURE</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
</tr>
<tr>
<td>STROKE TOLERANCE</td>
<td>±0.032</td>
<td>±0.032</td>
<td>±0.032</td>
</tr>
<tr>
<td>LUBRICATION</td>
<td>Permanently lubricated</td>
<td>—</td>
<td>Permanently lubricated</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Field repairable</td>
<td>Field repairable</td>
<td>Field repairable</td>
</tr>
</tbody>
</table>

*Hydraulic rating is based on non-shock hydraulic service.

### CYLINDER FORCE TABLE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIAMETER</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE lb/psi</th>
<th>AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE*</th>
<th>DISPLACEMENT gal/in OF STROKE*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>1/4</td>
<td>EXTEND</td>
<td>0.442</td>
<td>0.0019</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.393</td>
<td>0.0014</td>
<td></td>
</tr>
<tr>
<td>A3V</td>
<td></td>
<td>1</td>
<td>EXTEND</td>
<td>0.785</td>
<td>0.0029</td>
<td>0.0034</td>
</tr>
<tr>
<td>H3V</td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.709</td>
<td>0.0026</td>
<td>0.0031</td>
</tr>
<tr>
<td>A3</td>
<td>1-1/8</td>
<td>3/8</td>
<td>EXTEND</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.883</td>
<td>0.0032</td>
<td>0.0038</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>1/2</td>
<td>EXTEND</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0064</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.289</td>
<td>0.0048</td>
<td>0.0056</td>
</tr>
</tbody>
</table>

*Value per cylinder (Cyl 1 or Cyl 2). Total = 2X value.

### MAXIMUM ALLOWABLE EXTEND STROKE

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIAMETER</th>
<th>CYLINDER FORCE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4, 1&quot;, 1-1/8</td>
<td>1/4</td>
<td>100 200 500 1000 1500 2000 3000 5000</td>
</tr>
<tr>
<td>A3V</td>
<td></td>
<td>12&quot; 9&quot; 6&quot; 4&quot; 3&quot; — — —</td>
<td>1/2</td>
</tr>
<tr>
<td>H3V</td>
<td></td>
<td>18&quot; 13&quot; 8&quot; 6&quot; 5&quot; — — —</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>3/8</td>
<td>26&quot; 18&quot; 12&quot; 9&quot; 7&quot; — — —</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>48&quot; 34&quot; 21&quot; 15&quot; 12&quot; — — —</td>
<td></td>
</tr>
</tbody>
</table>

### UNIT WEIGHTS (lb)

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>UNIT WEIGHTS (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4</td>
<td>ZERO STROKE 0.67</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>ADDER PER INCH OF STROKE 0.04</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>1.52 0.07</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>4.12 0.12</td>
</tr>
</tbody>
</table>

*Total Stroke = Stroke Cylinder 1 (Total) + Stroke Cylinder 2 (3 Position Stroke)

### CYLINDER FORCE CALCULATIONS

Imperial

\[
F = P \times A
\]

- \(F\) = Cylinder Force lbs
- \(P\) = Operating Pressure psi
- \(A\) = Effective Area in² (Extend or Retract)

---

**Application & Sizing Assistance**

Use PHD’s free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)
**DIMENSIONS:** SERIES A3, A3V, H3V CYLINDERS; 3/4", 1", 1-1/8" BORE

### BASIC CYLINDER DIMENSIONS

- **B (MS9)**
  - 3X NT THREAD
  - 4X 0.219 DIA THRU

- **CF (MF2)**
  - 3X C'BORED HOLES FOR DB SHCS

- **F (MS8)**
  - 3X C'BORED HOLES FOR DB SHCS

- **L (MNR1)**
  - RM +0.000/-0.003 DIA

- **P (MP3)**
  - CD DIA THRU

### PORT POSITIONS:
- INDICATED BY CIRCLED NUMBERS

### CUSHIONS:
- ADD 0.500 in TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR CUSHIONS (ADD TOTAL OF 1.000 in TO OVERALL LENGTH)

### SHOCK PADS:
- ADD 0.250 in TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR SHOCK PADS (ADD TOTAL OF 0.500 in TO OVERALL LENGTH)

### DIMENSIONS COMMON TO ALL SERIES

#### BORE SIZE
- **3/4** 0.750
- **1** 1.000
- **1-1/8** 1.125

#### LETTER DIMENSION
- **BD**
- **D**
- **DB**
- **DF**
- **DN**
- **E**
- **EW**
- **FT**
- **NT**

### SERIES A3 CYLINDERS

#### BORE SIZE
- **3/4** 0.750
- **1** 1.000
- **1-1/8** 1.125

#### LETTER DIMENSION
- **AM**
- **CD**
- **KM**
- **LB**
- **P**
- **P1**
- **RM**
- **SD**
- **SD1**
- **SN**
- **V**
- **W1**
- **X1**
- **XT**
- **ZG**
- **ZJ**

### SERIES A3V CYLINDERS

#### BORE SIZE
- **3/4** 0.750
- **1** 1.000
- **1-1/8** 1.125

#### LETTER DIMENSION
- **AM**
- **CD**
- **KM**
- **LB**
- **P**
- **P1**
- **RM**
- **SD**
- **SD1**
- **SN**
- **V**
- **W1**
- **X1**
- **XT**
- **ZG**
- **ZJ**

### SERIES H3V CYLINDERS

#### BORE SIZE
- **3/4** 0.750
- **1** 1.000
- **1-1/8** 1.125

#### LETTER DIMENSION
- **AM**
- **CD**
- **KM**
- **LB**
- **P**
- **P1**
- **RM**
- **SD**
- **SD1**
- **SN**
- **V**
- **W1**
- **X1**
- **XT**
- **ZG**
- **ZJ**

All standard rod ends have four wrench flats (two wrench flats with "I" option).
DIMENSIONS: SERIES A3V, H3V CYLINDERS; 1-3/8" BORE

BASIC CYLINDER DIMENSIONS

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>B  (MS4)</td>
<td>4X 1/4-28 THREAD x 0.375 DP</td>
</tr>
<tr>
<td>CF  (MF2)</td>
<td>4X 0.281 DIA THRU</td>
</tr>
<tr>
<td>F  (MS2)</td>
<td>1-1/2-12 THREAD</td>
</tr>
<tr>
<td>T  (MN1)</td>
<td>8.515 + STROKE (CYL 1 &amp; CYL 2)</td>
</tr>
<tr>
<td>K  (MP1)</td>
<td>0.500 DIA THRU</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically toleranced.

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS
SHOCK PADS: ADD 0.250 in TO (+ STROKE) DIMENSIONS OF EACH CYLINDER 1 AND CYLINDER 2 (ADD A TOTAL OF 0.500 in TO OVERALL LENGTH)

All standard rod ends have four wrench flats (two wrench flats with “I” option).

PORT CONTROL®

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

ADJUSTABLE CUSHION

PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.

3/4", 1", 1-1/8” Series A3, A3V, H3V = Cushion Block
1-3/8” Series A3V, H3V = Poppet Style

Effective cushion length 1/2”

STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS
(3/4", 1", 1-1/8” Bore Series A3, A3V, and H3V Cylinders)

Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A3, A3V, and H3V. Consult PHD for special Port Control® or cushion needle positions.

PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION
(3/4", 1", 1-1/8” Bore Series A2, A3V, and H3V Cylinders)

Cushion and Port Control® combination arranged in series provides a compact efficient control system for maximum space weight and cost savings. The cushion is activated when the piston extension enters a seal in the cushion block. The remaining volume in the cylinder exhausts past an adjustable needle. A check seal in the adjusting needle is closed during deceleration, but opens to permit full flow for immediate reversing. The cushion seal in the block is an o-ring for air units.

POPPET STYLE

B SHOCK PADS

Polyurethane pads for absorption of shock and noise (not available on hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available together with all options EXCEPT:
• Same end as Cushion (-D)

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches:

COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

M REED SWITCHES

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches:

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

V FLUOROELASTOMER SEALS

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.


SELF-ALIGNING PISTON ROD COUPLERS

Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.


<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>250</td>
<td>1/4-28</td>
</tr>
<tr>
<td>312</td>
<td>5/16-24</td>
</tr>
<tr>
<td>375</td>
<td>3/8-24</td>
</tr>
<tr>
<td>437</td>
<td>7/16-20</td>
</tr>
</tbody>
</table>

To order, specify the model number.

All dimensions are reference only unless specifically toleranced.

### EYE BRACKET KIT

- **CD DIA THRU**: 0.750
- **0.500 DIA THRU**: 0.312
- **4X CB BORED HOLE FOR DD SHCS**

### ROD EYE KIT

- **CD DIA THRU**: 0.438
- **FT THREAD**: Thru

### CLEVIS BRACKET KIT - PIN INCLUDED

- **4X CB'ED HOLE FOR DD SHCS**
- **CD DIA THRU**: 0.312

### ROD CLEVIS KIT - PIN INCLUDED

- **CD DIA THRU**: 0.125
- **FT THREAD**: Thru

### EYE BRACKET KIT

- **0.500 DIA THRU**: 0.250
- **1.000 DIA**: 0.500

### ROD EYE KIT

- **0.625**: 0.438

### ROD CLEVIS KIT - PIN INCLUDED

- **0.500 DIA THRU**: 1.125

---

**BORE SIZE** | **CYLINDER SERIES** | **PART NO.** | **LETTER DIMENSION** |
---|---|---|---|
**A3, A3V, H3V** | **PART NO.** | **CA** | **CB** | **CC** | **CD** | **CD1** | **DD** | **E** | **FA** | **FL** | **L** |
| 3/4 | A3, A3V, H3V | 1077-01 | 0.750 | 0.248 | 0.500 | 0.250 | 0.250 | 1/4-28 x 0.375 DP |
| 1 | A3 | 1075-02 | 0.875 | 0.373 | 0.750 | 0.250 | 0.250 | 3/8-24 x 0.372 DP |
| 1-1/8 | A3V, H3V | 1075-04 | 0.875 | 0.373 | 0.750 | 0.250 | 0.250 | 3/8-24 x 0.375 DP |

*For 3/4 bore thru hole only.

---

**BORE SIZE** | **CYLINDER SERIES** | **PART NO.** | **LETTER DIMENSION** |
---|---|---|---|
**A3, A3V, H3V** | **PART NO.** | **CA** | **CB** | **CC** | **CD** | **CD1** | **DD** | **E** | **FA** | **FL** | **L** |
| 3/4 | A3, A3V, H3V | 12901 | 0.812 | 0.254 | 0.750 | 0.437 | 0.250 | 0.250 | #10 | 1.375 | 0.500 | 1.250 | 0.531 |
| 1 | A3 | 12906 | 0.875 | 0.373 | 0.750 | 0.562 | 0.250 | 0.250 | #10 | 1.375 | 0.500 | 1.250 | 0.531 |
| 1-1/8 | A3V, H3V | 12903 | 0.875 | 0.373 | 0.750 | 0.562 | 0.375 | 0.375 | 3/8-24 x 0.375 DP |

*For 3/4 bore thru hole only.

---

**BORE SIZE** | **CYLINDER SERIES** | **PART NO.** | **LETTER DIMENSION** |
---|---|---|---|
**A3, A3V, H3V** | **PART NO.** | **CA** | **CB** | **CC** | **CD** | **CD1** | **DD** | **E** | **FA** | **FL** | **L** |
| 3/4 | A3, A3V, H3V | 12904 | 0.812 | 0.254 | 0.750 | 0.250 | 0.250 | 1/4-28 TO SLOT |
| 1 | A3 | 12907 | 0.875 | 0.373 | 0.750 | 0.375 | 0.375 | 5/16-24 TO SLOT |
| 1-1/8 | A3V, H3V | 12905 | 0.875 | 0.373 | 0.750 | 0.375 | 0.375 | 3/8-24 TO SLOT |

**BORE SIZE** | **CYLINDER SERIES** | **PART NO.** | **LETTER DIMENSION** |
---|---|---|---|
**A3, A3V, H3V** | **PART NO.** | **FT** |
| 3/4 | A3, A3V, H3V | 12908 | 3/8-24 TO SLOT |
| 1 | A3V, H3V | 12909 | 3/8-24 TO SLOT |

---

All dimensions are reference only unless specifically tolerated.

Visit [www.phdinc.com/a3v](http://www.phdinc.com/a3v) • [800] 624-8511
**HEAVY DUTY CYLINDERS**

**Major Benefits**

- Designed to provide long life and high performance in applications requiring a more rugged, higher pressurized cylinder.
- Standard bore sizes include 3/4", 1-1/8", and 1-3/8".
- Standard stroke lengths range from 1/2" to 6" in 1/2" increments.
- Can be specified with built-in flow controls, cushions, shock pads, stroke adjustment, and magnetic piston for hall effect or reed switches.
- Wide range of options and sizes makes it fast and easy to select a cylinder to fit your application.
- The tie rod construction of the Tom Thumb® cylinders permit field repairing for extended life.
ORDERING DATA: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

**TO ORDER SPECIFY:**
Series, Mounting Style, Bore Size, Stroke, Port Controls, Cushions and Shock Pads, Oversize Rod, and Options.

**BORE SIZE**
- 3/4" BORE
- 3/8" Std. Rod Dia.
- 1/4-28 Thread
- 1-1/8" BORE
- 1/2" Std. Rod Dia.
- 3/8-24 Thread
- 1-3/8" BORE
- 5/8" Std. Rod Dia.
- 7/16-20 Thread

**BUILT-IN METER OUT FLOW CONTROL VALVE**
- P - Flow control on both ends
- PR - Flow control on head end
- Not available on MT1
- PC - Flow control on cap end
- Not available on MT2

**OVERSIZED ROD**
- 1-1/8 and 1-3/8" bore only. To be specified only when using a non-standard rod diameter. See page 1-114.

**MOUNTING STYLE**
- MS2 - Foot Mount through holes in head and cap
- MS4 - Bottom Mount, tapped holes in head and cap
- MF1 - Rod End Flange
- MF2 - Cap End Flange
- MT1 - Head Trunnion
- MT2 - Cap Trunnion
- MP1 - Clevis Mount, cap end with pin
- MR1 - Rod Mount, tapped holes on front face of head

**STANDARD STROKE LENGTHS**
- STOCK STROKE LENGTHS
  - 1/2" to 6"
  - In 1/2" increments
- Consult PHD for longer lengths.

**CUSHION OR SHOCK PAD**
- D - Cushions on both ends
- DR - Cushion on rod end
- DC - Cushion on cap end
- B - Shock Pads on both ends
- BR - Shock Pad on rod end
- BC - Shock Pad on cap end
- (Cushions and Shock Pads are not available on the same end of cylinder. Shock Pads are not available for hydraulic use.)

**OPTIONS**
- A - Stroke Adjustment (1/2" standard)
- E - Magnetic Piston for PHD Hall Effect Switches (Series EA and EL only)
- F - #1 Rod End (see note 1)
- I - #4 Rod End, female thread on rod (see note 1)
- J - #2X Rod End, twice as long as standard thread (see note 1)
- _K - Extra Rod Extensions (see note 2)
- L - Coarse Thread Rod End (see note 1)
- M - Magnetic Piston for PHD Reed Switches (Series EA and EL only)
- N - Plain Rod End (see note 1)
- R - Port in Position 2
- T - Port in Position 3
- U - Port in Position 4
- V - Fluoroelastomer Seals
- W - Close Tolerance Stroke, ±0.005 stroke length
- Y - SAE Ports on Series EH and ES Cylinders
- Z1 - Electroless Nickel Plate all ferrous parts excluding rod ends

**NOTES:**
1) For double rod cylinders, rod end options will be applied to both ends of cylinder.
2) For double rod cylinders, _K extension will be applied to one end only (head end/primary mounting end).

**CAUTION:** Options may affect unit length. See dimensional pages and option information details.

**PROXIMITY SWITCH MOUNTING BRACKETS**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>BORE</th>
<th>SIZE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA, EL</td>
<td>3/4&quot;</td>
<td>-35</td>
</tr>
<tr>
<td></td>
<td>1-1/8&quot;</td>
<td>-36</td>
</tr>
<tr>
<td></td>
<td>1-3/8&quot;</td>
<td>-37</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete ordering information. Switch brackets must be ordered separately.

**COMPACT HALL EFFECT SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

**COMPACT REED SWITCHES**

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

**CAD & Sizing Assistance**

Use PHD’s free online Product Sizing and CAD Configurator at [www.phdinc.com/myphd](http://www.phdinc.com/myphd)
### ENGINEERING DATA: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>SERIES EA</th>
<th>SERIES EL</th>
<th>SERIES EH</th>
<th>SERIES ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rod Seals</td>
<td>Single block vee</td>
<td>(2) Block vee with back-up ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston Seals</td>
<td>(2) Block vee</td>
<td>(2) Block vee with back-up ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube Seals</td>
<td>O-ring</td>
<td>O-ring with back-up ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod Wiper</td>
<td>Nitrile rod wiper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston Rod</td>
<td>Hardchrome plated high strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>steel 100,000 psi min. yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod Bushing</td>
<td>Cast iron rod cartridge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder Barrel</td>
<td>Hardcoated aluminum</td>
<td></td>
<td>Zinc-plated steel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Honed steel</td>
<td></td>
<td>Heat treated stainless steel</td>
<td></td>
</tr>
<tr>
<td>End Caps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pistons Rod</td>
<td>Hardchrome plated high strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>steel 100,000 psi min. yield</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod Wiper</td>
<td>Nitrile rod wiper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>Permanently lubricated for non-lube air</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working Pressure</td>
<td>150 psi air max.</td>
<td>500 psi hyd. max.</td>
<td>3000 psi hyd. max.</td>
<td>5000 psi hyd. max.</td>
</tr>
<tr>
<td>Standard Strokes</td>
<td>1/2’ to 6’ in 1/2’ increments (longer strokes available, consult PHD)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### CYLINDER FORCE (TABLE 1)

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER BORE</th>
<th>ROD DIAMETER</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE lb/psi</th>
<th>FREE AIR CONSUMPTION 80 lbs CUBIC ft/in OF STROKE</th>
<th>DISPLACEMENT gal/in OF STROKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA, EL, EH, ES</td>
<td>3/4</td>
<td>3/8</td>
<td>Push</td>
<td>0.442</td>
<td>0.0016</td>
<td>0.0019</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>1/2</td>
<td>Push</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
</tr>
<tr>
<td></td>
<td>1-1/8</td>
<td>5/8</td>
<td>Push</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>5/8</td>
<td>Push</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0065</td>
</tr>
<tr>
<td></td>
<td>1-3/8</td>
<td>3/4</td>
<td>Push</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0065</td>
</tr>
</tbody>
</table>

**NOTE:** Use the Pull figures for calculating double rod cylinder forces in both directions.

#### MAXIMUM ALLOWABLE PUSH FORCE (TABLE 2)

<table>
<thead>
<tr>
<th>SERIES</th>
<th>CYLINDER FORCE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>27” 19” 12” 8” 7” 6” 5” 4”</td>
</tr>
<tr>
<td>1-1/8</td>
<td>48” 34” 21” 15” 12” 11” 9” 7”</td>
</tr>
<tr>
<td>1-3/8 AV, HV</td>
<td>74” 53” 33” 24” 19” 17” 14” 11”</td>
</tr>
<tr>
<td>3/4</td>
<td>107” 76” 48” 34” 28” 24” 20” 15”</td>
</tr>
</tbody>
</table>

### Application & Sizing Assistance

Use PHD’s free online Product Sizing Application at [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)
LUBRICATION - HYDRAULIC FLUIDS
All air units are permanently lubricated at the factory and can be used for non-lubricated air service. Static and dynamic seals are compatible with standard petroleum-based oil used for lubrication of air cylinders or as a power source for hydraulic cylinders. For service with other lubricants or hydraulic media, please specify to insure proper seals are supplied.

TEMPERATURE LIMITS - SEALS
All series have Nitrile seals and rod wipers for general use between -20° and +180°F. Consult PHD for higher temperatures.

HOW TO DETERMINE BORE AND PISTON SIZE
1. Determine stroke and force required.
2. Calculate the force (lb) produced by using the effective area figures in Table 1 on page 1-107 and multiplying them times the operating pressure (psi).
3. Check Table 2 on page 1-107 to verify that rod size is sufficient for force. If stroke required is greater than length listed in Table 2, increase rod diameter or go to larger bore size.

NOTE: Table 2 shows maximum stroke lengths for mounting styles MS2, MS4, MR1, MF1, MF2 fastened to rigid base.

For mounting style MP1; divide table value by 2.
For mounting styles MT1, and MT2; divide table value by 1.75.

To avoid excessive wear on rod bushings and seals, it is recommended that cylinders with strokes exceeding the following lengths be equipped with 1” long stop tubes or stopped externally 1” short of full push stroke.

<table>
<thead>
<tr>
<th>Bore x Stroke</th>
<th>3/4” Bore x 8”</th>
<th>1-1/8” Bore x 12”</th>
<th>1-3/8” Bore x 18”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BREAKAWAY
The breakaway pressure for all pneumatic cylinders is 20 psi at zero load. The breakaway pressure for all hydraulic cylinders is 40 psi at zero load.

MAXIMUM WORKING PRESSURES

<table>
<thead>
<tr>
<th>SERIES</th>
<th>AIR MAX. psi</th>
<th>HYDRAULIC MAX. psi</th>
<th>WITH -E OR -M OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>150</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>EL</td>
<td>—</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>EH</td>
<td>—</td>
<td>3000</td>
<td>—</td>
</tr>
<tr>
<td>ES</td>
<td>—</td>
<td>5000</td>
<td>—</td>
</tr>
</tbody>
</table>

STROKE TOLERANCE
Tolerance on the nominal stroke length is ±0.032 for all cylinders.
DIMENSIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

BASIC CYLINDER DIMENSIONS

All standard rod ends have four wrench flats (two wrench flats with “I” option).

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>1-1/8</td>
<td></td>
</tr>
<tr>
<td>1-3/8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>1-1/8</td>
<td></td>
</tr>
<tr>
<td>1-3/8</td>
<td></td>
</tr>
</tbody>
</table>

| PORT POSITIONS: INDICATED BY CIRCLED NUMBERS. |
| CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS. |
| SHOCK PADS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF SHOCK PADS |
| "MS4 MTG. STYLE: UNITS WITH OPTION -R OR -U WITH/-P. THE NT THREAD SIZE AND DEPTH WILL BE REDUCED AS FOLLOWS: 3/4" BORE NOT AVAILABLE WITH -R OR -U WITH/-P. 1-1/8" BORE NT=10-32 x 0.19, 1-3/8" BORE NT=1/4-28 x 0.25 |

All dimensions are reference only unless specifically tolerated.

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PDV3
**DIMENSIONS: SERIES DEA, DEL, DEH, DES HEAVY DUTY CYLINDERS**

### BASIC CYLINDER DIMENSIONS

![Diagram of cylinder dimensions]

**MS4**

- 4X NT* THREAD
- 4X FB DIA THRU

**MR1**

- 4X RT THREAD
- BD SQ

**MS2**

- 4X FB DIA THRU

**MT1**

- TD +0.000/-0.001 DIA BOTH SIDES

**MF1**

- 4X FB DIA THRU

---

All standard rod ends have four wrench flats (two wrench flats with “I” option).

---

**BORE**

<table>
<thead>
<tr>
<th>SIZE</th>
<th>A</th>
<th>BD</th>
<th>D</th>
<th>E</th>
<th>EE</th>
<th>F</th>
<th>FB</th>
<th>FT</th>
<th>GA</th>
<th>K</th>
<th>LB</th>
<th>MM</th>
<th>NT*</th>
<th>P</th>
<th>R</th>
<th>RM</th>
<th>RT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>0.750</td>
<td>1.000</td>
<td>0.312</td>
<td>1.375</td>
<td>1/4</td>
<td>0.312</td>
<td>0.219</td>
<td>1/4-28</td>
<td>1.812</td>
<td>0.000</td>
<td>4.687</td>
<td>0.375</td>
<td>10-32 x 0.25 DP</td>
<td>2.188</td>
<td>0.938</td>
<td>0.750</td>
<td>10-32 x 0.25 DP</td>
</tr>
<tr>
<td>1-1/8</td>
<td>0.750</td>
<td>1.250</td>
<td>0.438</td>
<td>1.750</td>
<td>1/4</td>
<td>0.500</td>
<td>0.281</td>
<td>3/8-24</td>
<td>2.188</td>
<td>0.250</td>
<td>5.437</td>
<td>0.500</td>
<td>1/4-28 x 0.31 DP</td>
<td>2.312</td>
<td>1.250</td>
<td>1.000</td>
<td>1/4-28 x 0.50 DP</td>
</tr>
<tr>
<td>1-3/8</td>
<td>0.750</td>
<td>1.625</td>
<td>0.562</td>
<td>2.250</td>
<td>3/8</td>
<td>0.500</td>
<td>0.344</td>
<td>7/16-20</td>
<td>2.625</td>
<td>0.312</td>
<td>6.312</td>
<td>0.625</td>
<td>5/16-24 x 0.50 DP</td>
<td>2.438</td>
<td>1.625</td>
<td>1.250</td>
<td>5/16-24 x 0.62 DP</td>
</tr>
</tbody>
</table>

---

**PORT POSITIONS:** INDICATED BY CIRCLED NUMBERS.

- **CUSHIONS:** CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS. MT1 (-DR) CUSHION NEEDLES ARE IN POSITION 3.
- **SHOCK PADS:** CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF SHOCK PADS.
- **MS2 MTG. STYLE:** NOT AVAILABLE ON 1-1/8" & 1-3/8" SERIES ES CYLINDERS.
- **MS4 MTG. STYLE:** UNITS WITH OPTION -R OR -U WITH/-P. THE NT THREAD SIZE AND DEPTH WILL BE REDUCED AS FOLLOWS: 3/4" BORE NOT AVAILABLE WITH -R OR -U WITH/-P. 1-1/8" BORE NT=10-32 x 0.19, 1-3/8" BORE NT=1/4-28 x 0.25

---

All dimensions are reference only unless specifically tolerated.
**OPTIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS**

**PORT CONTROL®**  
Not available with -Y SAE ports option

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

**STANDARD PORT CONTROL AND CUSHION NEEDLE POSITIONS**

Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.

**ADJUSTABLE CUSHION**

PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.  
Series E = Poppet Style

**PORT CONTROL AND ADJUSTABLE CUSHION COMBINATION**

The cushion and Port Control® combination is also available. This cushion is activated when a seal, which is traveling with the piston, seals against the cylinder end cap. This causes the remaining volume in the cylinder to exhaust past an adjustable needle which controls the amount of deceleration. The spring, which extends the seal from the piston, permits the seal to act as a check valve to allow full flow back into the cylinder for immediate reversing. The cushion seal for air units is made of urethane while seals for oil units are close tolerance metal.

**SHOCK PADS**

Polyurethane pads for absorption of shock and noise (not available on hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available together with all options EXCEPT:  
- Same end as Cushion  
- Same end as Stroke Adjustment
OPTIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

A CYLINDER STROKE ADJUSTMENT

Stroke adjustment screws are available to decrease the retraction stroke. The standard adjusting range is 1/2 inch. Longer adjusting lengths are available on request.

Available with all options EXCEPT:
- Cushion on the cap end
- Shock pad on the cap end
- Pivot Mount

---

PORT POSITIONS

Port position 1 is standard on all cylinders.

PORT POSITION 1 (STANDARD)

PORT POSITION 2

PORT POSITION 3

PORT POSITION 4

---

Y SAE PORTS FOR SERIES EH AND ES 3/4”, 1-1/8”, 1-3/8” BORE

SAE Ports are available on Series EH and ES Hydraulic Cylinders. Port locations are the same as the NPT ports. Port sizes are shown to right.

---

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES AVAILABLE ON SERIES EA & EL ONLY

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches:

COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

M REED SWITCHES AVAILABLE ON SERIES EA & EL ONLY

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches:

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches must be ordered separately. See Switches and Sensors section for complete switch information.

---

All dimensions are reference only unless specifically tolerated.
**OPTIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS**

**V** FLUOROELASTOMER SEALS

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

**Z1** ELECTROLESS NICKEL PLATING

Electroless nickel plating is done on all externally exposed ferrous parts except rods and rod end, or parts made of stainless steel or aluminum. This optional plating treatment gives an alternative method of protecting the cylinder from severe environments.

**NOTE:** Standard plating is Brite Zinc.

**W** CLOSE TOLERANCE STROKE

This option may be specified when a precise stroke length is required and stroke adjustment is not acceptable. By specifying this option, a stroke length with a tolerance of ±0.005 will be supplied. Standard stroke tolerance is ±0.032.

Maximum stroke for cylinders with close tolerance is 18”.

**NOTE:** This option is not available with shock pads (-B).

**ACCESSORIES: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS**

**SELF-ALIGNING PISTON ROD COUPLERS**

Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32” lateral misalignment on push and pull stroke. (Miniature Couplers compensate for 1° of angular error.)

Couplers provide greater reliability and reduce cylinder and component wear, simplifying alignment problems in the field.

Rod Couplers are manufactured from high tensile and hardened steel components.

To order, specify the model number.

**MODEL NO.**

<table>
<thead>
<tr>
<th>NO.</th>
<th>LETTER DIMENSION</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>1/4-28</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.156</td>
<td></td>
</tr>
<tr>
<td>312</td>
<td>5/16-24</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.187</td>
<td></td>
</tr>
<tr>
<td>375</td>
<td>3/8-24</td>
<td>1.000</td>
<td>0.625</td>
<td>1.875</td>
<td>0.500</td>
<td>0.875</td>
<td>0.219</td>
<td></td>
</tr>
<tr>
<td>437</td>
<td>7/16-20</td>
<td>1.125</td>
<td>0.750</td>
<td>2.187</td>
<td>0.500</td>
<td>1.000</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>1/2-20</td>
<td>1.125</td>
<td>0.750</td>
<td>2.187</td>
<td>0.500</td>
<td>1.000</td>
<td>0.312</td>
<td></td>
</tr>
<tr>
<td>625</td>
<td>5/8-18</td>
<td>1.750</td>
<td>1.125</td>
<td>3.312</td>
<td>0.812</td>
<td>1.562</td>
<td>0.375</td>
<td></td>
</tr>
<tr>
<td>750</td>
<td>3/4-16</td>
<td>1.750</td>
<td>1.125</td>
<td>3.312</td>
<td>0.812</td>
<td>1.562</td>
<td>0.421</td>
<td></td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.

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**ACCESSORIES: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS**

### BORE SIZE

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>2414-01</td>
<td>0.375 0.375 0.750 1/4-28 0.562</td>
</tr>
<tr>
<td>1-1/8</td>
<td>12909</td>
<td>0.500 0.500 1.125 0.500 0.906 7/16-20 0.812</td>
</tr>
<tr>
<td>1-3/8</td>
<td>12915</td>
<td>0.625 0.625 1.375 0.625 1.812 9/16-18 0.912</td>
</tr>
</tbody>
</table>

### COARSE THREAD ROD END

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>2415-01</td>
<td>0.281 0.281 1.750 2.250 0.500 3.625 1.500</td>
</tr>
<tr>
<td>1-1/8</td>
<td>2415-02</td>
<td>0.281 0.281 2.000 2.500 1.750 3.250 4.000 1.750</td>
</tr>
<tr>
<td>1-3/8</td>
<td>2415-03</td>
<td>0.344 2.252 0.625 1.375 2.250 4.000 4.875 5.000</td>
</tr>
</tbody>
</table>

### ACCESSORIES: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

- **F ROD END STYLE #1**
- **I ROD END STYLE #4**
- **J ROD END STYLE #2X**
- **L COARSE THREAD ROD END**

### CLEVIS BRACKET - PIN INCLUDED

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4</td>
<td>2412-01</td>
<td>0.375 0.375 0.750 1/4-28 0.562</td>
</tr>
<tr>
<td>1-1/8</td>
<td>1375-01</td>
<td>0.500 0.500 1.125 0.500 0.906 7/16-20 0.812</td>
</tr>
<tr>
<td>1-3/8</td>
<td>2412-02</td>
<td>0.625 0.625 1.375 0.625 1.812 9/16-18 0.912</td>
</tr>
</tbody>
</table>

### E SERIES MOUNTING ATTACHMENTS

- **EYE BRACKET**
- **ROD CLEVIS - PIN INCLUDED**
- **TRUNNION BRACKET**

All dimensions are reference only unless specifically tolerated.

---

www.phdinc.com/ea_el_eh_es • (800) 624-8511
1-1/8" & 1-3/8" BORE NON-ROTATING HYDRAULIC & PNEUMATIC TIE ROD CYLINDERS

Major Benefits

- Non-rotating piston rod for consistent tooling position
- Piston rod provides superior sealing performance
- Repairable construction for extended life and long term savings
- Precision non-rotating rod adjustable design
- Long life design for low maintenance
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation

Series NP
Cutaway depicts a 1-1/8" bore NPG unit.

- Zinc-plated alloy steel heads and caps for durability
- Alloy steel non-rotating components to ensure long life
- Optional magnetic piston for use with PHD switches (not available on Series NHG)
- Anodized aluminum tube for long seal life and smooth motion
- Pressure and wear compensating long life Nitrile piston seals
- Pressure and wear compensating long life Nitrile rod seal
- Long life bronze bushing
- Hard chrome plated steel DOM tube rod for long rod seal life

www.phdinc.com/npg-nhg • (800) 624-8511
ORDERING DATA: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

TO ORDER SPECIFY:
Spring Return, Series, Mounting Style, Bore Size, Stroke, and Options.

SPRING RETURN
SC - Spring on cap end
SR - Spring on rod end
(Spring Return available on Series NPG Cylinders up to 3" of stroke in 1/4" increments.)

MOUNTING STYLE
MF1 - Head End Flange
MF2 - Cap End Flange
MT1 - Head Trunnion
MP1 - Clevis Mount, cap end
(furnished with pin)
MR1 - Rod Mount, tapped holes
front face of head
MS9 - Bottom Mount - 3 holes total,
tapped in head and cap
MS10 - Side Tab Mount with c bore
and through holes
MN1 - Threaded Nose on head
(shipped with mounting nut)

STANDARD STROKE LENGTHS
STOCK STROKE LENGTHS
1/2' to 18'
in 1/2' increments
Longer strokes available, consult PHD.

SHOCK PAD
B - Shock Pads on both ends
BR - Shock Pad on rod end
BC - Shock Pad on cap end
Shock Pads and Spring Return
are not available on the same
end of cylinder. Shock Pads are
not available for Hydraulic use.

OPTIONS
E - Magnetic Piston for PHD Hall Effect Switches
(not applicable on Series NHG)
H - Plain keyed rod end
M - Magnetic Piston for PHD Reed Switches
(not applicable on Series NHG)
N - Plain Rod End
S - Keyed and Threaded Rod End
V - Fluoroelastomer Seals
W - Close Tolerance Stroke, ±0.005 Stroke Length
Z1 - Electroless Nickel Plate all ferrous parts

CYLINDER SERIES
NPG - 150 psi Air
NHG - 1500 psi Hydraulic

BORE SIZE
1-1/8" BORE
5/8" Rod Dia.
7/16-20 Threads
1-3/8" BORE
3/4" Rod Dia.
9/16-18 Threads

PORT CONTROL®
BUILT-IN METER
OUT FLOW
CONTROL VALVE
P - Flow control both ends
PR - Flow control on head end
PC - Flow control on cap end

NOTE:
SAE Ports available. Consult PHD for sizes.

PROXIMITY SWITCH MOUNTING BRACKETS

<table>
<thead>
<tr>
<th>SERIES</th>
<th>BORE SIZE</th>
<th>SIZE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPG, NHG</td>
<td>1-1/8&quot;</td>
<td>-33</td>
</tr>
<tr>
<td>NPG, NHG</td>
<td>1-3/8&quot;</td>
<td>-36</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete ordering information.

COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

Switches are ordered separately

Cad & Sizing Assistance
Use PHD's free online Product Sizing and CAD Configurator at www.phdinc.com/myphd
ENGINEERING DATA: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

SPECIFICATIONS

<table>
<thead>
<tr>
<th>OPERATING PRESSURE</th>
<th>SERIES NPG</th>
<th>SERIES NHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Pressure</td>
<td>20 to 150 psi air</td>
<td>40 to 1500 psi hyd*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPERATING TEMPERATURE</th>
<th>SERIES NPG</th>
<th>SERIES NHG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-20° to +180°F [-29° to +82°C]</td>
<td>-20° to +180°F [-29° to +82°C]</td>
</tr>
</tbody>
</table>

| STROKE TOLERANCE       | ±0.032     | ±0.032     |
| REPEATABILITY          | ±0.001 of original position | ±0.001 of original position |
| LUBRICATION            | Permanently lubricated | — |
| MAINTENANCE            | Field repairable | Field repairable |

*Hydraulic rating is based on non-shock hydraulic service.

CYLINDER FORCE AND WEIGHT TABLE

<table>
<thead>
<tr>
<th>BORE DIA (in)</th>
<th>ROD DIAMETER (in)</th>
<th>ROD DIRECTION</th>
<th>EFFECTIVE AREA FORCE (lb/psi)</th>
<th>AIR CONSUMPTION at 80 psi (cubic ft/in of STROKE)</th>
<th>DISPLACEMENT gal/in OF STROKE*</th>
<th>BASE WEIGHT</th>
<th>ADDER PER 1&quot; OF STROKE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>1-1/8</td>
<td>EXTEND</td>
<td>0.994</td>
<td>0.0037</td>
<td>0.0043</td>
<td>1.55</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RETRACT</td>
<td>0.687</td>
<td>0.0026</td>
<td>0.0300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3/8</td>
<td>1-3/8</td>
<td>EXTEND</td>
<td>1.485</td>
<td>0.0055</td>
<td>0.0064</td>
<td>2.16</td>
<td>0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RETRACT</td>
<td>1.043</td>
<td>0.0039</td>
<td>0.0045</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MAXIMUM ALLOWABLE EXTEND STROKE

<table>
<thead>
<tr>
<th>BORE DIA (in)</th>
<th>ROD DIAMETER (in)</th>
<th>CYLINDER FORCE (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>1-1/8</td>
<td>1-1/8</td>
<td>44</td>
</tr>
<tr>
<td>1-3/8</td>
<td>1-3/8</td>
<td>44</td>
</tr>
</tbody>
</table>

CYLINDER FORCE CALCULATIONS

Imperial

\[
F = P \times A
\]

F = Cylinder Force (lbs)
P = Operating Pressure (psi)
A = Effective Area (in²) (Extend or Retract)

Application & Sizing Assistance

Use PHD’s free online Product Sizing Application at www.phdinc.com/apps/sizing

www.phdinc.com/npg-nhg • (800) 624-8511
**ENGINEERING DATA: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE**

**SIDELOADING**
Care should be taken to consider allowable side load versus stroke in the same manner as standard cylinders, including stop tubes and transverse support members as needed. Where appreciable side loads are expected, the use of powered slides, shown in the slide section of this catalog, is recommended. Rod deflection may be calculated according to the formula at right.

**TORSION AND BACKLASH**
Clearance between spline and broached teeth in piston is less than 1/2°. Additional deflection caused by rotational moments can be calculated using the following formula:

\[
\theta = \left( \frac{L_1}{K_1} + \frac{L_2}{K_2} + C \right)
\]

**MAXIMUM ALLOWABLE TORQUE**
Table shows maximum recommended torsional loads which may be applied to piston rod without spline rotating relative to cylinder cap. Safety factor equals approximately 4:1. Cylinder will encounter fractional losses due to torsional loads.

**WHERE:**
- \( \theta \) = Angular deflection in minutes of arc
- \( T \) = Torque applied (in/lb)
- \( L_1 \) = Distance that rod is extended
- \( L_2 \) = Stroke length
- \( K_1 \) = Constant reflecting the polar moment of inertia and the modulus of rigidity for the spline rod
- \( K_2 \) = Constant reflecting the polar moment of inertia and the modulus of rigidity for the piston rod
- \( C \) = Constant value of deflection on spline and piston rod regardless of piston position

---

**Bores and C Values**

<table>
<thead>
<tr>
<th>Bore</th>
<th>Series</th>
<th>C Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>NP</td>
<td>470.000</td>
</tr>
<tr>
<td>1-3/8</td>
<td>NP</td>
<td>990.000</td>
</tr>
</tbody>
</table>

**Formula for Deflection at Rod End**

\[
D = \frac{W \times L^2}{C}
\]

- \( D \) = Deflection at rod end
- \( W \) = Sideload in pounds
- \( L \) = Distance in inches from bushing to applied sideload

---

**Maximum Torque Values**

<table>
<thead>
<tr>
<th>Bore</th>
<th>Max. Torque</th>
<th>Tightening Torque on Jam Screws</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>48</td>
<td>85</td>
</tr>
<tr>
<td>1-3/8</td>
<td>72</td>
<td>85</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.
DIMENSIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

BASIC CYLINDER DIMENSIONS

All standard rod ends have four wrench flats (two wrench flats with “I” option).

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>A</th>
<th>BD</th>
<th>CB</th>
<th>CC</th>
<th>CD</th>
<th>CL</th>
<th>D</th>
<th>DB</th>
<th>E</th>
<th>FB</th>
<th>FT</th>
<th>KM</th>
<th>L</th>
<th>M</th>
<th>MM</th>
<th>MR</th>
<th>NT</th>
<th>R</th>
<th>RM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>0.750</td>
<td>1.125</td>
<td>0.375</td>
<td>0.875</td>
<td>0.375</td>
<td>0.875</td>
<td>0.500</td>
<td>#10</td>
<td>1.500</td>
<td>0.219</td>
<td>7/16-20</td>
<td>1-1/4-12</td>
<td>0.750</td>
<td>0.375</td>
<td>0.625</td>
<td>0.440</td>
<td>10-32 x 0.25 DP</td>
<td>1.000</td>
<td>1.250</td>
</tr>
<tr>
<td>1-3/8</td>
<td>1.000</td>
<td>1.375</td>
<td>0.500</td>
<td>1.250</td>
<td>0.500</td>
<td>1.125</td>
<td>0.625</td>
<td>1/4</td>
<td>1.750</td>
<td>0.281</td>
<td>9/16-18</td>
<td>1-1/2-12</td>
<td>0.625</td>
<td>0.500</td>
<td>0.750</td>
<td>0.720</td>
<td>1/4-28 x 0.38 DP</td>
<td>1.250</td>
<td>1.500</td>
</tr>
</tbody>
</table>

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
SHOCK PADS: ADD 0.250 IN TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)

All dimensions are reference only unless specifically tolerated.
OPTIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

SR  SC  SPRING RETURN

All standard NP Cylinders from 1/4" to 3" of stroke can be built with internal springs to return or extend the piston rod in single acting applications. The standard spring provides a preload and a spring rate per chart below. Other spring combinations will be quoted on request.

Available with all options EXCEPT:
- Cushion on the spring end
- Shock pad on the spring end
- Stroke adjustment on the spring end

<table>
<thead>
<tr>
<th>STROKE</th>
<th>PRELOAD RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot;-3&quot;</td>
<td>4 lb  7 lb/in</td>
</tr>
<tr>
<td>3-1/4&quot;-6&quot;</td>
<td>2 lb  3-1/2 lb/in</td>
</tr>
</tbody>
</table>

W  CLOSE TOLERANCE STROKE

This option may be specified when a precise stroke length is required and stroke adjustment is not acceptable. By specifying this option, a stroke length with a tolerance of ±0.005 will be supplied. Standard stroke tolerance is ±0.032.

Maximum stroke for cylinders with close tolerance is 18".

NOTE: This option is not available with shock pads (-B).

H  PLAIN KEYED ROD ENDS

All standard rod ends have four wrench flats.

N  PLAIN ROD END

S  KEYED AND THREADED ROD ENDS

KEYWAY ORIENTATION: FULLY ADJUSTABLE
KEY: INCLUDED FOR "D" KEYWAY

All dimensions are reference only unless specifically tolerated.

www.phdinc.com/npg-nhg  •  (800) 624-8511
OPTIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

HALL EFFECT SWITCHES

PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches:

COMPACT HALL EFFECT SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17503-2-06</td>
<td>NPN Type 10-30 VDC</td>
</tr>
<tr>
<td>17504-2-06</td>
<td>PNP Type 10-30 VDC</td>
</tr>
<tr>
<td>17523-2</td>
<td>NPN Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17524-2</td>
<td>PNP Type 10-30 VDC, Quick Connect</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete switch information.

REED SWITCHES

The PHD Magnetic Reed Switches may be used in situations where the Hall Effect Switches are not applicable. As with the Hall Effect Switches, a magnetic band (specify -M) on the piston activates the externally mounted PHD Reed Switches. The Reed Switches may be used to signal a programmable controller, sequencer, relay, or in some cases, a valve solenoid. This option is for use with the following switches:

COMPACT REED SWITCHES

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>17502-2-06</td>
<td>Sink or Source Type 10-30 VDC</td>
</tr>
<tr>
<td>17509-3-06</td>
<td>AC Type 110-120 VAC with Current Limit</td>
</tr>
<tr>
<td>17522-2</td>
<td>Sink or Source Type 10-30 VDC, Quick Connect</td>
</tr>
<tr>
<td>17529-3</td>
<td>AC Type 110-120 VAC, Quick Connect with Current Limit</td>
</tr>
</tbody>
</table>

See Switches and Sensors section for complete switch information.

PORT CONTROL®

The exclusive PHD Port Control®, based on the “meter-out” principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

SHOCKPADS

Polyurethane pads for absorption of shock and noise (not available on hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available with all options EXCEPT:
- Same end as Cushion
- Spring end of Spring Return cylinder
- Same end as Stroke Adjustment

FLUOROElastomer sealS

Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

Electroless nickel plating is done on all externally exposed ferrous parts except rods and rod end, or parts made of stainless steel or aluminum. This optional plating treatment gives an alternative method of protecting the cylinder from severe environments.

NOTE: Standard plating is Brite Zinc.
ACCESSORIES: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

**EYE BRACKET KIT**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>CYLINDER SERIES</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>NPG, NHG</td>
<td>2412-01</td>
<td>1.000 0.375 0.375 0.219 1.375 0.812 1.125 0.750</td>
</tr>
<tr>
<td>1-3/8</td>
<td>NPG, NHG</td>
<td>1330</td>
<td>1.375 0.500 0.500 0.281 1.875 0.875 1.250 1.000</td>
</tr>
</tbody>
</table>

**ROD EYE KIT**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>PART NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>2414-02</td>
<td>7/16-20 x 1.00 DP</td>
</tr>
<tr>
<td>1-3/8</td>
<td>2414-03</td>
<td>9/16-18 x 1.00 DP</td>
</tr>
</tbody>
</table>

**ROD CLEVIS KIT - PIN INCLUDED**

<table>
<thead>
<tr>
<th>BORE SIZE</th>
<th>KIT NO.</th>
<th>LETTER DIMENSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/8</td>
<td>12914</td>
<td>7/16-20</td>
</tr>
<tr>
<td>1-3/8</td>
<td>12915</td>
<td>9/16-18</td>
</tr>
</tbody>
</table>

All dimensions are reference only unless specifically tolerated.