

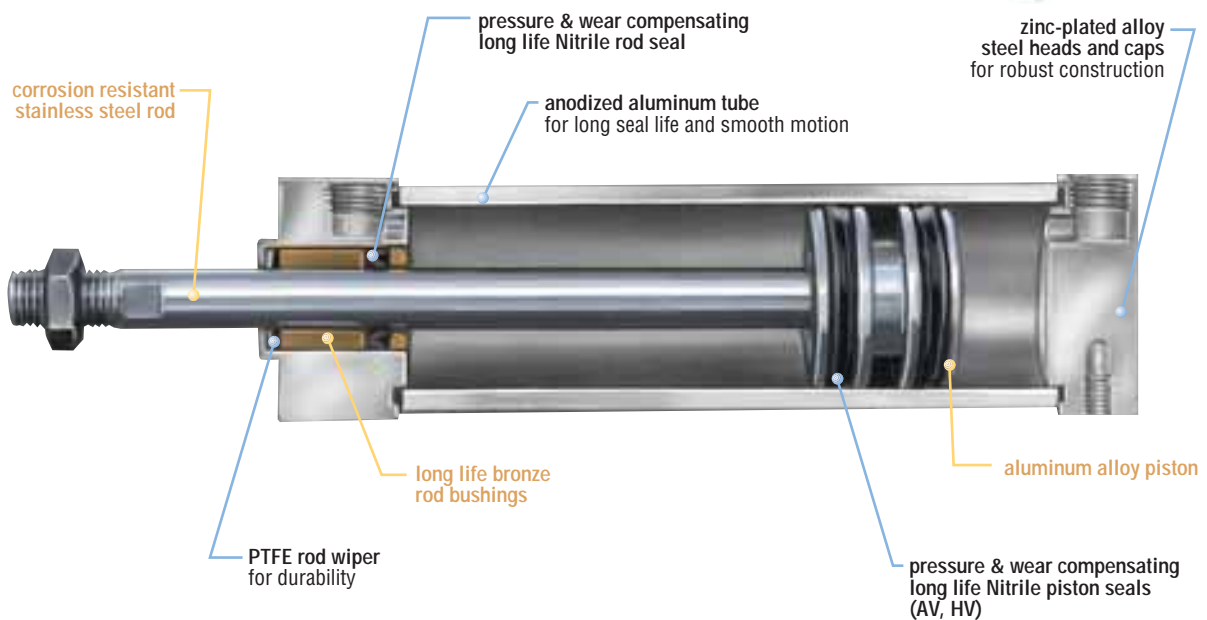
# AV, HV, A



tom thumb®

AV, HV, A

## TIE ROD CYLINDERS 3/4", 1", AND 1-1/8" BORE WITH A WIDE VARIETY OF STYLES AND OPTIONS



SERIES AV



SERIES HV  
Hydraulic Service



SERIES A  
Shortest Length

### 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
- Two working day delivery
- Wide range of mounting styles for easy installation

### Industry Uses

- Packaging
- Assembly machines
- Machine loading/unloading
- General industrial automation

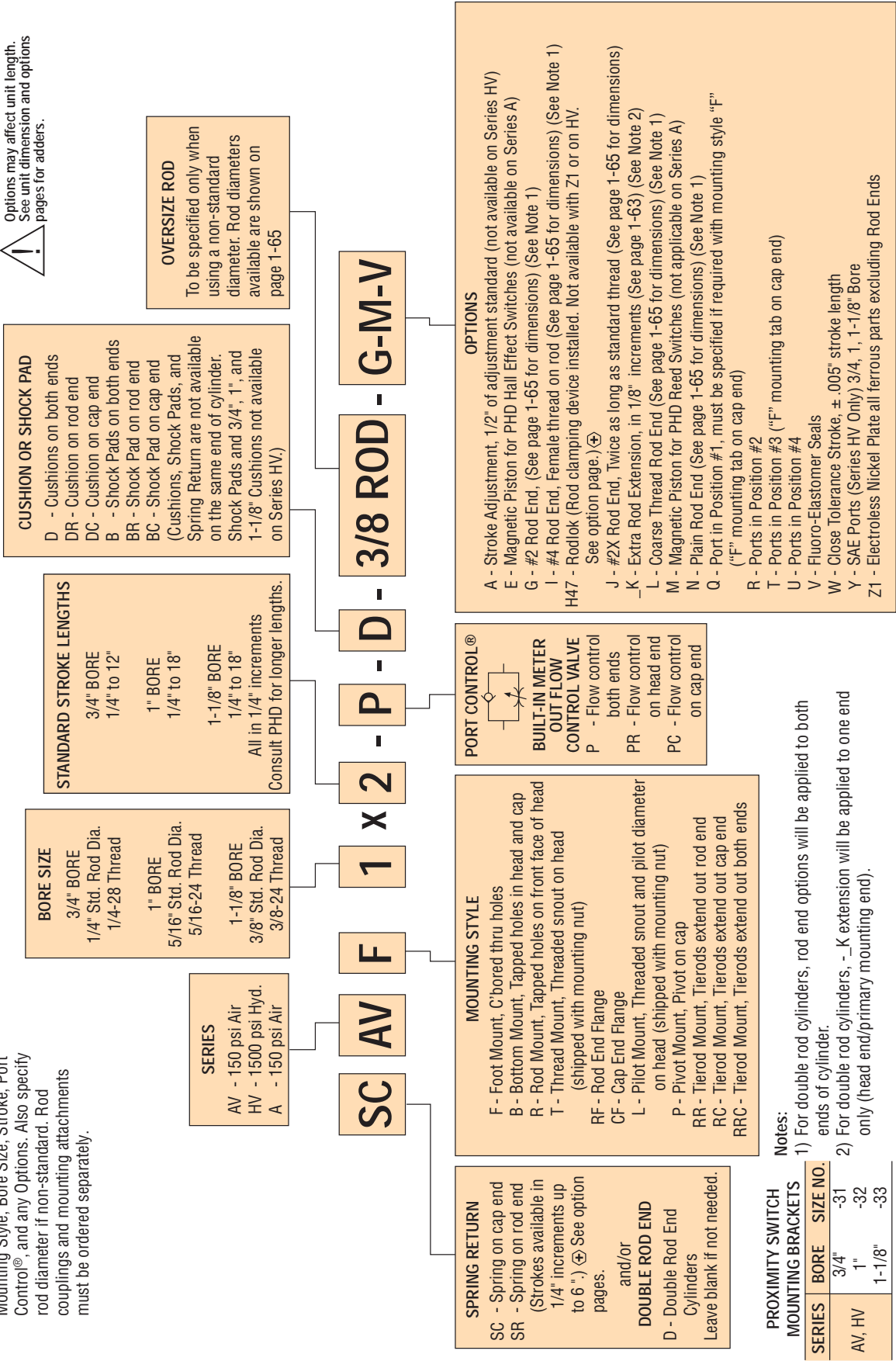
ORDERING DATA: SERIES A, AV, HV, 3/4", 1", 1-1/8" BORE

AV, HV, A

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 may affect unit length. See unit dimension and options pages for adders.



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).

PROXIMITY SWITCH

MOUNTING BRACKETS

SERIES	BORE	SIZE NO.
AV, HV	3/4"	-31
	1"	-32
	1-1/8"	-33

See Switches and Sensors section for complete ordering information.

⊕ Marked options provide additional cylinder flexibility, but may alter the dimensions.

# ENGINEERING DATA: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

SPECIFICATIONS	SERIES AV	SERIES HV	SERIES A
OPERATING PRESSURE			
STANDARD CYLINDER (NO RODLOK®)	20 to 150 psi air	40 to 1500 psi hyd*	20 to 150 psi air
CYLINDER WITH RODLOK®	30 to 150 psi air	—	30 to 150 psi air
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	± .032	± .032	± .032
LUBRICATION	Permanently lubricated	—	Permanently lubricated
MAINTENANCE	Field repairable	Field repairable	Field repairable

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

## CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
AV, HV, A	3/4	1/4	EXTEND	.442	.0016	.0019
			RETRACT	.393	.0014	.0017
	3/4	5/16	EXTEND	.442	.0016	.0019
			RETRACT	.365	.0013	.0016
	1	5/16	EXTEND	.785	.0029	.0034
			RETRACT	.709	.0026	.0031
	1	3/8	EXTEND	.785	.0029	.0034
			RETRACT	.676	.0025	.0029
	1-1/8	3/8	EXTEND	.994	.0037	.0043
			RETRACT	.883	.0032	.0038
	1-1/8	1/2	EXTEND	.994	.0037	.0043
			RETRACT	.799	.0029	.0034
	1-3/8	1/2	EXTEND	1.485	.0055	.0064
			RETRACT	1.289	.0048	.0056
	1-3/8	5/8	EXTEND	1.485	.0055	.0064
			RETRACT	1.178	.0044	.0051

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

## MAXIMUM ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
3/4", 1", 1-1/8" AV, HV, A	1/4	12"	9"	6"	4"	3"	—	—	—
	5/16	18"	13"	8"	6"	5"	—	—	—
	3/8	26"	18"	12"	9"	7"	—	—	—
	1/2	46"	32"	21"	15"	12"	—	—	—

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
PLAIN UNIT	3/4	.42	.04
	1	.87	.07
	1-1/8	.95	.10

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

F = Cylinder Force                      lbs  
P = Operating Pressure                  psi  
A = Effective Area                        in<sup>2</sup>  
(Extend or Retract)

## SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

# AV, HV, A

**1000 Series Piston and Pin Assembly**

**Dimensions:**

- Top View (Piston Head):**
  - Overall width:  $E\ SQ$
  - Callout 1: Points to the outer edge of the crown.
  - Callout 2: Points to the crown radius, labeled **RM DIA**.
  - Callout 3: Points to the inner edge of the crown.
  - Callout 4: Points to the center of the crown.
- Side View (Piston and Pin):**
  - Pin:**
    - Length:  $.625$
    - Head diameter:  $.250$
    - Head length:  $.125$
    - Head width:  $.500$
    - Head to skirt distance:  $1.500 + \text{STROKE}$
    - Head to skirt distance (alternative):  $2.625 + \text{STROKE}$
    - Head to skirt distance (alternative):  $2.250 + \text{STROKE}$
    - Head to skirt distance (alternative):  $.750$
    - Head to skirt distance (alternative):  $.500$
  - Skirt:**
    - Length:  $2.625 + \text{STROKE}$
    - Head diameter:  $2X\ 1/8\ NPT$
  - Other Callouts:**
    - WA:** Wrist Arm
    - FT THREAD:** Foot Thread
    - D WRENCH FLAT:** D Wrench Flat

Technical drawing of a 4-hole flange. The drawing includes the following dimensions and callouts:

- 1**: 4X RT THREAD (4 Right Hand Threads)
- 2**: BD SQ (Bore Diameter Square)
- 3**: RM  $+^{+0.000}_{-0.003}$  DIA (Root Mean Square Diameter)
- 4**: 4 Holes (4 Holes)

MF2)

4X .219 DIA THRU

①

④

②

RE

③

TF

UF

2.875 + STROKE

.250

**F (MF1)**

4X .219 DIA THRU

①

②

R E

③

T F I/F

RM<sup>+0.000</sup>/<sub>-0.003</sub> DIA

2.875 + STROKE  
.125

.625

.250

Technical drawings of the DB SHCS. The left drawing is a top view showing a square flange with four mounting holes (1, 2, 3, 4) and a central hole. The right drawing is a side view showing the cylinder body with dimensions: 3.125 + STROKE for the total length, 250 for the main body length, and .375 for the flange thickness. The mounting holes are labeled XB and SD1 + STROKE.

Technical drawing of a 1/2" x 10" x 10" 303 stainless steel piston rod assembly. The drawing includes a side view and a cross-sectional view.

**Side View Dimensions:**

- Total length:  $3.062 + \text{STROKE}$
- Piston pin diameter:  $.438$
- Piston pin length:  $.312$
- CD DIA THRU (Cross-hatched area)
- .445 RAD (Piston pin radius)

**Cross-sectional View Dimensions:**

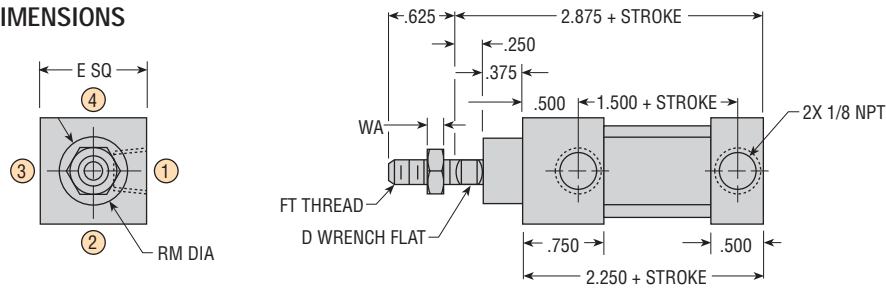
- Piston diameter:  $.750$
- Piston pin diameter:  $.445 \text{ RAD}$
- Labels: 1, 2, 3, 4
- EW (End View)

BORE		LETTER DIMENSION																										
SIZE	AA	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN	TF	TN	UF	WA	W1	XB	XT	ZG	XY
3/4	#6-32	.625	.750	.250	3/16	#8	.625	1.000	.250	1/4-28	5/8-18	8-32 x .18 DP	.500	.625	.687	8-32 x .25 DP	1.812	2.312	1.812	1.500	.625	2.000	.156	.875	.562	.562	3.125	.750
1	#8-32	.625	1.000	.375	1/4	#10	.875	1.375	.375	5/16-24	3/4-16	10-32 x .25 DP	.875	.750	.812	8-32 x .25 DP	1.750	2.250	1.750	1.875	.875	2.375	.188	.875	.625	.625	3.125	1.030
1-1/8	10-32	.875	1.125	.375	5/16	#10	1.000	1.500	.375	3/8-24	1-14	10-32 x .25 DP	1.000	.750	1.062	10-32 x .25 DP	1.750	2.250	1.750	2.000	1.000	2.500	.219	1.125	.625	.625	3.375	1.125

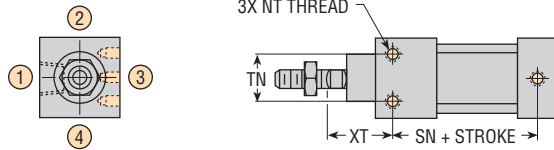
OVERSIZE RODS: SEE PAGE 1-65 FOR OVERSIZE ROD SPECIFICATIONS.

# DIMENSIONS: SERIES HV; 3/4", 1", 1-1/8" BORE

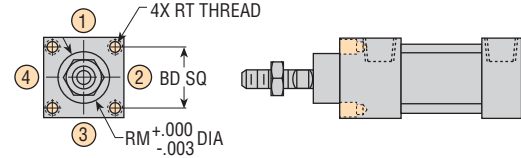
## BASIC CYLINDER DIMENSIONS



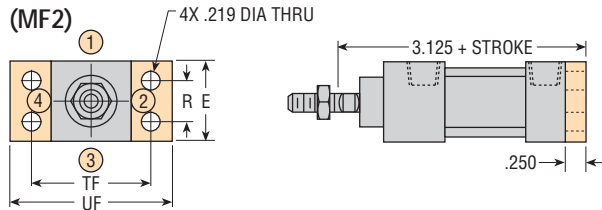
### B (MS9)



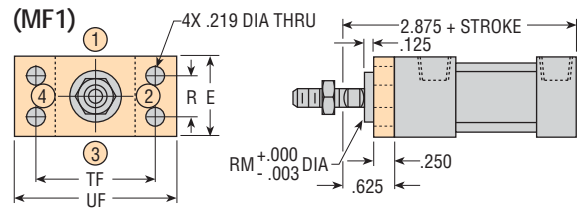
### R (MR1)



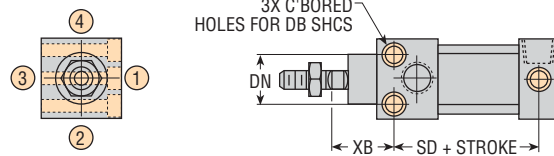
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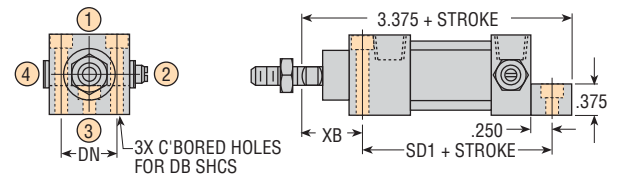
### RF (MF1)



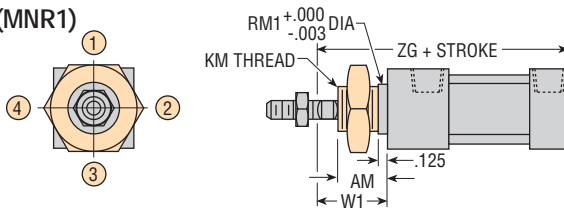
### F (MS8) SEE NOTE



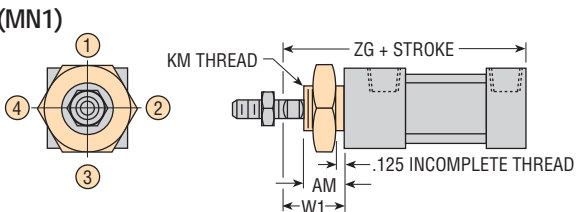
### F (MS8) - WITH PORT CONTROL ON CAP END



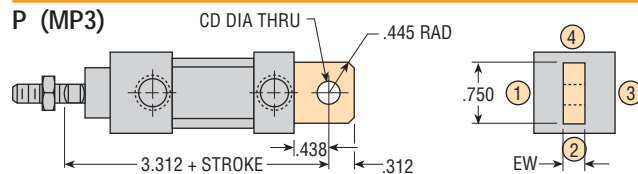
### L (MNR1)



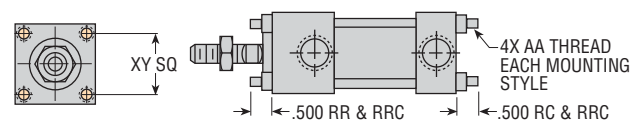
### T (MN1)



### P (MP3)



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



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

BORE	LETTER DIMENSION																							
SIZE	AA	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN	TF	TN	UF	WA	W1
3/4	#6-32	.625	.750	.250	3/16	#8	.625	1.000	.250	1/4-28	5/8-18	8-32 x .18 DP	.500	.625	.687	8-32 x .25 DP	1.812	2.312	1.812	1.500	.625	2.000	.156	.875
1	#8-32	.625	1.000	.375	1/4	#10	.875	1.375	.375	5/16-24	3/4-16	10-32 x .25 DP	.875	.750	.812	8-32 x .25 DP	1.750	2.250	1.750	1.875	.875	2.375	.188	.875
1-1/8	#10-32	.875	1.125	.375	5/16	#10	1.000	1.500	.375	3/8-24	1-14	10-32 x .25 DP	1.000	.750	1.062	10-32 x .25 DP	1.750	2.250	1.750	2.000	1.000	2.500	.219	1.125

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

CUSHIONS: ADD 1/2" 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 1-65 FOR OVERSIZE ROD SPECIFICATIONS.

All dimensions are reference only unless specifically tolerated.

# AV, HV, A

### MEASUREMENTS

The drawing includes the following dimensions and labels:

- Front View (Left):**
  - Overall width:  $E \text{ SQ}$  (labeled 4)
  - Inner hole diameter:  $RM \text{ DIA}$  (labeled 2)
  - Outer hole diameter:  $2X \text{ 1/8 NPT}$  (labeled 1)
  - Feature 3: A small circular feature on the left edge (labeled 3).
- Side View (Right):**
  - Overall length:  $2.125 + \text{STROKE}$
  - Distances from the left face:
    - $.625$
    - $.250$
    - $.125$
    - $.500$
    - $1.000 + \text{STROKE}$
  - Labels: **WA** (Washer), **FT THREAD** (Flange Thread), **D WRENCH FLAT** (Diameter Wrench Flat).
  - Bottom dimensions:
    - From the left face to the start of the stroke:  $.750$
    - From the start of the stroke to the right face:  $.500$
    - Total length:  $1.750 + \text{STROKE}$

Technical drawing of a 4x4 RT thread plate. The drawing shows a top view and a side view. The top view is a square with a central circular hole. The side view shows the thickness of the plate. The dimensions and callouts are as follows:

- 1**: 4X RT THREAD (Four right-hand threads in the corners)
- 2**: BD SQ (Bottom square)
- 3**: RM+.000 / -.002 DIA (Root mean square diameter tolerance)
- 4**: 4X RT THREAD (Four right-hand threads in the corners)

[illegible][illegible]

Technical drawing of a 3D printed part. The left side shows a cross-section with four numbered callouts: 1 (outer shell), 2 (inner shell), 3 (hatched infill), and 4 (central hole). The right side shows a side view of the part with dimensions:  $DN$  (depth of the hole),  $XB$  (width of the hole),  $SD + STROKE$  (total length), and  $3X \text{ C'BORED HOLES FOR DB SHCS}$  (three pre-bored holes for double shear bolts).

3X C' BORED HOLES FOR DB SHCS

Technical drawing of a hydraulic cylinder assembly. The side view shows a cylinder with a piston rod. Key dimensions include: .250 DIA THRU (piston rod diameter), .445 RAD (fillet radius), 2.562 + STROKE (total length), .438 (piston rod diameter), and .312 (piston rod diameter). The end view shows a cylinder with a piston rod. Key dimensions include: .750 (cylinder diameter), .438 (piston rod diameter), and .312 (piston rod diameter). The end view is labeled with 1, 2, 3, and 4, and EW (End View).

Technical drawing of the 1000 Series Hydraulic Cylinder. The left view is an end view showing a square mounting flange with four mounting holes. The distance between the centers of opposite mounting holes is labeled  $XY\ SQ$ . The right view is a side view showing the cylinder body with a mounting bracket. Dimensions for the mounting bracket are indicated:  $500\ RR\ \&\ RRC$  for the main body width and  $500\ RC\ \&\ RRC$  for the bracket width. A note points to the mounting holes: **4X AA THREAD EACH MOUNTING STYLE**.

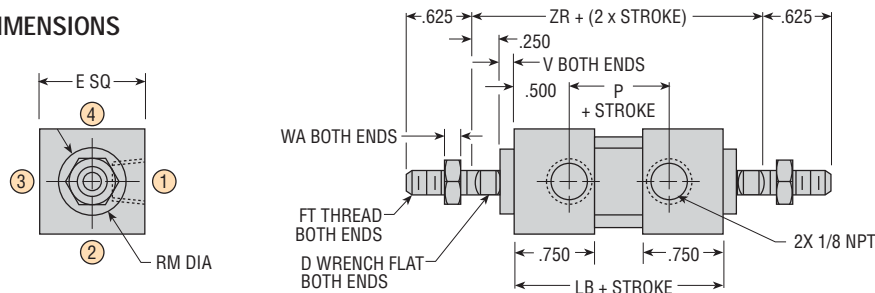
BORE SIZE	LETTER DIMENSION																							
	AA	BD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN	TF	TN	UF	WA	XB	XT	XY
3/4	#6-32	.750	3/16	#8	.625	1.000	.250	1/4-28	5/8-18	8-32 x .18 DP	.500	.625	.687	8-32 x .25 DP	1.312	1.812	1.312	1.500	.625	2.000	.156	.562	.562	.750
1	#8-32	1.000	1/4	#10	.875	1.375	.375	5/16-24	3/4-16	10-32 x .25 DP	.875	.750	.812	8-32 x .25 DP	1.250	1.750	1.250	1.875	.875	2.375	.188	.625	.625	1.30
1-1/8	#10-32	1.125	5/16	#10	1.000	1.500	.375	3/8-24	3/4-16	10-32 x .25 DP	1.000	.750	.812	10-32 x .25 DP	1.250	1.750	1.250	2.000	1.000	2.500	.219	.625	.625	1.125

OVERSIZE RODS: SEE PAGE 1-65 FOR OVERSIZE ROD SPECIFICATIONS.

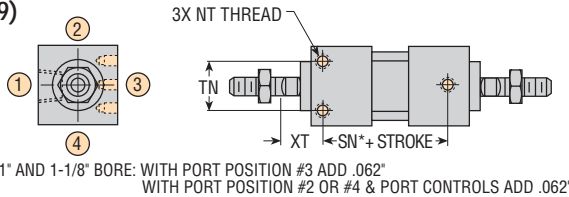


# DIMENSIONS: SERIES DAV, DHV, DA DOUBLE ROD; 3/4", 1", 1-1/8" BORE

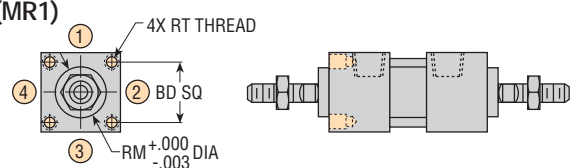
## BASIC CYLINDER DIMENSIONS



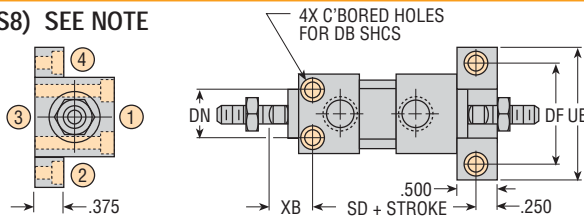
### B (MS9)



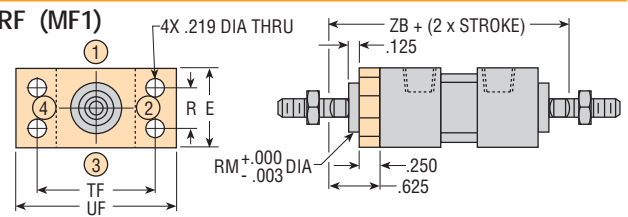
### R (MR1)



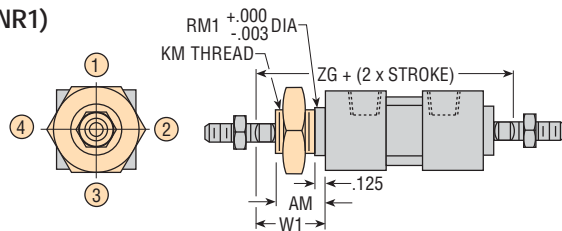
### F (MS8) SEE NOTE



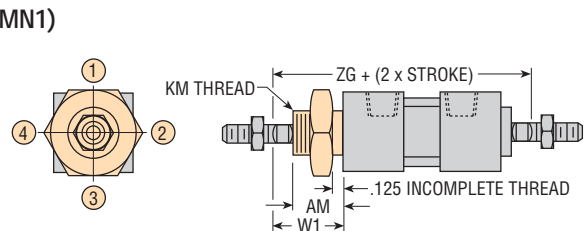
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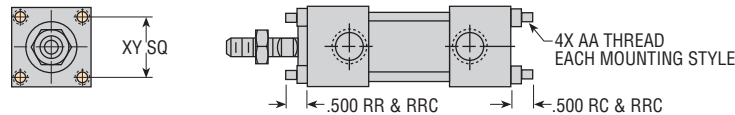
### L (MNR1)



### T (MN1)



### 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

BORE SIZE	LETTER DIMENSION													
	AA	BD	D	DB	DF	DN	E	FT	NT	R	RM	RT	TF	TN
3/4	#6-32	.750	3/16	#8	1.375	.625	1.000	1/4-28	8-32 x .18 DP	.500	.625	8-32 x .25 DP	1.500	.625
1	#8-32	1.000	1/4	#10	1.750	.875	1.375	5/16-24	10-32 x .25 DP	.875	.750	8-32 x .25 DP	1.875	.875
1-1/8	#10-32	1.125	5/16	#10	1.875	1.000	1.500	3/8-24	10-32 x .25 DP	1.000	.750	10-32 x .25 DP	2.000	1.000

#### SERIES DA CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	.625	5/8-18	2.000	1.000	.687	2.063	1.562	.125	.875	.562	.562	3.000	3.250	2.750
1	.625	3/4-16	2.000	1.000	.812	2.000	1.500	.125	.875	.625	.625	3.000	3.250	2.750
1-1/8	.625	3/4-16	2.000	1.000	.812	2.000	1.500	.125	.875	.625	.625	3.000	3.250	2.750

#### SERIES DHV CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	.625	5/8-18	2.500	1.500	.687	2.562	2.062	.375	.875	.812	.812	3.750	4.000	3.750
1	.625	3/4-16	2.500	1.500	.812	2.500	2.000	.375	.875	.875	.875	3.750	4.000	3.750
1-1/8	.875	1-14	2.500	1.500	1.062	2.500	2.000	.375	1.125	.875	.875	3.750	4.250	3.750

#### SERIES DAV CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	.625	5/8-18	2.500	1.500	.687	2.562	2.062	.125	.875	.562	.562	3.500	3.750	3.250
1	.625	3/4-16	2.500	1.500	.812	2.500	2.000	.125	.875	.625	.625	3.500	3.750	3.250
1-1/8	.875	1-14	2.500	1.500	1.062	2.500	2.000	.125	1.125	.625	.625	3.500	4.000	3.250

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS  
 CUSHIONS: ADD 1/2" TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION  
 SHOCK PADS: ADD 1/4" 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 1-65 FOR OVERSIZE ROD SPECIFICATIONS.

All dimensions are reference only unless specifically tolerated.

## OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

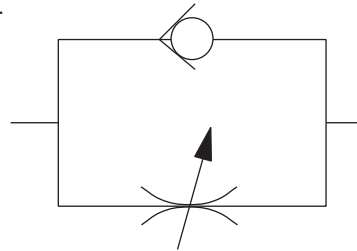
AV, HV, A

### **P** **PC** **PR** 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.



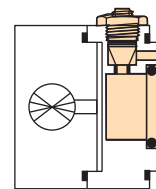
### **D** **DC** **DR** ADJUSTABLE CUSHION

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.

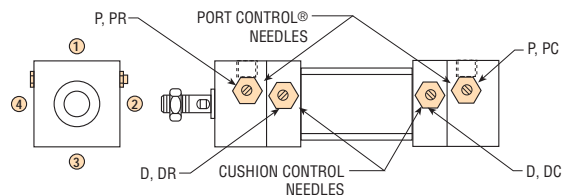
Effective cushion length 1/2"

#### CUSHION BLOCK



#### STANDARD PORT CONTROL® AND CUSHION NEEDLE POSITIONS

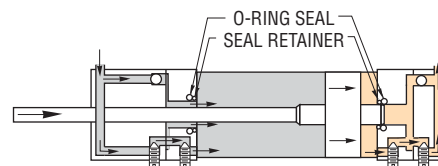
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A, AV, and HV.



#### PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

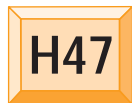
Cushion and Port Control® combination arranged in series provides a compact efficient control system for maximum space weight and cost savings. The cushion is activated when the piston extension enters a seal in the cushion block. The remaining volume in the cylinder exhausts past an adjustable needle. 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.

#### CUSHION BLOCK STYLE





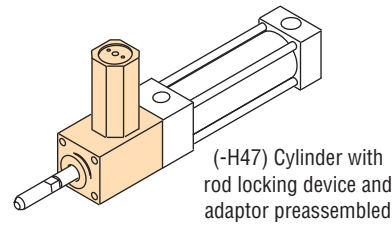
# OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE



## RODLOK® CYLINDER & RODLOK®

Available on single rod Series A and AV units only. (preassembled) <sup>⊕</sup>

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 PERSONNEL SAFETY DEVICE.



AV, HV, A

**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.

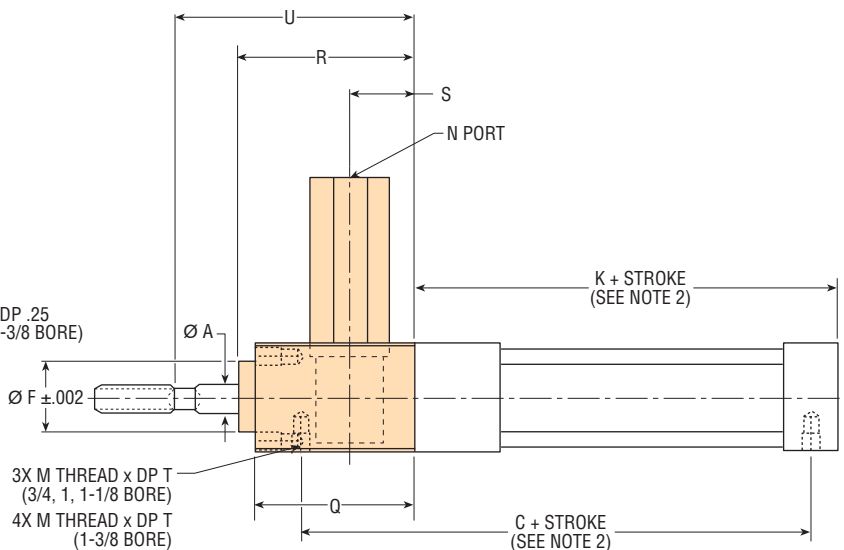
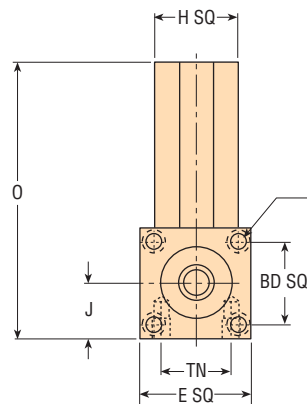
Replacement Rodlok® kits can be purchased separately. See chart at right. The locking device and adaptor are not available with the -Z1 corrosion resistant finish.

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

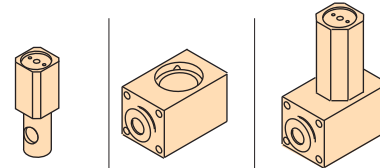
<sup>⊕</sup> This option does not dimensionally comply with the NFPA standard specifications.

BORE in	STATIC LOCKING FORCE*	
	lb	[N]
3/4	40	180
1	56	250
1-1/8	79	350

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



## REPLACEMENT RODLOK® KITS



BORE in	LOCKING DEVICE KIT	ADAPTOR KIT	COMPLETE RODLOK®
3/4	63932-01	63931-01	63935-01
1	63932-02	63931-02	63935-02
1-1/8	63932-03	63931-03	63935-03

PART NUMBERS LISTED ABOVE ARE INTENDED FOR REPLACEMENT PURPOSES ONLY.

BORE in	LETTER DIMENSION															
	A	C	E	F	H	J	K	L	M	N	O	Q	R	S	T	U
3/4	.250 [6.4]	3.063 [77.8]	1.000 [25.4]	.622 [15.8]	0.728 [18.5]	.500 [12.7]	2.250 [57.2]	8-32 UNC-2B	8-32 UNC-2B	10-32 UNF-2B	2.409 [61.2]	1.500 [38.1]	1.625 [41.3]	.625 [15.9]	.187 [4.7]	1.875 [47.6]
1	.312 [7.9]	3.000 [76.2]	1.375 [34.9]	.747 [19.0]	0.787 [20.0]	.688 [17.5]	2.250 [57.2]	8-32 UNC-2B	8-32 UNC-2B	10-32 UNF-2B	2.756 [70.0]	1.500 [38.1]	1.625 [41.3]	.625 [15.9]	.250 [6.4]	1.875 [47.6]
1-1/8	.375 [9.5]	3.000 [76.2]	1.500 [38.1]	.747 [19.0]	0.787 [20.0]	.750 [19.1]	2.250 [57.2]	10-32 UNF-2B	10-32 UNF-2B	10-32 UNF-2B	2.819 [71.6]	1.500 [38.1]	1.625 [41.3]	.625 [15.9]	.250 [6.4]	1.875 [47.6]

### NOTES:

1) Breakaway force on cylinders with Rodlok® approximately 30 psi.

2) For Series A 3/4, 1, and 1-1/8 bores, subtract .500  
(K = 1.750, C : 3/4 = 2.563, 1, 1-1/8 = 2.500)

All dimensions are reference only unless specifically tolerated.

# OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

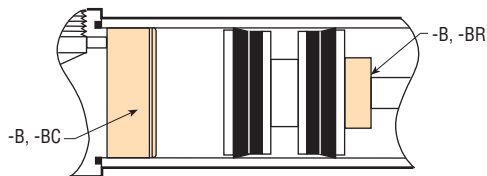
AV, HV, A

## B BC BR 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)



## SR SC SPRING RETURN

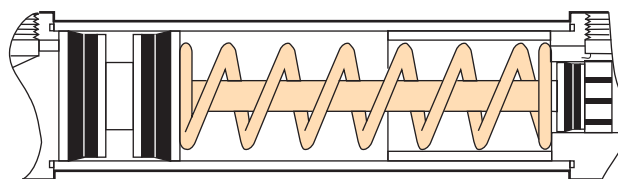
Available in 1/4" increments

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.

STROKE	PRELOAD	RATE
1/4"-3"	4 lb	7 lb/in
3-1/4" - 6"	2 lb	3-1/2 lb/in

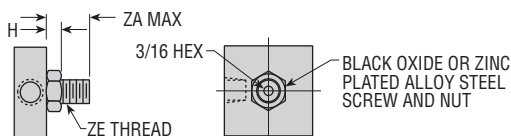
Available with all options EXCEPT -

- 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)



## A CYLINDER STROKE ADJUSTMENT

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.



BORE SIZE	H	ZA	ZE STANDARD	ZE WITH -P OR -PC
3/4	.370	1.031	3/8-24	5/16-24
1	.462	1.156	1/2-20	3/8-24
1-1/8	.462	1.156	1/2-20	1/2-20

Available with all options EXCEPT -

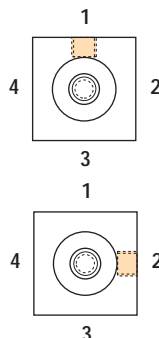
- Cushion on the cap end (-D or -DC)
- Shock pad on the cap end (-B or -BC)
- Spring on the cap end (-SC)
- Pivot Mount, Pivot on cap (P Mounting)
- Cap flange mount, flange on cap (CF Mounting)
- F Mounting on 3/4 bore with -P or -PC

## PORT POSITIONS

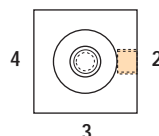
Port position 1 is standard on all cylinders except mounting style -F without port controls. The cap end port will be in position 4

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.

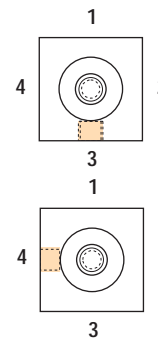
### STANDARD PORT POSITION 1



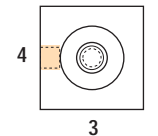
### R PORT POSITION 2



### T PORT POSITION 3



### U PORT POSITION 4



# OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

## MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

### E HALL EFFECT SWITCHES

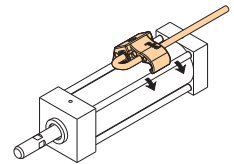
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

#### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

See Switches and Sensors section for complete switch information.

### V FLUORO-ELASTOMER SEALS

Fluoro-Elastomer 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.

### 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  $\pm .005$  will be supplied. Standard stroke tolerance is  $\pm .032$ .

Maximum stroke for cylinders with close tolerance is 18".

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

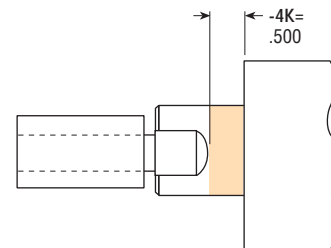
### \_K EXTRA ROD EXTENSION

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.



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

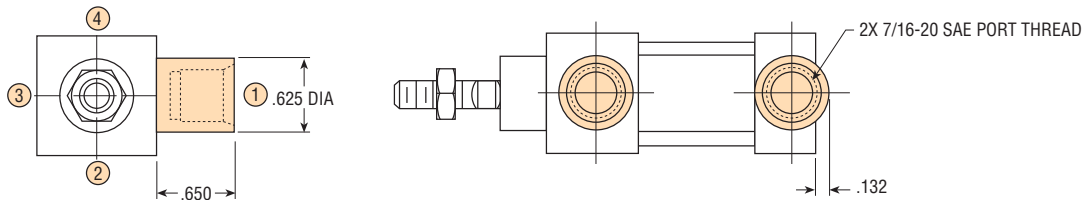
# OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE



## 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 & L mounting styles on 3/4" bore cylinders.



## SELF-ALIGNING PISTON ROD COUPLERS

To order, specify the model number.

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	.625	1.875	.500	.875	.156
312	5/16-24	1.000	.625	1.875	.500	.875	.187
375	3/8-24	1.000	.625	1.875	.500	.875	.219
437	7/16-20	1.125	.650	2.187	.500	1.000	.250
500	1/2-20	1.125	.650	2.187	.500	1.000	.312
625	5/8-18	1.750	1.125	3.312	.812	1.562	.375
750	3/4-16	1.750	1.125	3.312	.812	1.562	.421

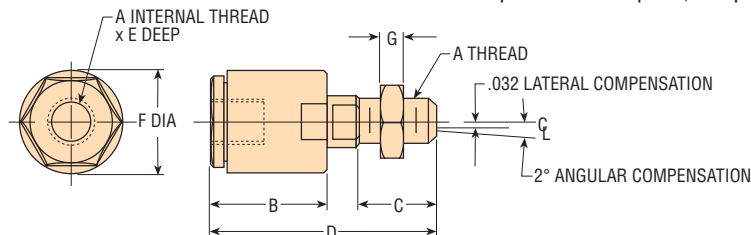
Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

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.

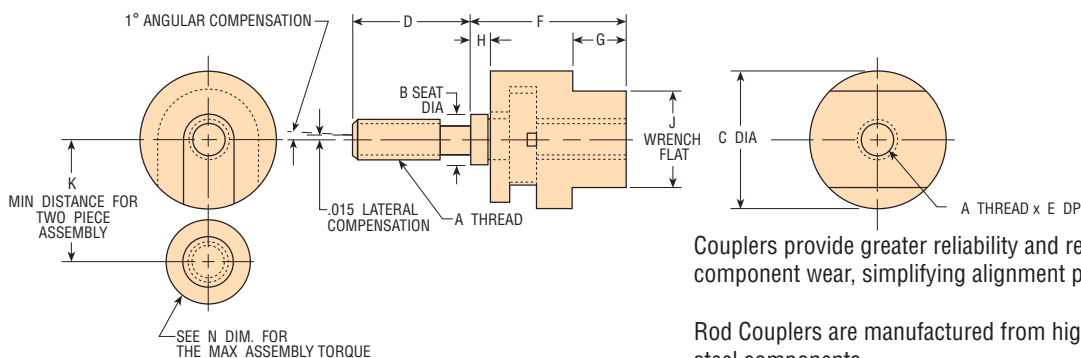
Couplers provide greater reliability and reduce cylinder and component wear, simplifying alignment problems in the field.

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

For metric piston rod couplers, see page 1-44.



## 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.

MODEL NO.	LETTER DIMENSION										
	A	B	C	D	E	F	G	H	J	K	N
19300-01	5-40	.160	.440	.375	.250	.500	.170	.066	5/16	.390	20 in-lbs
19300-02	10-32	.250	.560	.500	.281	.558	.200	.058	3/8	.490	70 in-lbs

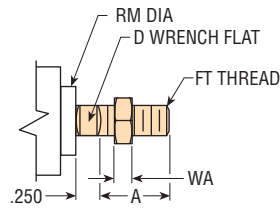
All dimensions are reference only unless specifically toleranced.

[www.phdinc.com/av](http://www.phdinc.com/av) • (800) 624-8511

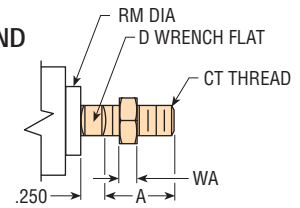


# OPTIONS: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

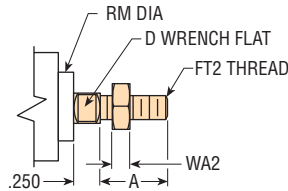
**STANDARD (#1 ROD END)**



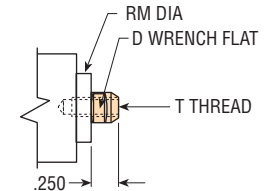
**L COARSE THREAD ROD END**



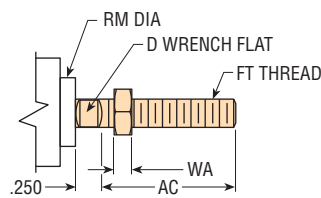
**G ROD END STYLE #2**



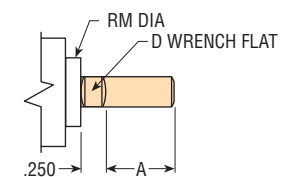
**I ROD END STYLE #4**



**J ROD END STYLE #2X**



**N PLAIN ROD END**



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

BORE SIZE	ROD TYPE	ROD DIA.	LETTER DIMENSION									
			A	AC	CT	D	FT	FT2	RM	T	WA	WA2
3/4	STANDARD	.250	.625	1.250	1/4-20	7/32	1/4-28	10-32	.625	6-32 x .437 DP	.156	.130
	OVERSIZE	.312	.625	1.250	5/16-18	1/4	5/16-24	1/4-28	.625	10-32 x .625 DP	.187	.156
1	STANDARD	.312	.625	1.250	5/16-18	1/4	5/16-24	1/4-28	.750	10-32 x .625 DP	.187	.156
	OVERSIZE	.375	.625	1.250	3/8-16	5/16	3/8-24	5/16-24	.750	1/4-28 x .625 DP	.219	.187
1-1/8	STANDARD	.375	.625	1.250	3/8-16	5/16	3/8-24	5/16-24	.750	1/4-28 x .625 DP	.219	.187
	OVERSIZE	.500	.750	1.500	1/2-13	7/16	1/2-20	7/16-20	A-.750	3/8-24 x .625 DP	.312	.250
									AV-HV 1.000			

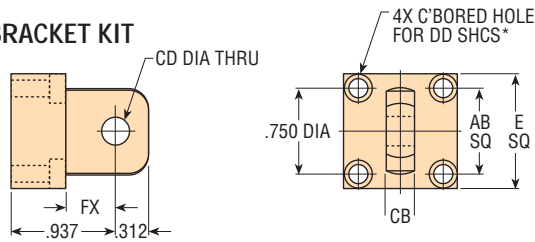
**NOTE:** On double rod cylinders, both rod ends will be the same on both ends of the cylinder.

AV, HV, A

# ACCESSORIES: SERIES A, AV, HV; 3/4", 1", 1-1/8" BORE

AV, HV, A

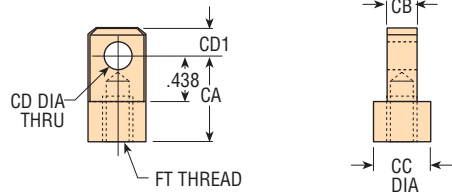
## EYE BRACKET KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION					
			AB	CB	CD	DD*	E	FX
3/4	A,AV,HV	1077-01	.750	.248	.250	#6	1.000	.577
1 &	A	1077-02	1.000	.373	.250	#10	1.375	.437
1-1/8	AV,HV	1077-03	1.000	.373	.375	#10	1.375	.437

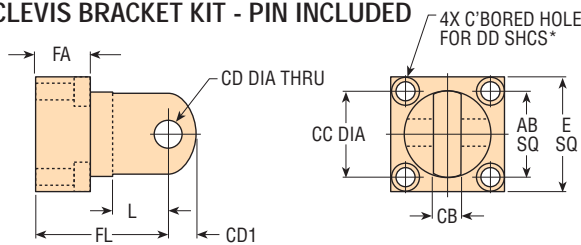
\*For 3/4 bore thru hole only.

## ROD EYE KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CD	CD1	FT	
3/4	A,AV,HV	1075-01	.750	.248	.500	.250	.250	1/4-28 x .375 DP	
1	A	1075-02	.875	.373	.750	.250	.375	5/16-24 x .375 DP	
	AV,HV	1075-04	.875	.373	.750	.375	.375	5/16-24 x .375 DP	
1-1/8	A	1075-03	.875	.373	.750	.250	.375	3/8-24 x .312 DP	
	AV,HV	1075-05	.875	.373	.750	.375	.375	3/8-24 x .312 DP	

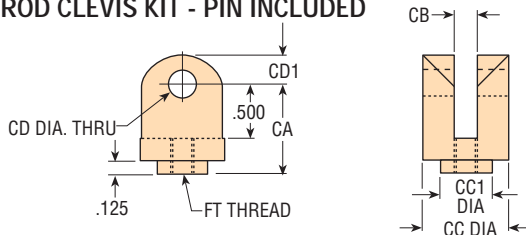
## CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION									
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A,AV,HV	12901	.750	.254	.750	.250	.250	#6	1.000	.360	1.187	.500
1 &	A	12902	1.000	.379	.875	.250	.375	#10	1.375	.500	1.250	.531
1-1/8	AV,HV	12903	1.000	.379	.875	.375	.375	#10	1.375	.500	1.250	.531

\*For 3/4 bore thru hole only.

## ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION							
			CA	CB	CC	CC1	CD	CD1	FT	
3/4	A,AV,HV	12904	.812	.254	.750	.437	.250	.250	1/4-28 TO SLOT	
1	A	12905	.875	.379	.875	.562	.250	.375	5/16-24 TO SLOT	
	AV,HV	12906	.875	.379	.875	.562	.375	.375	5/16-24 TO SLOT	
1-1/8	A	12907	.875	.379	.875	.562	.250	.375	3/8-24 TO SLOT	
	AV,HV	12908	.875	.379	.875	.562	.375	.375	3/8-24 TO SLOT	

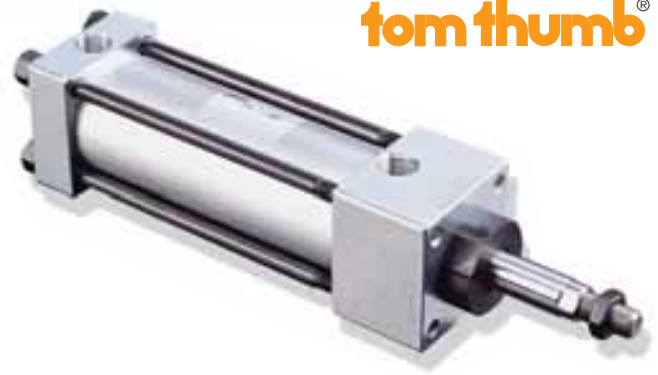


# AV, HV

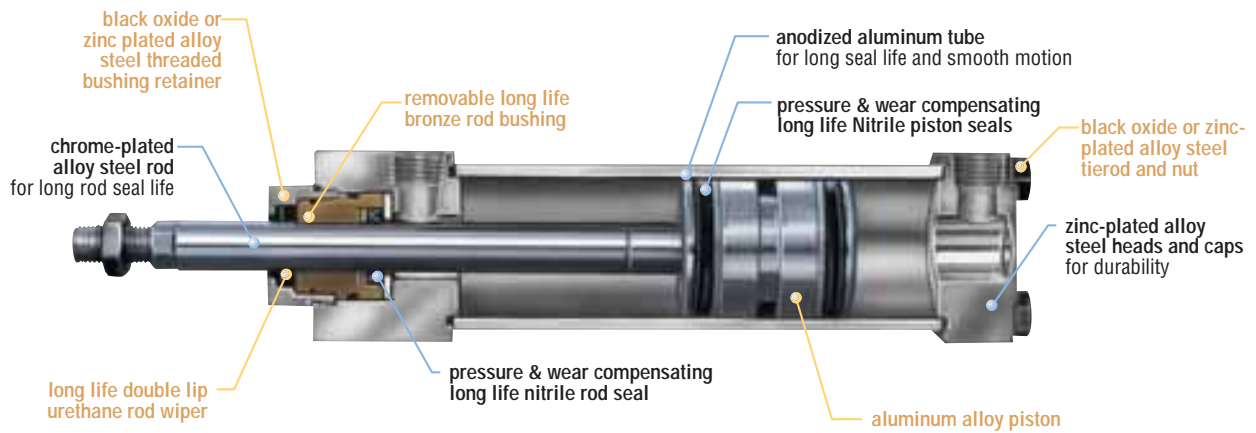


tom thumb®

## TIE ROD CYLINDERS 1-3/8" BORE WITH A WIDE VARIETY OF STYLES AND OPTIONS



1-3/8" AV, HV



### 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
- Two working day delivery
- Wide range of mounting styles for easy installation

### Industry Uses

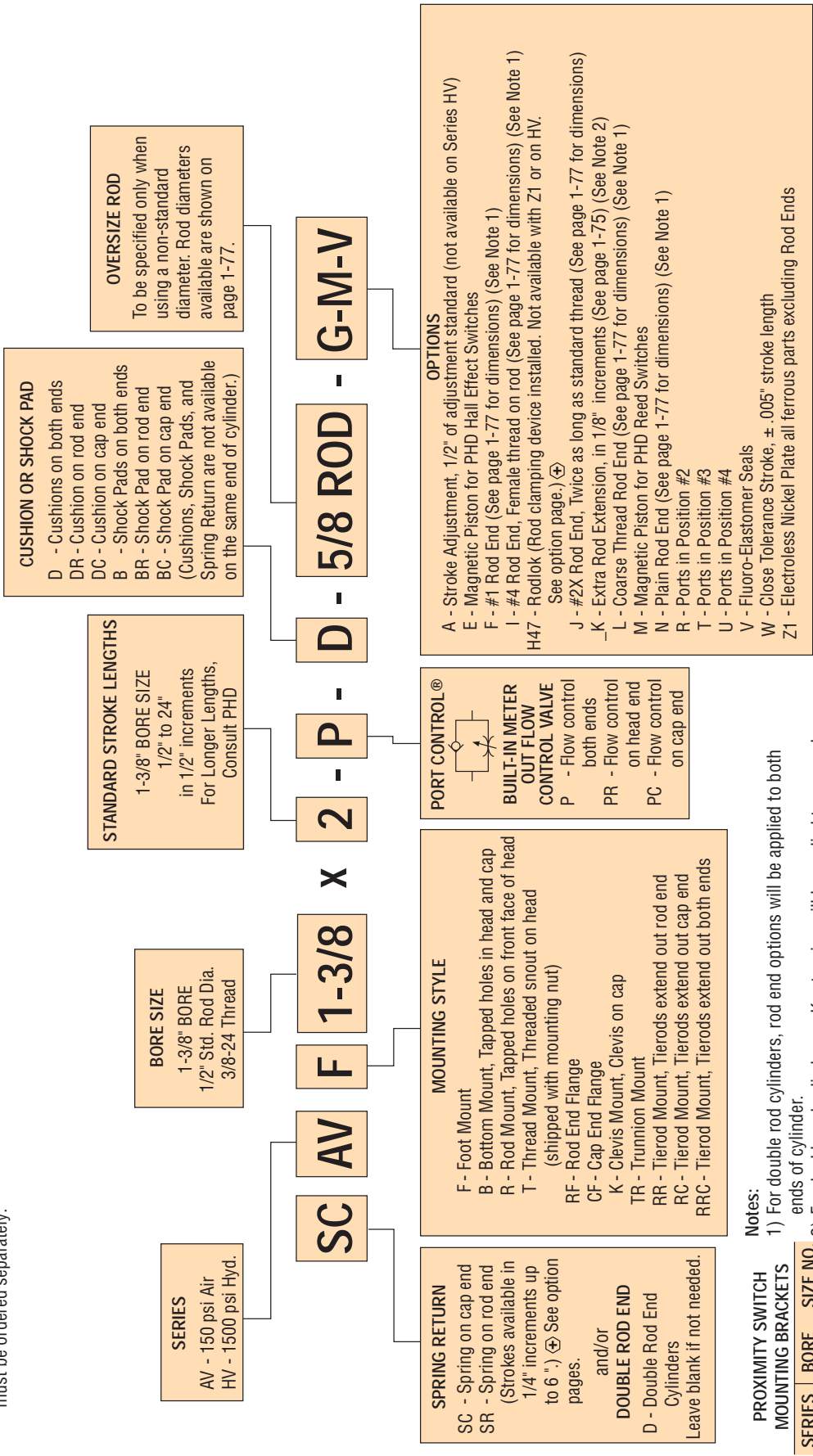
- Packaging
- Assembly machines
- Machine loading/unloading
- General industrial automation

# ORDERING DATA: SERIES AV, HV; 1-3/8" BORE

1-3/8" AV, HV

## 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.



## 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).

## PROXIMITY SWITCH

## MOUNTING BRACKETS

SERIES	BORE	SIZE NO.
AV, HV	1-3/8"	-34

See Switches and Sensors section for complete ordering information.

⊕ Marked options provide additional cylinder flexibility, but may alter the dimensions.

# ENGINEERING DATA: SERIES AV, HV; 1-3/8" BORE

1-3/8" AV, HV

SPECIFICATIONS	SERIES AV	SERIES HV
OPERATING PRESSURE		
STANDARD CYLINDER (NO RODLOK®)	20 to 150 psi air	40 to 1500 psi hyd*
CYLINDER WITH RODLOK®	30 to 150 psi air	—
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	± .032	± .032
LUBRICATION	Permanently lubricated	—
MAINTENANCE	Field repairable	Field repairable

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

## CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
AV, HV	1-3/8	1/2	EXTEND	1.485	.0055	.0064
			RETRACT	1.289	.0048	.0056
	1-3/8	5/8	EXTEND	1.485	.0055	.0064
			RETRACT	1.178	.0044	.0051

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

## MAXIMUM ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
1-3/8" AV, HV	1/2	48"	34"	21"	15"	12"	11"	—	—
	5/8	74"	53"	33"	24"	19"	17"	—	—

SERIES	UNIT WEIGHTS (lb)	
	ZERO STROKE	ADDER PER INCH OF STROKE
PLAIN UNIT	2.56	.12

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

F = Cylinder Force      lbs  
P = Operating Pressure      psi  
A = Effective Area      in<sup>2</sup>  
(Extend or Retract)

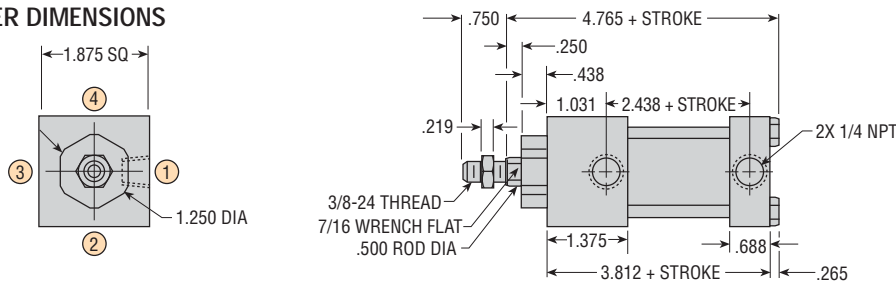
## SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

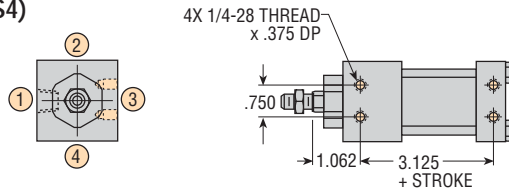
# DIMENSIONS: SERIES AV, HV; 1-3/8" BORE

1-3/8" AV, HV

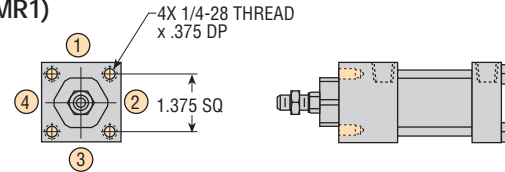
## BASIC CYLINDER DIMENSIONS



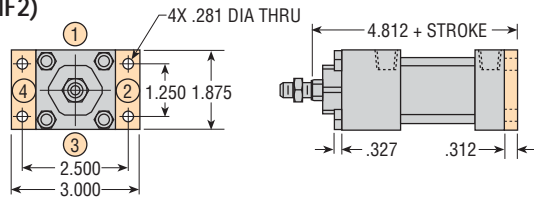
### B (MS4)



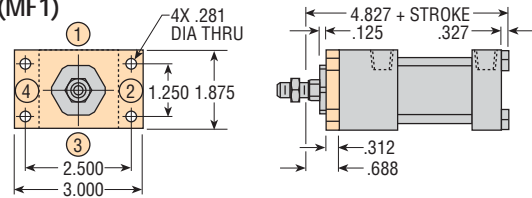
### R (MR1)



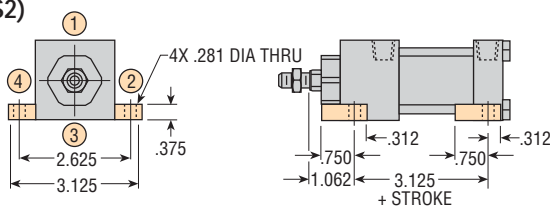
### CF (MF2)



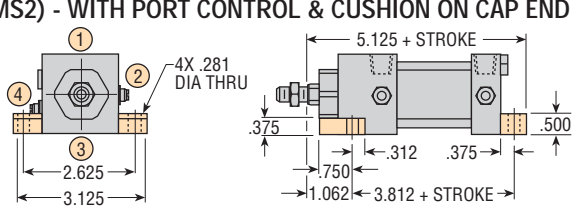
### RF (MF1)



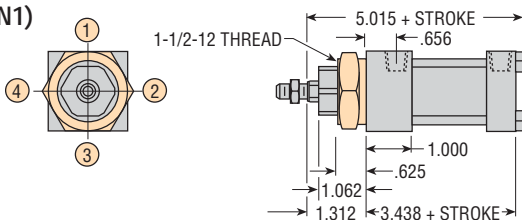
### F (MS2)



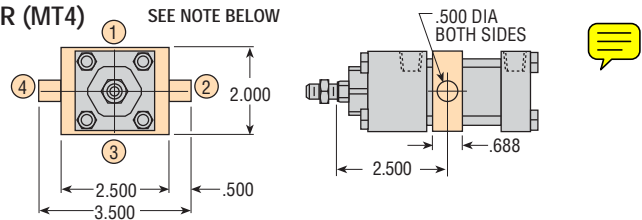
### F (MS2) - WITH PORT CONTROL & CUSHION ON CAP END



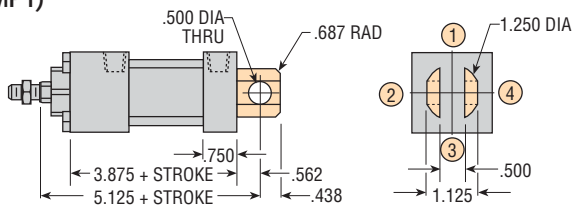
### T (MN1)



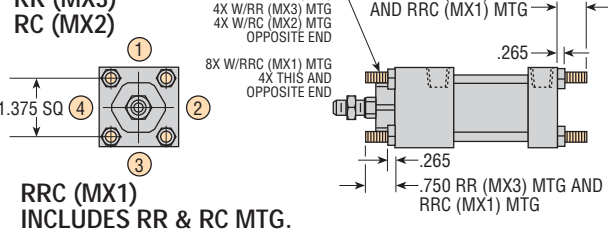
### TR (MT4)



### K (MP1)



### RR (MX3)



### RRC (MX1) INCLUDES RR & RC MTG.

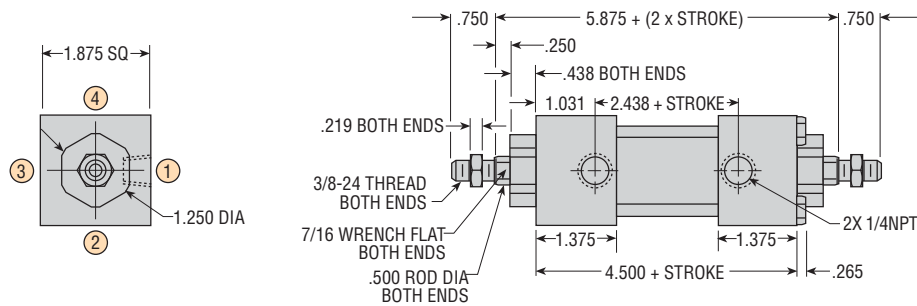
All standard rod ends have four wrench flats (two wrench flats with "I" option).

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS  
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS  
SHOCK PADS: ADD 1/4" TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD  
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO (+ STROKE) DIMENSIONS (2 x STROKE)  
OVERSIZE RODS: SEE PAGE 1-77 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.

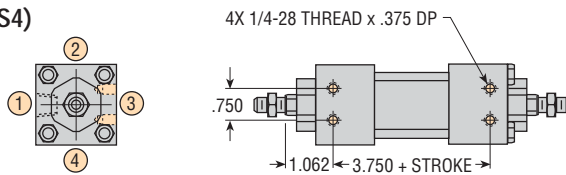
# DIMENSIONS: SERIES DAV, DHV DOUBLE ROD END; 1-3/8" BORE

## BASIC CYLINDER DIMENSIONS

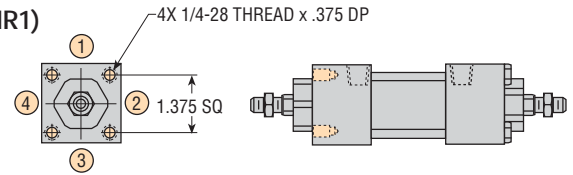


1-3/8" AV, HV

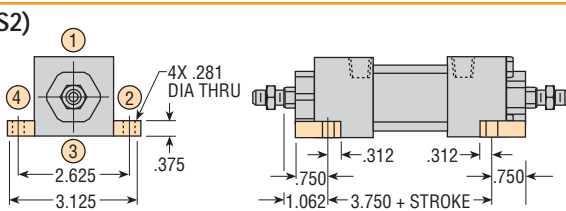
### B (MS4)



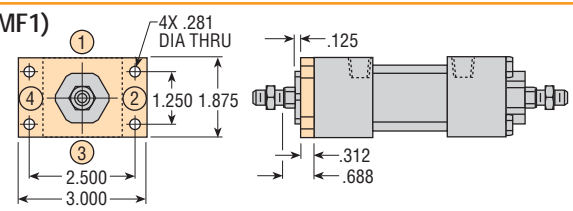
### R (MR1)



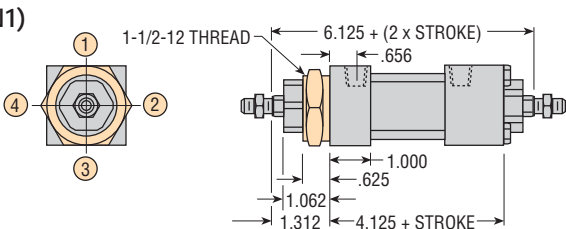
### F (MS2)



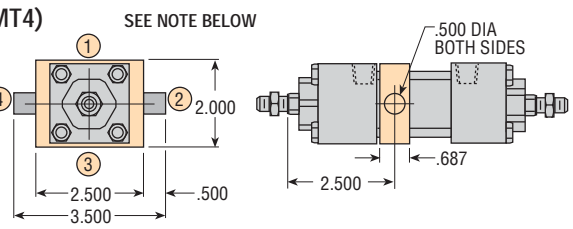
### RF (MF1)



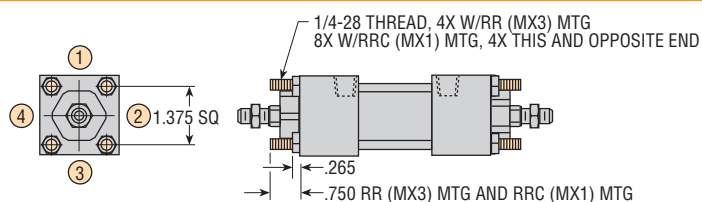
### T (MN1)



### TR (MT4)



### 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 1/4" 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 1-77 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.

## OPTIONS: SERIES AV, HV; 1-3/8" BORE

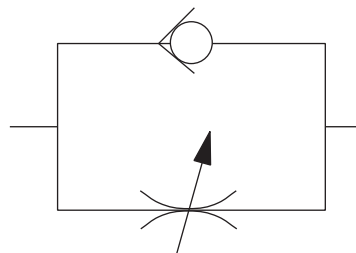
### **P** **PC** **PR** PORT CONTROL®

1-3/8" AV, HV

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.

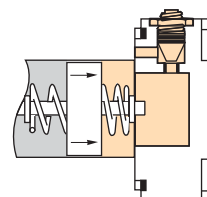


### **D** **DC** **DR** ADJUSTABLE CUSHION

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"

#### POPPET STYLE

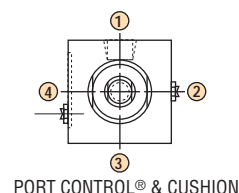
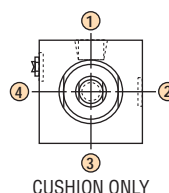
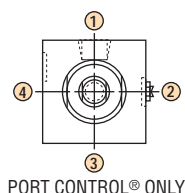
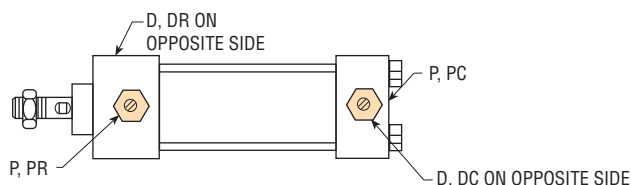


1-3/8" BORE

#### 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.

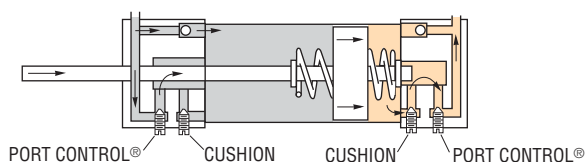
Location may vary depending on mounting and option combinations.



#### 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.

#### POPPET STYLE





# OPTIONS: SERIES AV, HV; 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 PERSONNEL SAFETY DEVICE.

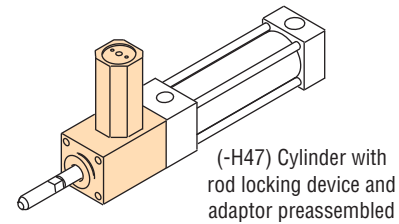
Option H47 provides a cylinder and Rodlok® pre-assembled. The port for the Rodlok® will be assembled in the same position as the port on the extend end of the cylinder.

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.

BORE in	STATIC LOCKING FORCE*	
	lb	[N]
1-3/8	135	600

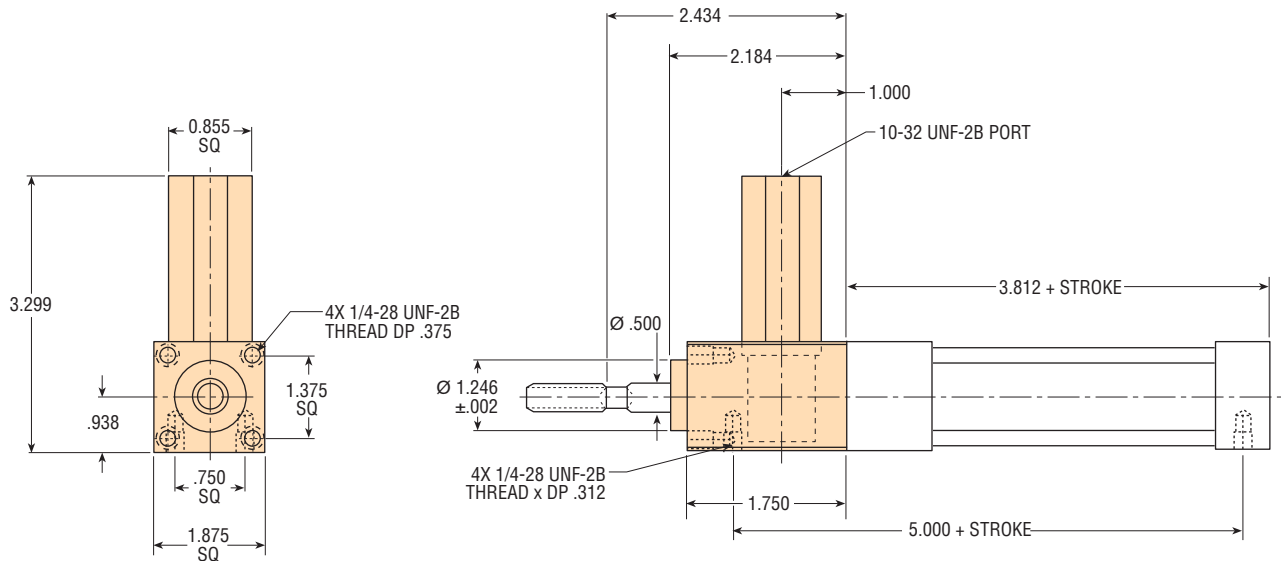
NOTE: \*LOCKING FORCE GIVEN IS THE ACTUAL LOCKING FORCE WITH A DRY, CLEAN ROD AND DOES NOT INCLUDE ANY SAFETY FACTOR.



## REPLACEMENT RODLOK® KITS

BORE in	LOCKING DEVICE KIT	ADAPTOR KIT	COMPLETE RODLOK®
1-3/8	63932-04	63931-04	63935-04

PART NUMBERS LISTED ABOVE ARE INTENDED FOR REPLACEMENT PURPOSES ONLY.



NOTE:  
Breakaway force on cylinders with Rodlok® approximately 30 psi.

All dimensions are reference only unless specifically tolerated.

# OPTIONS: SERIES AV, HV; 1-3/8" BORE

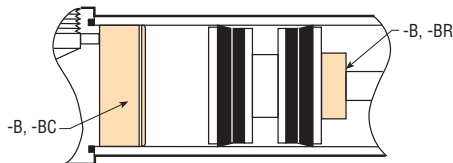
1-3/8" AV, HV

## B BC BR 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, -DC, or -DR)
- Spring end of Spring Return cylinder (SR or SC)
- Same end as Stroke Adjustment (-A)



## SR SC SPRING RETURN

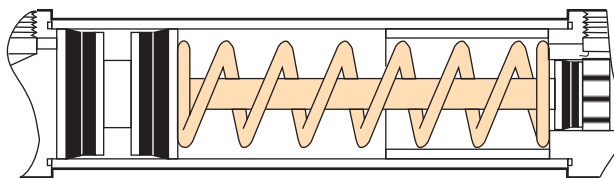
Available in 1/4" increments

All standard 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.

STROKE	PRELOAD	RATE
1/4"-3"	4 lb	7 lb/in
3-1/4" - 6"	2 lb	3-1/2 lb/in

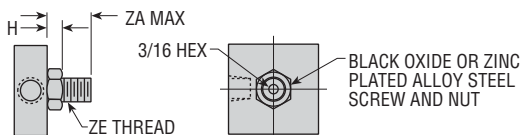
Available with all options EXCEPT -

- 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)



## A CYLINDER STROKE ADJUSTMENT (AV SERIES)

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.



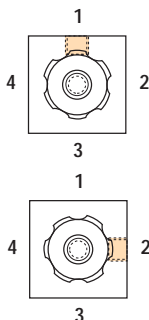
BORE SIZE	H	ZA	ZE
1-3/8	.462	1.000	1/2-20

Available with all options EXCEPT -

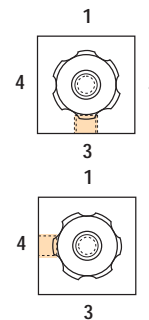
- Cushion on the cap end (-D or -DC)
- Shock pad on the cap end (-B or -BC)
- Spring on the cap end (SC)
- Cap flange mounting (CF)
- Clevis mount on cap (K)

## PORT POSITIONS

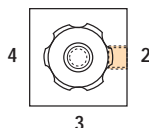
### STANDARD PORT POSITION 1



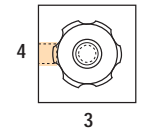
### T PORT POSITION 3



### R PORT POSITION 2



### U PORT POSITION 4



# OPTIONS: SERIES AV, HV; 1-3/8" BORE

## MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

### E HALL EFFECT SWITCHES

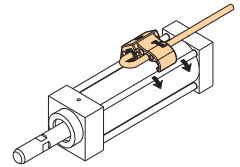
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

#### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

See Switches and Sensors section for complete switch information.

### V FLUORO-ELASTOMER SEALS

Fluoro-Elastomer 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  $\pm .005$  will be supplied. Standard stroke tolerance is  $\pm .032$ .

Maximum stroke for cylinders with close tolerance is 18".

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

### \_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" [1 mm] increments.

Length code example (for imperial units)

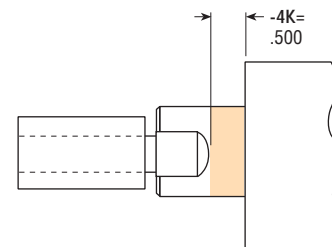
-4K = 1/2 of extra rod extension

-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 and -\_K specified will be applied to one end of cylinder only (head end/primary mounting end).

# OPTIONS: SERIES AV, HV; 1-3/8" BORE

## SELF-ALIGNING PISTON ROD COUPLERS

1-3/8" AV, HV

To order, specify the model number.

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
375	3/8-24	1.000	.625	1.875	.500	.875	.219
437	7/16-20	1.125	.650	2.187	.500	1.000	.250
500	1/2-20	1.125	.650	2.187	.500	1.000	.312

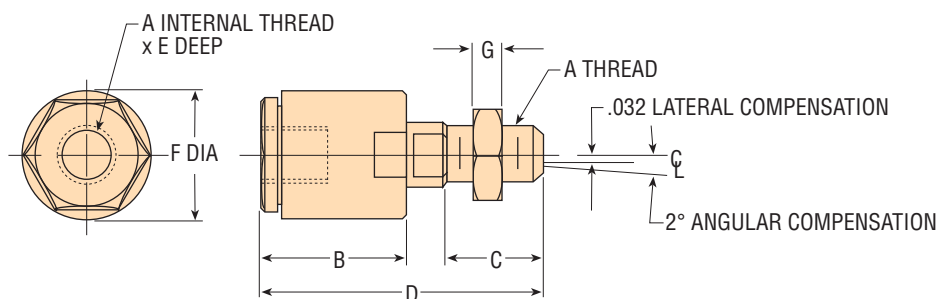
Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

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.

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.

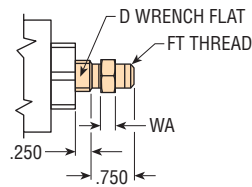
For metric piston rod couplers, see page 1-44.



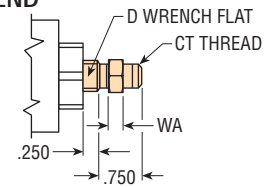
# OPTIONS: SERIES AV, HV; 1-3/8" BORE

## 1-3/8" BORE CYLINDERS

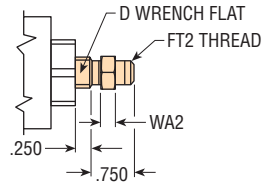
### G ROD END STYLE #2 STANDARD ON: (1-3/8" BORE)



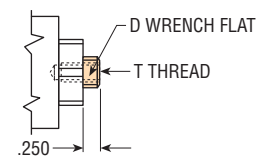
### L COARSE THREAD ROD END



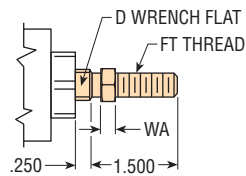
### F ROD END STYLE #1



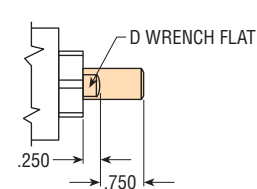
### I ROD END STYLE #4



### J ROD END STYLE #2X



### N PLAIN ROD END

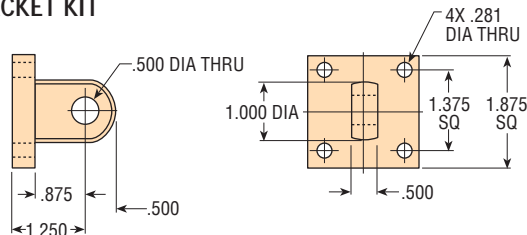


All standard rod ends have four wrench flats (two wrench flats with "I" option).

BORE SIZE	ROD TYPE	ROD DIA.	LETTER DIMENSION						WA	WA2
			CT	D	FT	FT2	T			
1-3/8	STANDARD	.500	3/8-16	7/16	3/8-24	7/16-20	3/8-24 x	.625 DP	.219	.250
	OVERSIZE	.625	7/16-14	9/16	7/16-20	1/2-20	7/16-20 x	.625 DP	.250	.312

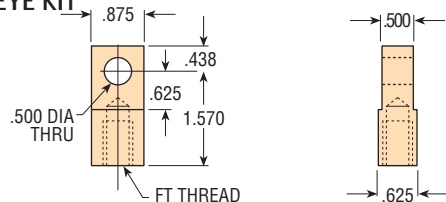
NOTE: On double rod cylinders, both rod ends will be the same on both ends of the cylinder.

## EYE BRACKET KIT



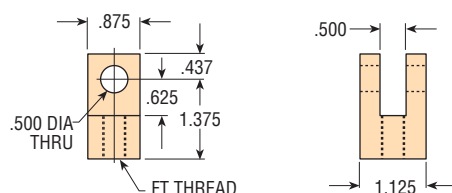
BORE SIZE	PART NO.
1-3/8	1330

## ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION FT
1-3/8	1375-01	3/8-24 x .750 DP
1-3/8	1375-02	7/16-20 x .750 DP
1-3/8	1375-03	1/2-20 x .750 DP

## ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	KIT NO.	LETTER DIMENSION FT
1-3/8	12909	3/8-24 TO SLOT
1-3/8	12910	7/16-20 TO SLOT
1-3/8	12911	1/2-20 TO SLOT

All dimensions are reference only unless specifically tolerated.

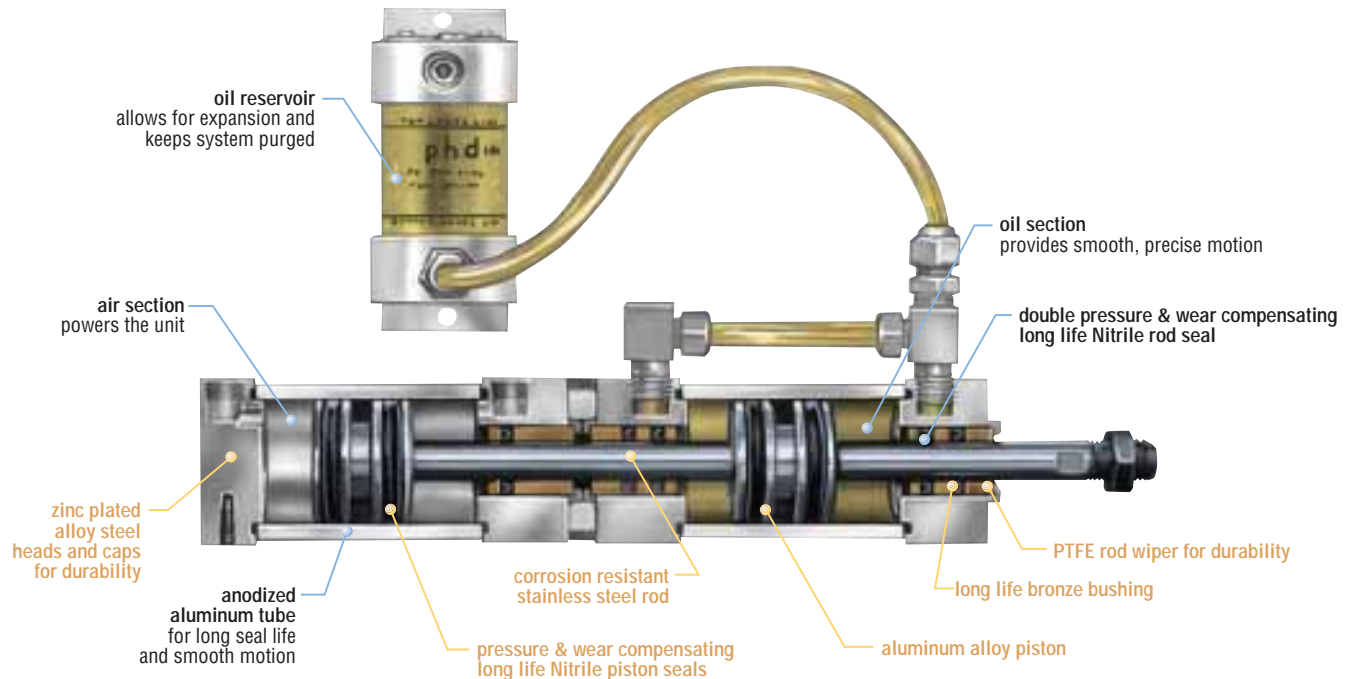




## TANDEM CYLINDERS 3/4", 1", 1-1/8", AND 1-3/8" BORE FOR DUAL POWER WITHOUT -Z OR -X OPTIONS

### SERIES TD

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



### Major Benefits

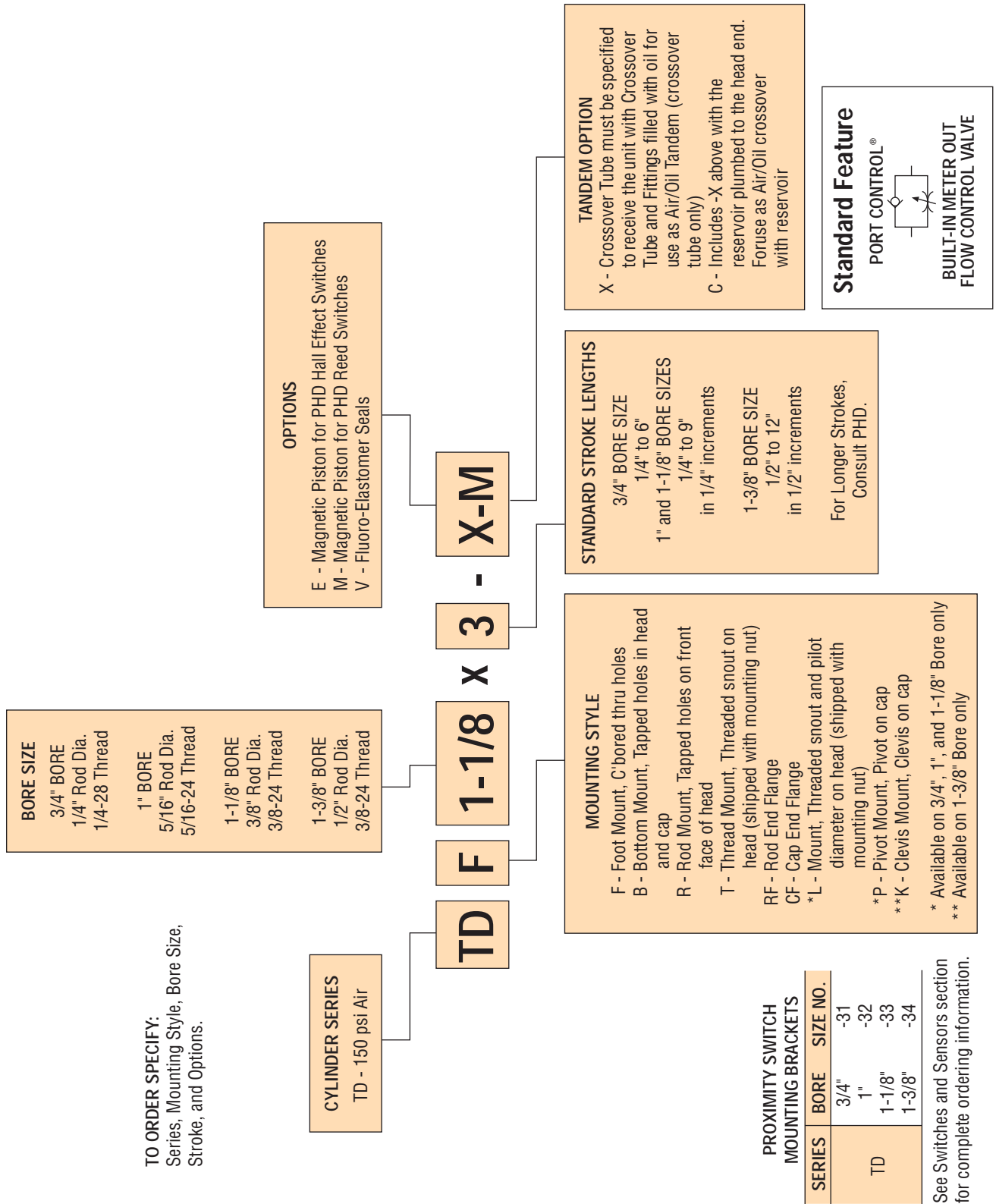
- Precise speed control and smooth operation at low velocities with -C option
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Two working day delivery
- Wide range of mounting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

### Industry Uses

- Packaging
- Assembly machines
- Machine loading/unloading
- Slow speed/precision applications
- General industrial automation

ORDERING DATA: SERIES TD AIR/OIL TANDEM 3/4", 1", 1-1/8", 1-3/8" BORE

TD



Consult PHD for Maintenance Videos.

# ENGINEERING DATA: SERIES TD AIR/OIL TANDEM 3/4", 1", 1-1/8", 1-3/8"

SPECIFICATIONS	SERIES TD
OPERATING PRESSURE STANDARD WITH -X OR -C	20 psi min to 150 psi max air 30 psi min to 150 psi max air
RESERVOIR PRESSURE	20 psi recommended
OPERATING TEMPERATURE	-20° to +180°F [-28° to +82°C]
STROKE TOLERANCE	± .032
LUBRICATION	Permanently lubricated
TANDEM FLUID	SAE 32 weight oil (viscosity at 100°F is 158. SSU at 250° is 45.1)
MAINTENANCE	Field repairable

TD

## CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE		AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
				WITH -C OR -X lb/psi	W/OUT -C OR -X lb/psi		
TD	3/4	1/4	EXTEND	.442	.835	.0016	.0019
			RETRACT	.393	.786	.0014	.0017
	1	5/16	EXTEND	.785	1.494	.0029	.0034
			RETRACT	.709	1.418	.0026	.0031
	1-1/8	3/8	EXTEND	.994	1.877	.0037	.0043
			RETRACT	.883	1.766	.0032	.0038
	1-3/8	1/2	EXTEND	1.485	2.774	.0055	.0064
			RETRACT	1.289	2.578	.0048	.0056

## MAXIMUM ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
3/4", 1", 1-1/8" TD	1/4	12"	9"	6"	—	—	—	—	—
	5/16	18"	13"	8"	—	—	—	—	—
	3/8	26"	18"	12"	—	—	—	—	—
1-3/8" TD	1/2	48"	34"	21"	—	—	—	—	—

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](http://www.phdinc.com) to view working cutaways and applications.

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

PRESSURE psi		BORE			
		3/4"	1"	1-1/8"	1-3/8"
40	Extend	0.68	2.26	2.66	3.07
	Retract	1.00	2.26	2.30	2.60
60	Extend	1.26	3.07	3.33	4.13
	Retract	1.50	3.00	3.24	3.52
80	Extend	1.71	3.42	4.28	4.80
	Retract	2.00	3.42	3.87	4.44
100	Extend	2.06	4.28	5.00	5.21
	Retract	2.44	4.44	4.61	4.80

Minimum recommended velocity for all bore sizes at pressures from 40 to 150 psi is .133 in/sec.

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

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

lbs  
psi  
in<sup>2</sup>

## SIZING AND APPLICATION ASSISTANCE

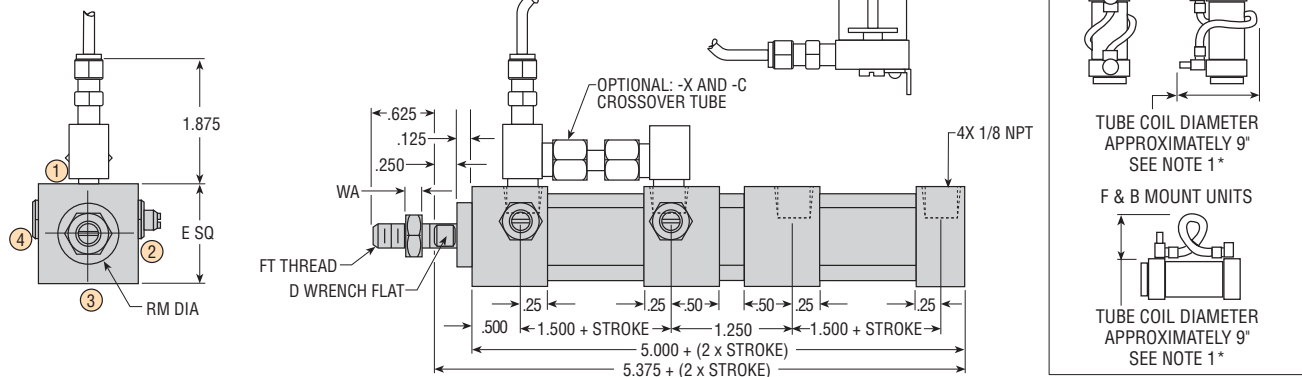
See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

# DIMENSIONS: SERIES TD AIR/OIL TANDEM 3/4", 1", 1-1/8", BORE

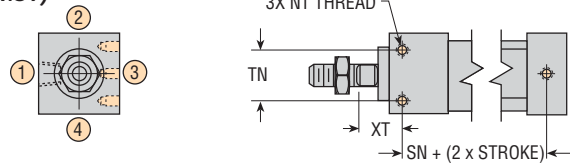
## BASIC CYLINDER DIMENSIONS

For -C reservoir dimensions and for operation notes, see next page (1-3/8) 1-83.

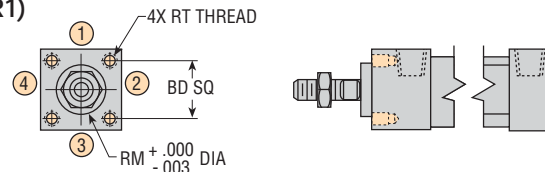
TD



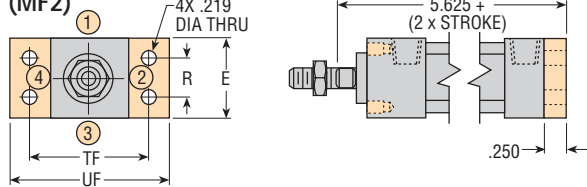
### B (MS9)



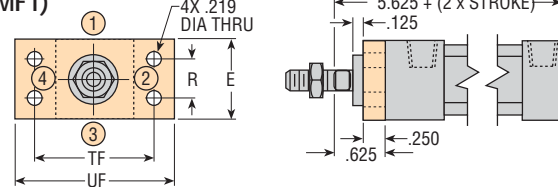
### R (MR1)



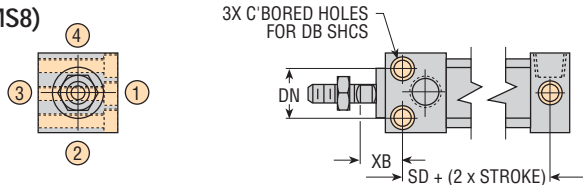
### CF (MF2)



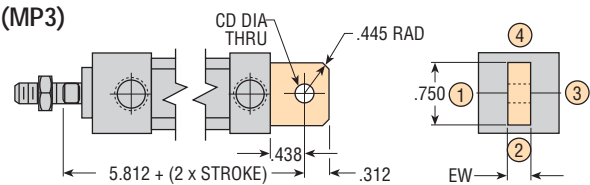
### RF (MF1)



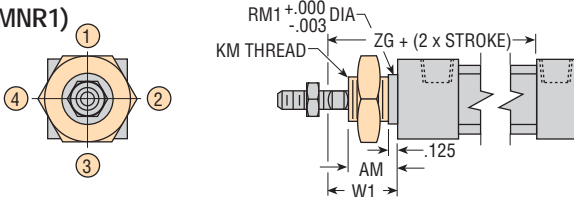
### F (MS8)



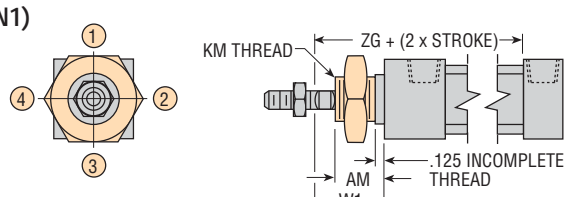
### P (MP3)



### L (MNR1)



### T (MN1)



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

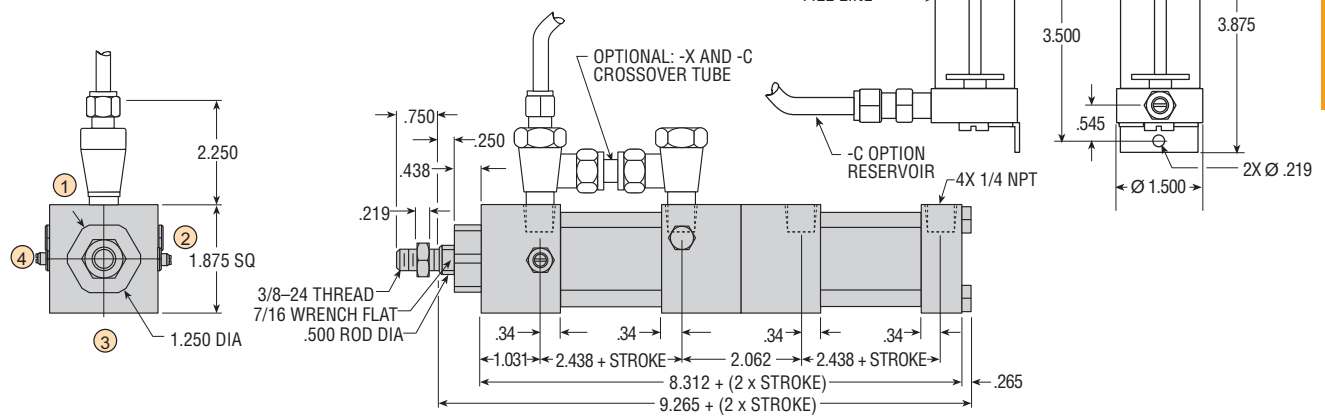
BORE SIZE	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SN	TF	TN	UF	WA	W1	XB	XT	ZG
3/4	.625	.750	.250	3/16	#8	.625	1.000	.250	1/4-28	5/8-18	8-32 x .18 DP	.500	.625	.687	8-32 x .25 DP	4.593	4.593	1.500	.625	2.000	.156	.875	.562	.562	5.875
1	.625	1.000	.375	1/4	#10	.875	1.375	.375	5/16-24	3/4-16	10-32 x .25 DP	.875	.750	.812	8-32 x .25 DP	4.531	4.531	1.875	.875	2.375	.188	.875	.625	.625	5.875
1-1/8	.875	1.125	.375	5/16	#10	1.000	1.500	.375	3/8-24	1-14	10-32 x .25 DP	1.000	.750	1.062	10-32 x .25 DP	4.531	4.531	2.000	1.000	2.500	.219	1.125	.625	.625	6.125

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

NOTE: \*FOR -X AND -C OPTIONS WITH STROKES OF 1/2" 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.

# DIMENSIONS: SERIES TD AIR/OIL TANDEM 1-3/8" BORE

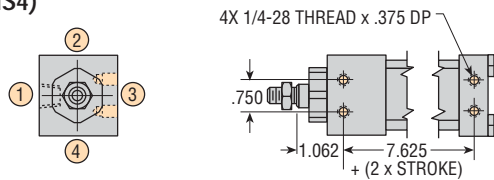
## BASIC CYLINDER DIMENSIONS



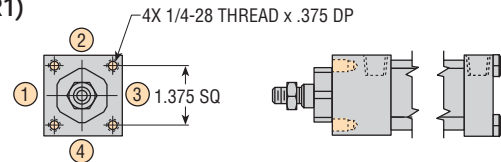
### -C Option Air/Oil Tandem Mounting and Operation Notes:

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.

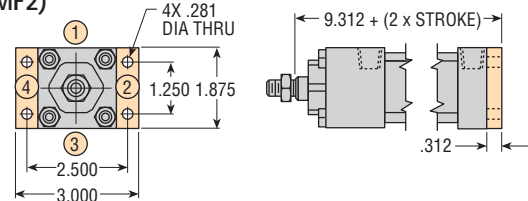
### B (MS4)



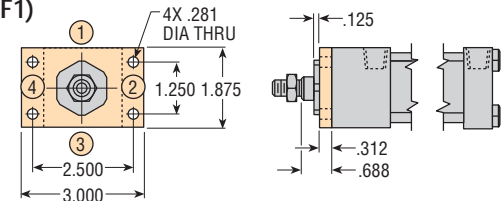
### R (MR1)



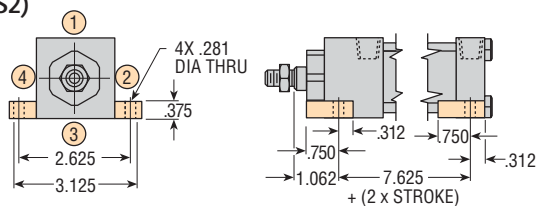
### CF (MF2)



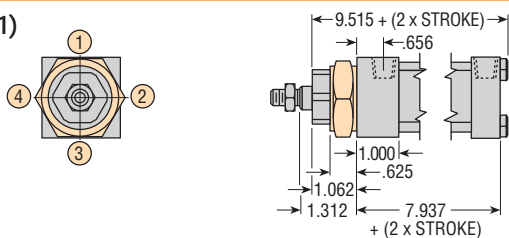
### RF (MF1)



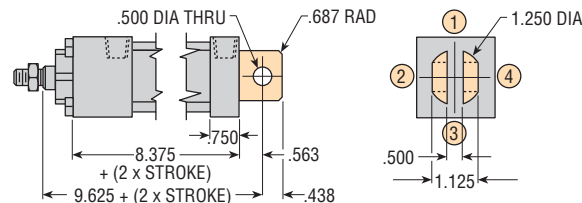
### F (MS2)



### T (MN1)



### K (MP1)



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

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

All dimensions are reference only unless specifically tolerated.

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# OPTIONS: SERIES TD AIR/OIL TANDEM 3/4", 1", 1-1/8", 1-3/8" BORE

## MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

TD

### E HALL EFFECT SWITCHES

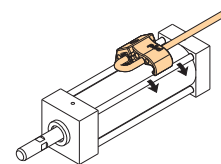
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

#### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

See Switches and Sensors section for complete switch information.

### V FLUORO-ELASTOMER SEALS

Fluoro-Elastomer 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.

### 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.)

### 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).

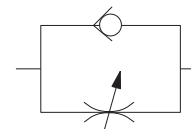
- 1) Mount reservoir vertically above hydraulic section. Extra tubing may be coiled or cut off. Shorten tubing in a manner that minimizes oil loss. Tubing and crossover should be kept full at all times.
- 2) Keep a constant 20 psi on inlet port of reservoir during operation.
- 3) Oil level in reservoir should be kept at levels indicated on tube label.

## 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", 1-3/8" BORE

## SELF-ALIGNING PISTON ROD COUPLERS

To order, specify the model number.

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	.625	1.875	.500	.875	.156
312	5/16-24	1.000	.625	1.875	.500	.875	.187
375	3/8-24	1.000	.625	1.875	.500	.875	.219
437	7/16-28	1.125	.650	2.187	.500	1.000	.250
500	1/2-20	1.125	.650	2.187	.500	1.000	.312

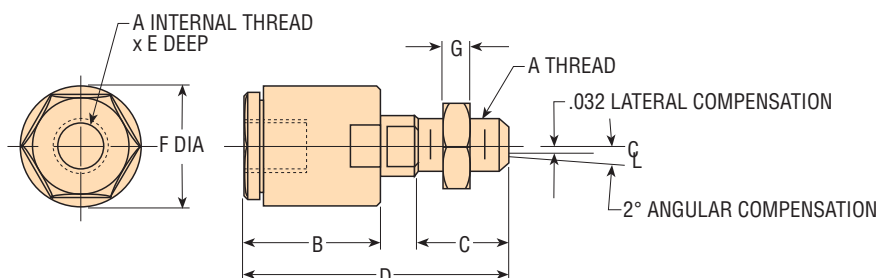
Rod Couplers eliminate expensive precision machining for mounting fixed or rigid cylinder on guide or slide applications.

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.

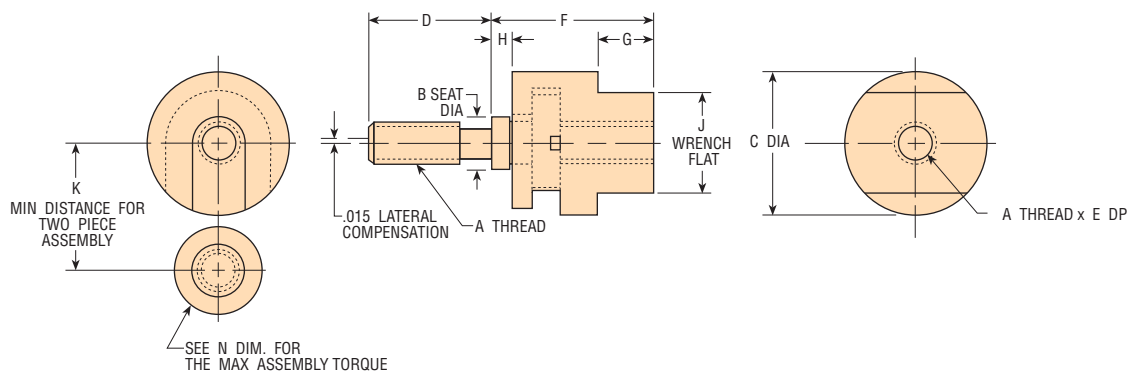
Couplers provide greater reliability and reduce cylinder and component wear, simplifying alignment problems in the field.

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

For metric piston rod couplers, see page 1-44.



## MINIATURE COUPLERS



MODEL NO.	LETTER DIMENSION										
	A	B	C	D	E	F	G	H	J	K	N
19300-01	5-40	.160	.440	.375	.250	.500	.170	.066	5/16	.390	20 in-lbs
19300-02	10/32	.250	.560	.500	.281	.558	.200	.058	3/8	.490	70 in-lbs

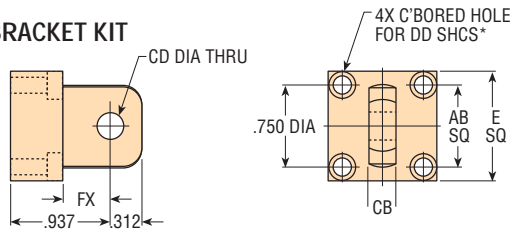
All dimensions are reference only unless specifically tolerated.

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# ACCESSORIES: SERIES TD AIR/OIL TANDEM 3/4", 1", 1-1/8", 1-3/8" BORE

TD

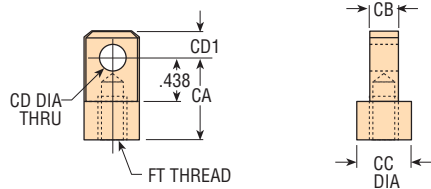
## EYE BRACKET KIT



BORE SIZE	PART NO.	LETTER DIMENSION					
		AB	CB	CD	DD*	E	FX
3/4	1077-01	.750	.248	.250	#6	1.000	.577
1 & 1-1/8	1077-03	1.000	.373	.375	#10	1.375	.437

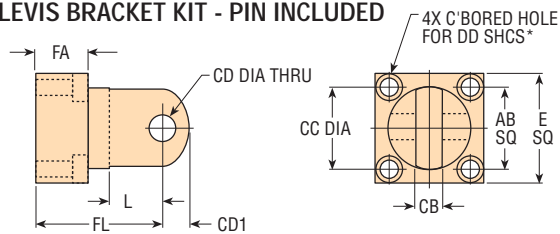
\*For 3/4 bore thru hole only.

## ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION					
		CA	CB	CC	CD	CD1	FT
3/4	1075-01	.750	.248	.500	.250	.250	1/4-28 x .375 DP
1	1075-04	.875	.373	.750	.375	.375	5/16-24 x .375 DP
1-1/8	1075-05	.875	.373	.750	.375	.375	3/8-24 x .312 DP

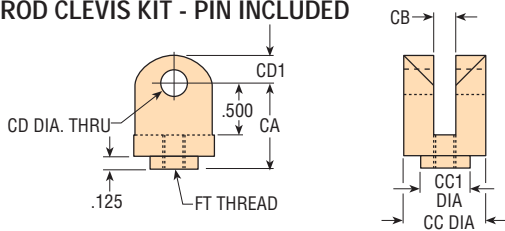
## CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	KIT NO.	LETTER DIMENSION									
		AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	12901	.750	.254	.750	.250	.250	#6	1.000	.360	1.187	.500
1 & 1-1/8	12903	1.000	.379	.875	.375	.375	#10	1.375	.500	1.250	.531

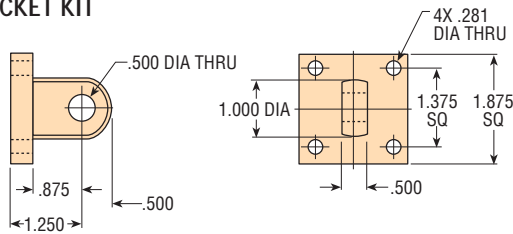
\*For 3/4 bore thru hole only.

## ROD CLEVIS KIT - PIN INCLUDED



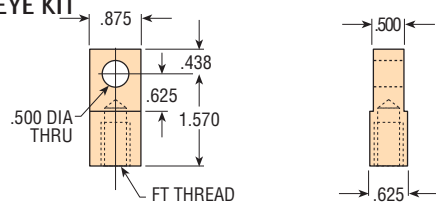
BORE SIZE	KIT NO.	LETTER DIMENSION						
		CA	CB	CC	CC1	CD	CD1	FT
3/4	12904	.812	.254	.750	.437	.250	.250	1/4-28 TO SLOT
1	12906	.875	.379	.875	.562	.375	.375	5/16-24 TO SLOT
1-1/8	12908	.875	.379	.875	.562	.375	.375	3/8-24 TO SLOT

## EYE BRACKET KIT



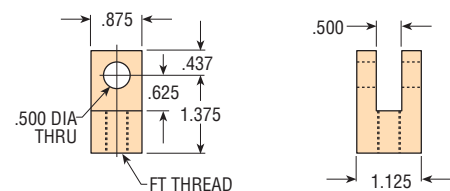
BORE SIZE	PART NO.
1-3/8	1330

## ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION	
		FT	
1-3/8	1375-01	3/8-24 x .750 DP	
1-3/8	1375-02	7/16-20 x .750 DP	

## ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	KIT NO.	LETTER DIMENSION	
		FT	
1-3/8	12909	3/8-24 TO SLOT	
1-3/8	12910	7/16-20 TO SLOT	

# AV2, HV2, A2



**tom thumb®**

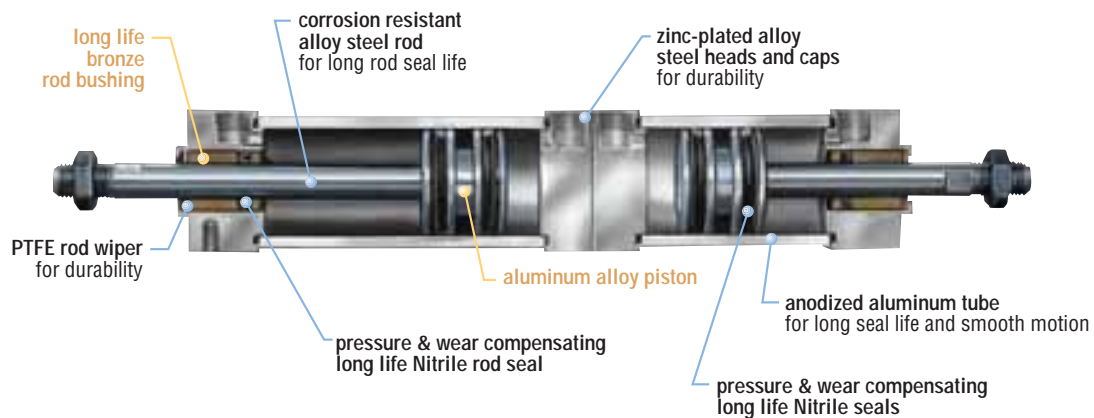
**SERIES AV2, HV2, A2  
BACK-TO-BACK  
3/4", 1", 1-1/8", AND  
1-3/8" BORE**



AV2, HV2, A2

## Series AV2

*Cutaway depicts  
a 1-1/8" bore AV2 unit.*



## 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
- Two working days delivery
- Wide range of mounting styles for easy installation
- Simple four position operation

## Industry Uses

- Packaging
- Assembly machines
- Machine loading/unloading
- General industrial automation
- Gate/diverter applications

ORDERING DATA: A2, AV2, HV2, BACK-TO-BACK; 3/4", 1", 1-1/8" , 1-3/8" BORE

AV2, HV2, A2

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  
(Series A not available  
in 1-3/8" Bore.)

AV

2

TYPE

2 - Back to Back Cylinder

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.

2

x

1

B

1-3/8

2

AV

MOUNTING STYLE

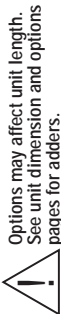
F - Foot Mount, C'bored through holes  
B - Bottom Mount, Tapped holes in head  
and cap  
R - Rod Mount, Tapped holes on front  
face of head  
T - Thread Mount, Threaded snout on  
head (shipped with mounting nut)  
RF - Rod end flange  
\*L - Pilot Mount, Threaded snout and pilot  
diameter on head (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 - Fluoro-Elastomer Seals

PROXIMITY SWITCH MOUNTING BRACKETS		
SERIES	BORE	SIZE NO.
AV, HV	3/4"	-31
	1"	-32
	1-1/8"	-33
	1-3/8"	-34

See Switches and Sensors section  
for complete ordering information.



Options may affect unit length.  
See unit dimension and options  
pages for adders.

# ENGINEERING DATA: A2, AV2, HV2, BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

SPECIFICATIONS	SERIES AV2	SERIES HV2	SERIES A2
OPERATING PRESSURE	20 to 150 psi air	40 to 1500 psi hyd*	20 to 150 psi air
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	±.032	±.032	±.032
LUBRICATION	Permanently lubricated	—	Permanently lubricated
MAINTENANCE	Field repairable	Field repairable	Field repairable

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

## CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
AV2, HV2, A2	3/4	1/4	EXTEND	.442	.0016	.0019
			RETRACT	.393	.0014	.0017
	1	5/16	EXTEND	.785	.0029	.0034
			RETRACT	.709	.0026	.0031
	1-1/8	3/8	EXTEND	.994	.0037	.0043
			RETRACT	.883	.0032	.0038
	1-3/8	1/2	EXTEND	1.485	.0055	.0064
			RETRACT	1.289	.0048	.0056

## MAXIMUM ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
3/4", 1", 1-1/8" AV2, HV2, A2	1/4	12"	9"	6"	4"	3"	2"	—	—
	5/16	18"	13"	8"	6"	5"	4"	—	—
	3/8	26"	18"	12"	9"	7"	6"	—	—
1-3/8" AV2, HV2	1/2	48"	34"	21"	15"	12"	11"	—	—

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
AV2 PLAIN	3/4	.42	.04
	1	.87	.07
	1-1/8	.95	.10
	1-3/8	2.56	.12

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

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

## SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

## AV2, HV2, A2



## SERIES A2 CYLINDERS

## SERIES AV2 CYLINDERS

## SERIES HV2 CYLINDERS

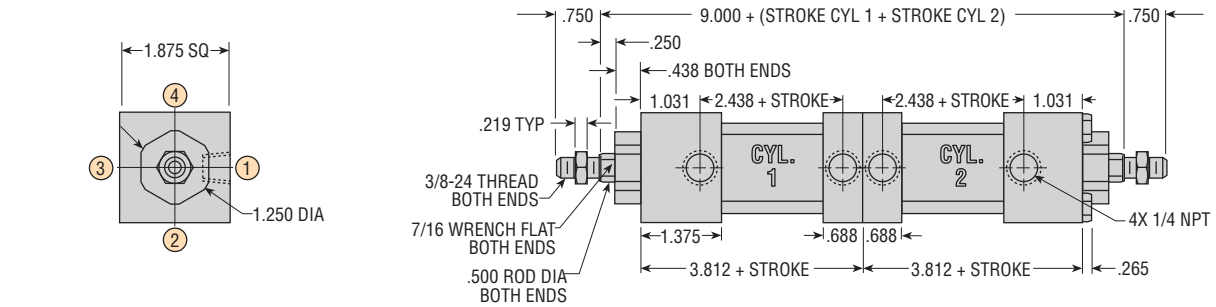
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

CUSHIONS: ADD 1" TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (2" TOTAL TO OVERALL)

**SHOCK PADS: ADD 1/2" TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (1" TOTAL TO OVERALL)**

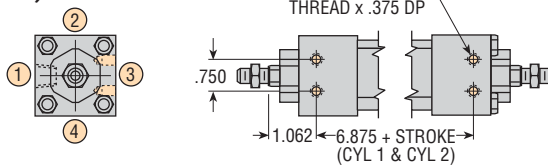
# DIMENSIONS: SERIES AV2, HV2 BACK-TO-BACK; 1-3/8" BORE

## BASIC CYLINDER DIMENSIONS

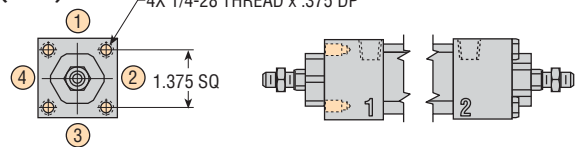


AV2, HV2, A2

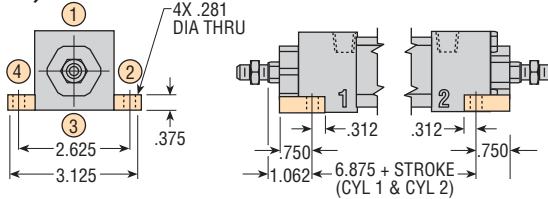
### B (MS4)



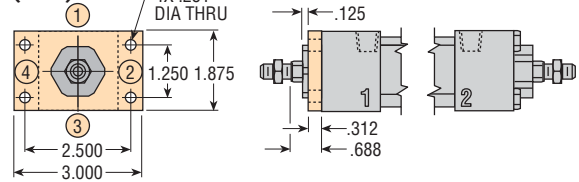
### R (MR1)



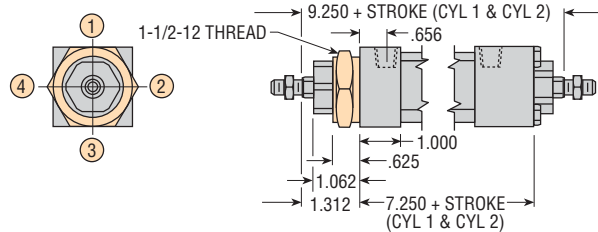
### F (MS2)



### RF (MF1)



### T (MN1)



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 1/2" TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (1" TOTAL TO OVERALL)

# OPTIONS: SERIES A2, AV2, HV2 BACK-TO-BACK; 3/4", 1", 1-1/8" , 1-3/8" BORE

P

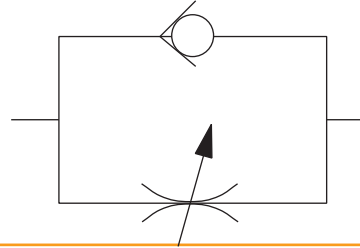
## PORT CONTROL®

AV2, HV2, A2

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.



D

## ADJUSTABLE CUSHION

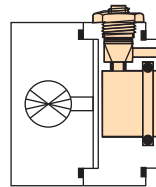
PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

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

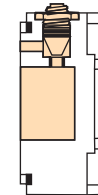
Effective cushion length 1/2"

CUSHION BLOCK



3/4", 1", 1-1/8" BORE

POPPET STYLE

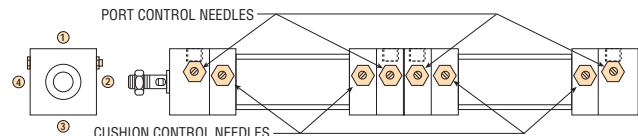


1-3/8" BORE

## STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS

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

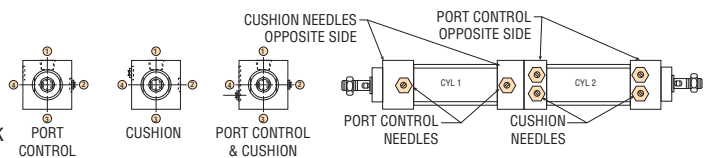
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A2, AV2, and HV2. Consult PHD for special Port Control® or cushion needle positions.



## 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.

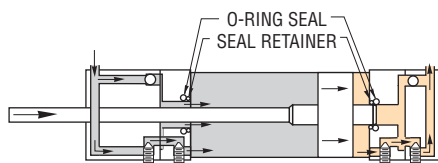


## PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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.

CUSHION BLOCK STYLE

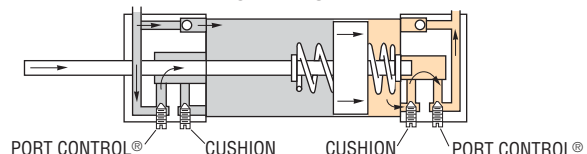


## PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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.

POPPET STYLE





# OPTIONS: SERIES A2, AV2, HV2 BACK-TO-BACK; 3/4", 1", 1-1/8" , 1-3/8" BORE

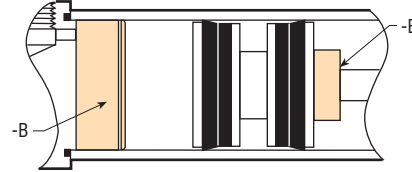


## SHOCK PADS

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

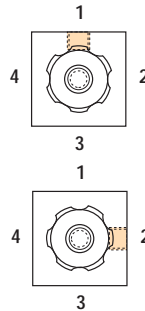


AV2, HV2, A2

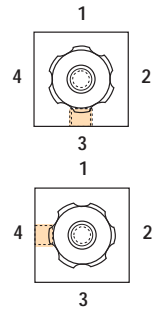
## PORT POSITIONS

Port position 1 is standard on all cylinders.

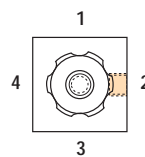
### PORT POSITION 1 (STANDARD)



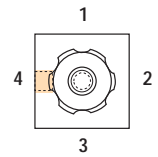
### PORT POSITION 3



### PORT POSITION 2



### 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.

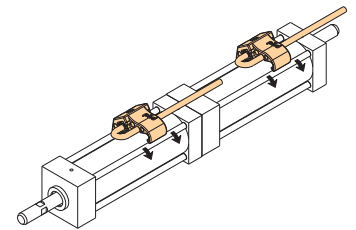
#### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

See Switches and Sensors section for complete switch information.



### FLUORO-ELASTOMER SEALS



### 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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

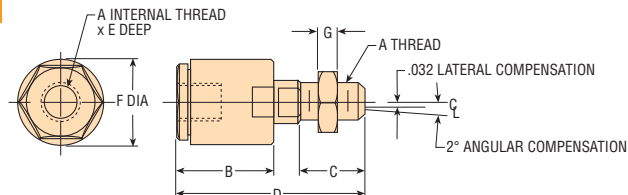
See Switches and Sensors section for complete switch information.

# ACCESSORIES: A2, AV2, HV2 MOUNTING ATTACHMENTS 3/4", 1", 1-1/8", 1-3/8"

## SELF-ALIGNING PISTON ROD COUPLERS

To order, specify the model number.

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	.625	1.875	.500	.875	.156
312	5/16-24	1.000	.625	1.875	.500	.875	.187
375	3/8-24	1.000	.625	1.875	.500	.875	.219
437	7/16-20	1.125	.650	2.187	.500	1.000	.250



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

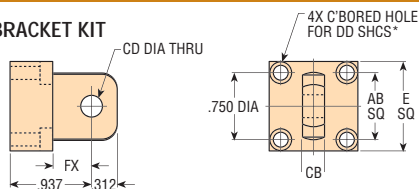
Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.

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.

For metric piston rod couplers, see page 1-44.

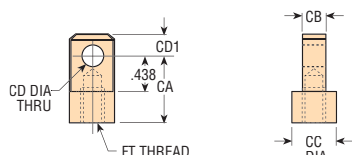
### EYE BRACKET KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION						
			AB	CB	CD	DD*	E	FX	
3/4	A2, AV2, HV2	1077-01	.750	.248	.250	#6	1.000	.577	
1 &	A2	1077-02	1.000	.373	.250	#10	1.375	.437	
1-1/8	AV2, HV2	1077-03	1.000	.373	.375	#10	1.375	.437	

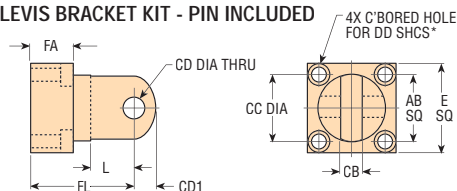
\*For 3/4 bore thru hole only.

### ROD EYE KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CD	CD1	FT	
3/4	A2, AV2	1075-01	.750	.248	.500	.250	.250	1/4-28 x .375 DP	
1	A2	1075-02	.875	.373	.750	.250	.375	5/16-24 x .375 DP	
	AV2	1075-04	.875	.373	.750	.375	.375	5/16-24 x .375 DP	
1-1/8	A2	1075-03	.875	.373	.750	.250	.375	3/8-24 x .312 DP	
	AV2	1075-05	.875	.373	.750	.375	.375	3/8-24 x .312 DP	

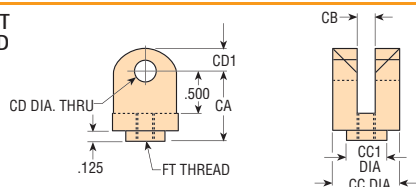
### CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION									
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A2, AV2	12901	.750	.254	.750	.250	.250	#6	1.000	.360	1.187	.500
1 &	A2	12902	1.000	.379	.875	.250	.375	#10	1.375	.500	1.250	.531
1-1/8	AV2	12903	1.000	.379	.875	.375	.375	#10	1.375	.500	1.250	.531

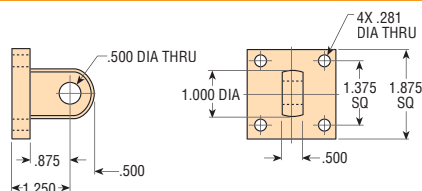
\*For 3/4 bore thru hole only.

### ROD CLEVIS KIT - PIN INCLUDED



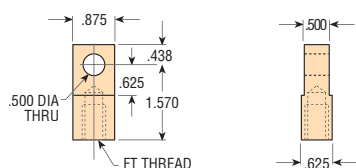
BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION							
			CA	CB	CC	CC1	CD	CD1	FT	
3/4	A2, AV2	12904	.812	.254	.750	.437	.250	.250	1/4-28 TO SLOT	
1	A2	12905	.875	.379	.875	.562	.250	.375	5/16-24 TO SLOT	
	AV2	12906	.875	.379	.875	.562	.375	.375	5/16-24 TO SLOT	
1-1/8	A2	12907	.875	.379	.875	.562	.250	.375	3/8-24 TO SLOT	
	AV2	12908	.875	.379	.875	.562	.375	.375	3/8-24 TO SLOT	

### EYE BRACKET KIT



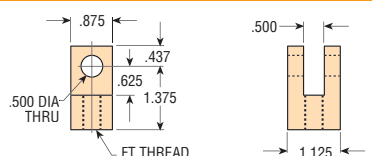
BORE SIZE	CYL SERIES	PART NO.
1-3/8	AV2, HV2	1330

### ROD EYE KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION FT
1-3/8	AV2, HV2	1375-01	3/8-24 x .750 DP

### ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION FT
1-3/8	AV2, HV2	12909	3/8-24 TO SLOT

# A3V, H3V, A3



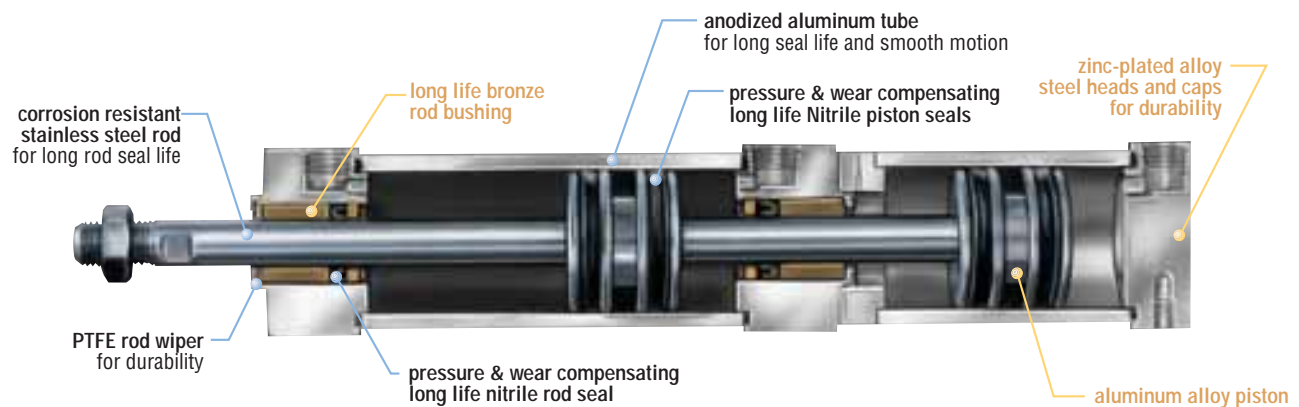
## SERIES A3V, H3V, A3 THREE POSITION 3/4", 1", 1-1/8", AND 1-3/8" BORE

**tom thumb®**

A3, A3V, H3V

### SERIES A3V

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



### Major Benefits

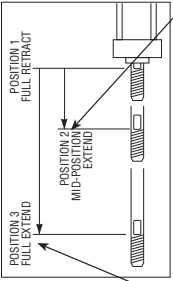
- Four linear positions from piston rod
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Two working days delivery
- Wide range of mounting styles for easy installation
- Simple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

### Industry Uses

- Packaging
- Assembly machines
- Machine loading/unloading
- General industrial automation
- Gate/diverter applications

ORDERING DATA: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE

A3, A3V, H3V



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 TIRED FAILURE.

CYLINDER SERIES

AV - 150 psi Air  
HV - 1500 psi Hyd.  
A - 150 psi Air  
(Series A 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 (TOTAL STROKE)

3/4" BORE SIZE  
1/4" to 6"  
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 (FROM RETRACT TO MID POSITION)

3/4" BORE SIZE  
1/4" to 6"  
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

A 3 V

R - 3/4 x 1

1/2 - P-M

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)  
\* 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", 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 all heads and cap, full extension and retraction only, not on mid-position extension  
V - Fluoro-Elastomer Seals

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	BORE	SIZE NO.
AV, HV	3/4"	-31
	1"	-32
	1-1/8"	-33
	1-3/8"	-34

See Switches and Sensors section for complete ordering information.

Options may affect unit length. See unit dimension and options pages for adders.

# ENGINEERING DATA: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE

SPECIFICATIONS	SERIES AV3	SERIES HV3	SERIES A3
OPERATING PRESSURE	20 to 150 psi air	40 to 1500 psi hyd*	20 to 150 psi air
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	±.032	±.032	±.032
LUBRICATION	Permanently lubricated	—	Permanently lubricated
MAINTENANCE	Field repairable	Field repairable	Field repairable

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

## CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
A3V, H3V, A3	3/4	1/4	EXTEND	.442	.0016	.0019
			RETRACT	.393	.0014	.0017
	1	5/16	EXTEND	.785	.0029	.0034
			RETRACT	.709	.0026	.0031
	1-1/8	3/8	EXTEND	.994	.0037	.0043
			RETRACT	.883	.0032	.0038
	1-3/8	1/2	EXTEND	1.485	.0055	.0064
			RETRACT	1.289	.0048	.0056

## MAXIMUM ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
3/4", 1", 1-1/8" A3V, H3V, A3	1/4	12"	9"	6"	4"	3"	—	—	—
	5/16	18"	13"	8"	6"	5"	—	—	—
	3/8	26"	18"	12"	9"	7"	—	—	—
1-3/8" A3V, H3V	1/2	48"	34"	21"	15"	12"	—	—	—

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
AVR	3/4	.42	.04
	1	.87	.07
	1-1/8	.95	.10
	1-3/8	2.56	.12

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

F = Cylinder Force                      lbs  
P = Operating Pressure                      psi  
A = Effective Area                      in<sup>2</sup>  
(Extend or Retract)

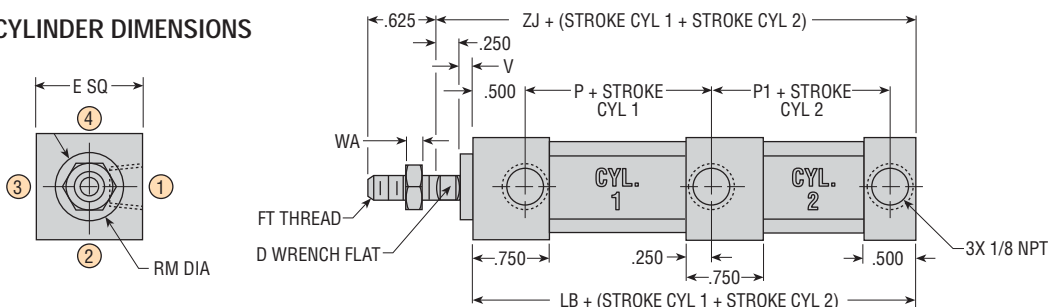
## SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

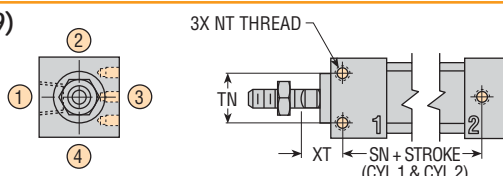
# DIMENSIONS: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", BORE

A3, A3V, H3V

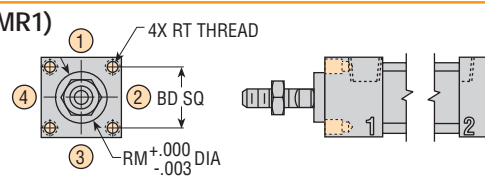
## BASIC CYLINDER DIMENSIONS



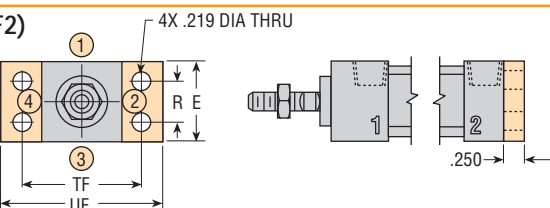
### B (MS9)



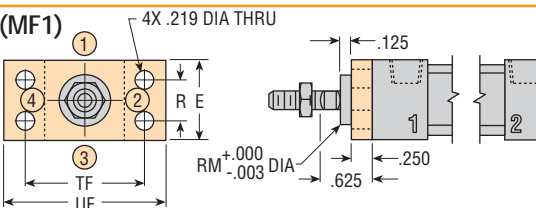
### R (MR1)



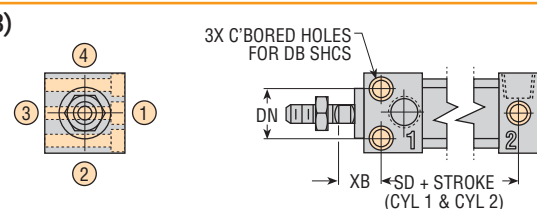
### CF (MF2)



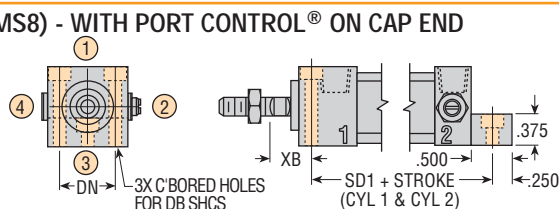
### RF (MF1)



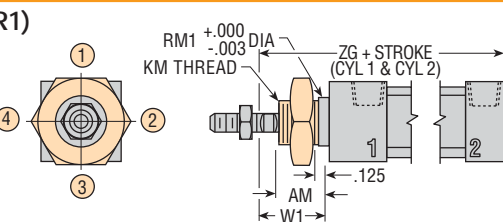
### F (MS8)



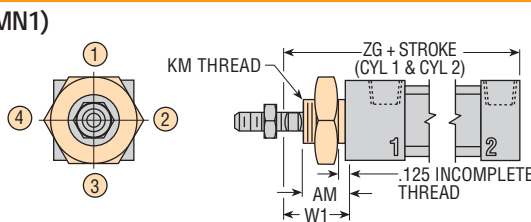
### F (MS8) - WITH PORT CONTROL® ON CAP END



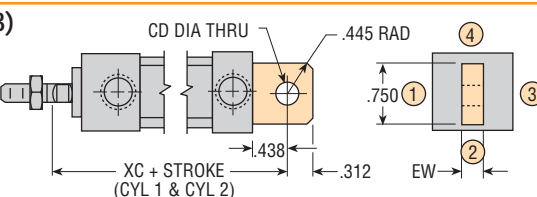
### L (MNR1)



### T (MN1)



### P (MP3)



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

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS  
CUSHIONS: ADD 1/2" TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR CUSHIONS (ADD TOTAL OF 1" TO OVERALL LENGTH)  
SHOCK PADS: ADD 1/4" TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR SHOCK PADS (ADD TOTAL OF 1/2" TO OVERALL LENGTH)

#### DIMENSIONS COMMON TO ALL SERIES

BORE SIZE	BD	D	DB	DF	DN	E	EW	FT	NT	R	RM	RT	TF	TN	UB	UF	WA
3/4	.750	3/16	#8	1.375	.625	1.000	.250	1/4-28	8-32 x .18 DP	.500	.625	8-32 x .25 DP	1.500	.625	1.750	2.000	.156
1	1.000	1/4	#10	1.750	.875	1.375	.375	5/16-24	10-32 x .25 DP	.875	.750	8-32 x .25 DP	1.875	.875	2.125	2.375	.188
1-1/8	1.125	5/16	#10	1.875	1.000	1.500	.375	3/8-24	10-32 x .25 DP	1.000	.750	10-32 x .25 DP	2.000	1.000	2.250	2.500	.219

#### SERIES A3 CYLINDERS

BORE SIZE	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	.625	.250	5/8-18	3.312	1.000	1.562	.687	2.875	3.375	2.875	.125	.875	.562	4.125	.562	4.187	3.687
1	.625	.250	3/4-16	3.312	1.000	1.562	.812	2.812	3.312	2.812	.125	.875	.625	4.125	.625	4.187	3.687
1-1/8	.625	.250	3/4-16	3.312	1.000	1.562	.812	2.812	3.312	2.812	.125	.875	.625	4.125	.625	4.187	3.687

#### SERIES A3V CYLINDERS

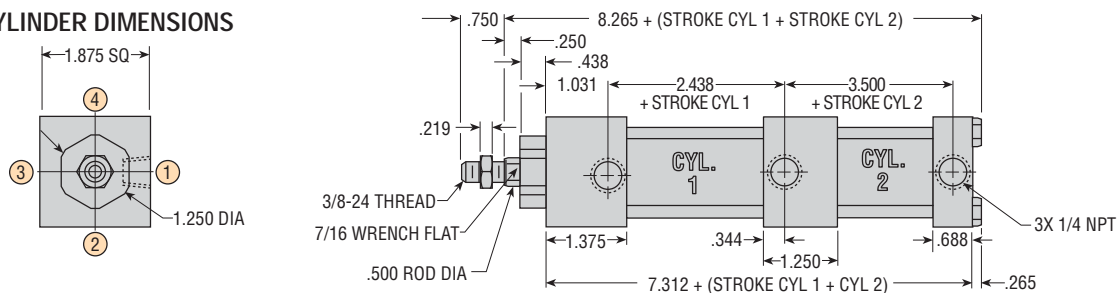
BORE SIZE	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	.625	.250	5/8-18	4.312	1.500	2.062	.687	3.875	4.375	3.875	.125	.875	.562	5.125	.562	5.187	4.687
1	.625	.375	3/4-16	4.312	1.500	2.062	.812	3.812	4.312	3.812	.125	.875	.625	5.125	.625	5.187	4.687
1-1/8	.625	.375	1-14	4.312	1.500	2.062	1.062	3.812	4.312	3.812	.125	1.125	.625	5.125	.625	5.437	4.687

#### SERIES H3V CYLINDERS

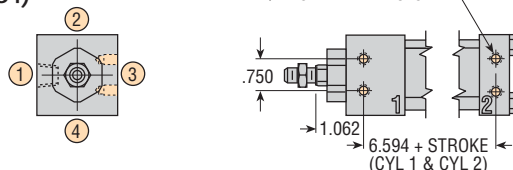
BORE SIZE	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	.625	.250	5/8-18	4.312	1.500	2.062	.687	3.875	4.375	3.875	.375	.875	.812	5.375	.812	5.187	4.937
1	.625	.375	3/4-16	4.312	1.500	2.062	.812	3.812	4.312	3.812	.375	.875	.875	5.375	.875	5.187	4.937
1-1/8	.875	.375	1-14	4.312	1.500	2.062	1.062	3.812	4.312	3.812	.375	1.125	.875	5.375	.875	5.437	4.937

# DIMENSIONS: SERIES A3V, H3V 1-3/8" BORE

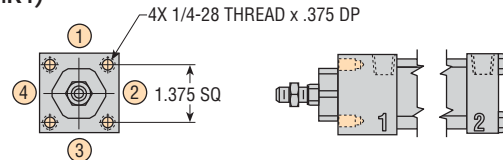
## BASIC CYLINDER DIMENSIONS



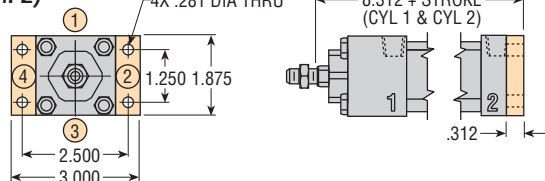
### B (MS4)



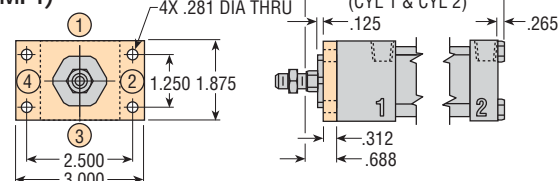
### R (MR1)



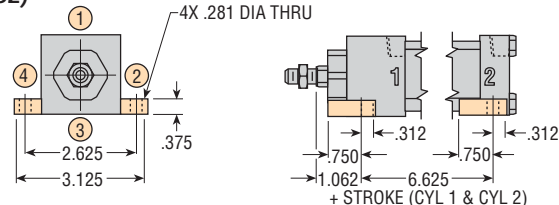
### CF (MF2)



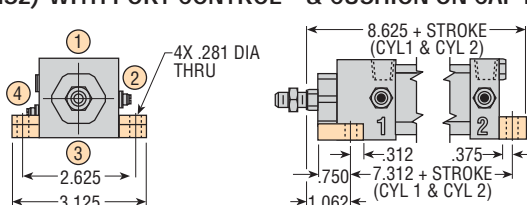
### RF (MF1)



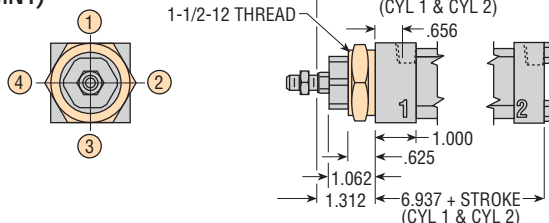
### F (MS2)



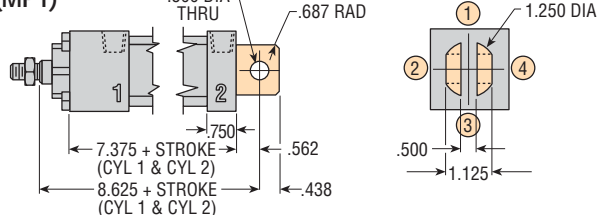
### F (MS2)-WITH PORT CONTROL® & CUSHION ON CAP END



### T (MN1)



### K (MP1)



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 1/4" TO (+ STROKE) DIMENSIONS OF EACH CYLINDER 1 AND CYLINDER 2 (ADD A TOTAL OF 1/2" TO OVERALL LENGTH)



# OPTIONS: SERIES A3, A3V, H3V, 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE

A3, A3V, H3V

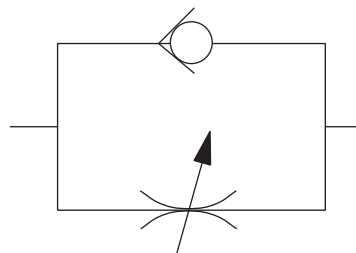
P

## 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.



D

## 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.

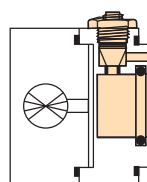
See Dimension pages for dimensional information.

3/4", 1", 1-1/8" Series A3, A3V, and H3V = Cushion Block

1-3/8" Series A3V and H3V = Poppet Style

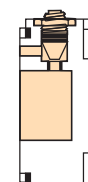
Effective cushion length 1/2"

### CUSHION BLOCK



3/4", 1", 1-1/8" BORE

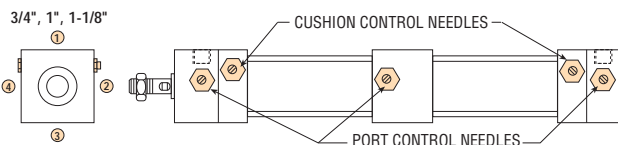
### POPPET STYLE



1-3/8" BORE

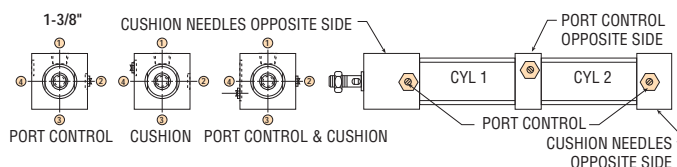
## STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS (3/4", 1", 1-1/8" Bore Series A3, A3V, and H3V Cylinders)

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.



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

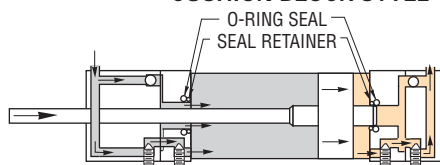
Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.



## PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION (3/4", 1", 1-1/8" Bore Series A3, 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.

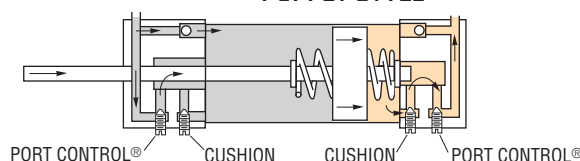
### CUSHION BLOCK STYLE



## PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION (1-3/8" Bore Series A3V and H3V 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.

### POPPET STYLE





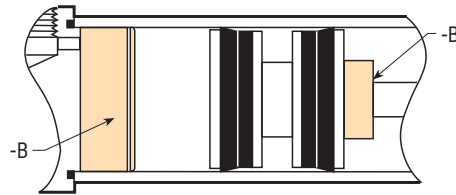
# OPTIONS: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE



## 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)



A3, A3V, H3V

## 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.

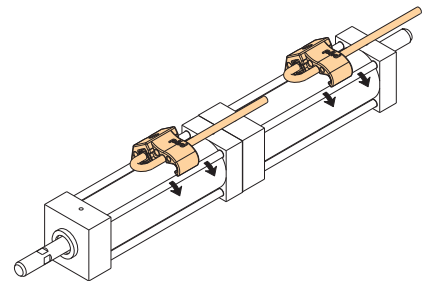
### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

See Switches and Sensors section for complete switch information.



## FLUORO-ELASTOMER SEALS

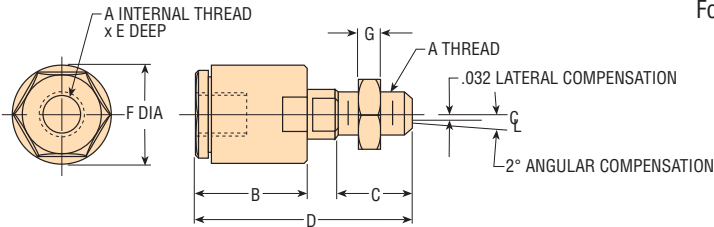
Fluoro-Elastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

# ACCESSORIES: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE

## SELF-ALIGNING PISTON ROD COUPLERS

To order, specify the model number.

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	.625	1.875	.500	.875	.156
312	5/16-24	1.000	.625	1.875	.500	.875	.187
375	3/8-24	1.000	.625	1.875	.500	.875	.219
437	7/16-20	1.125	.650	2.187	.500	1.000	.250



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.

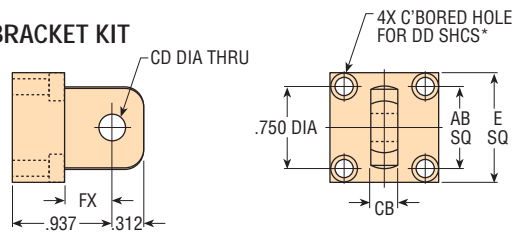
Couplers provide greater reliability and reduce cylinder and component wear, simplifying alignment problems in the field.

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

For metric piston rod couplers, see page 1-44.

# ACCESSORIES: SERIES A3, A3V, H3V 3/4", 1", 1-1/8", 1-3/8", 1-3/8" BORE

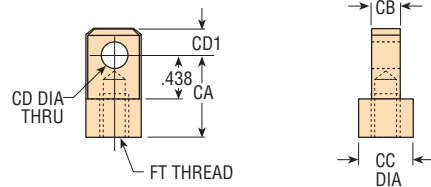
## EYE BRACKET KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION					
			AB	CB	CD	DD*	E	FX
3/4	A3, A3V, H3V	1077-01	.750	.248	.250	#6	1.000	.577
1 &	A3	1077-02	1.000	.373	.250	#10	1.375	.437
1-1/8	A3V, H3V	1077-03	1.000	.373	.375	#10	1.375	.437

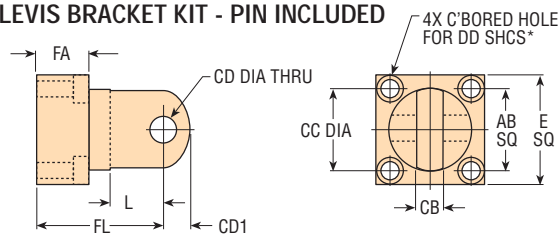
\*For 3/4 bore thru hole only.

## ROD EYE KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION					
			CA	CB	CC	CD	CD1	FT
3/4	A3, A3V, H3V	1075-01	.750	.248	.500	.250	.250	1/4-28 x .375 DP
1	A3	1075-02	.875	.373	.750	.250	.375	5/16-24 x .375 DP
	A3V, H3V	1075-04	.875	.373	.750	.375	.375	5/16-24 x .375 DP
1-1/8	A3	1075-03	.875	.373	.750	.250	.375	3/8-24 x .312 DP
	A3V, H3V	1075-05	.875	.373	.750	.375	.375	3/8-24 x .312 DP

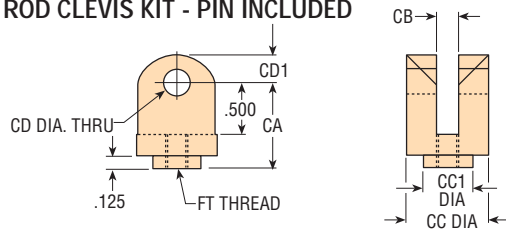
## CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION									
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A3, A3V, H3V	12901	.750	.254	.750	.250	.250	#6	1.000	.360	1.187	.500
1 &	A3	12902	1.000	.379	.875	.250	.375	#10	1.375	.500	1.250	.531
1-1/8	A3V, H3V	12903	1.000	.379	.875	.375	.375	#10	1.375	.500	1.250	.531

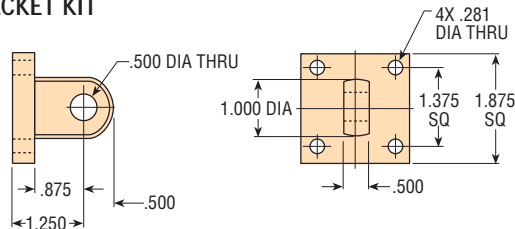
\*For 3/4 bore thru hole only.

## ROD CLEVIS KIT - PIN INCLUDED



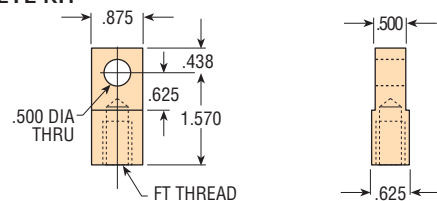
BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION							
			CA	CB	CC	CC1	CD	CD1	FT	
3/4	A3, A3V, H3V	12904	.812	.254	.750	.437	.250	.250	1/4-28 TO SLOT	
1	A3	12905	.875	.379	.875	.562	.250	.375	5/16-24 TO SLOT	
	A3V, H3V	12906	.875	.379	.875	.562	.375	.375	5/16-24 TO SLOT	
1-1/8	A3	12907	.875	.379	.875	.562	.250	.375	3/8-24 TO SLOT	
	A3V, H3V	12908	.875	.379	.875	.562	.375	.375	3/8-24 TO SLOT	

## EYE BRACKET KIT



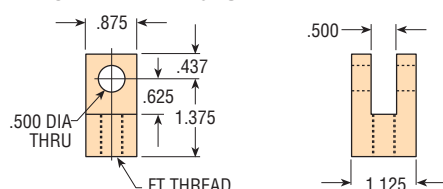
BORE SIZE	CYL SERIES	PART NO.
1-3/8	A3V, H3V	1330

## ROD EYE KIT



BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION FT
1-3/8	A3V, H3V	1375-01	3/8-24 x .750 DP

## ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	CYL SERIES	KIT NO.	LETTER DIMENSION FT
1-3/8	A3V, H3V	12909	3/8-24 TO SLOT



# NPG, NHG



tom thumb®

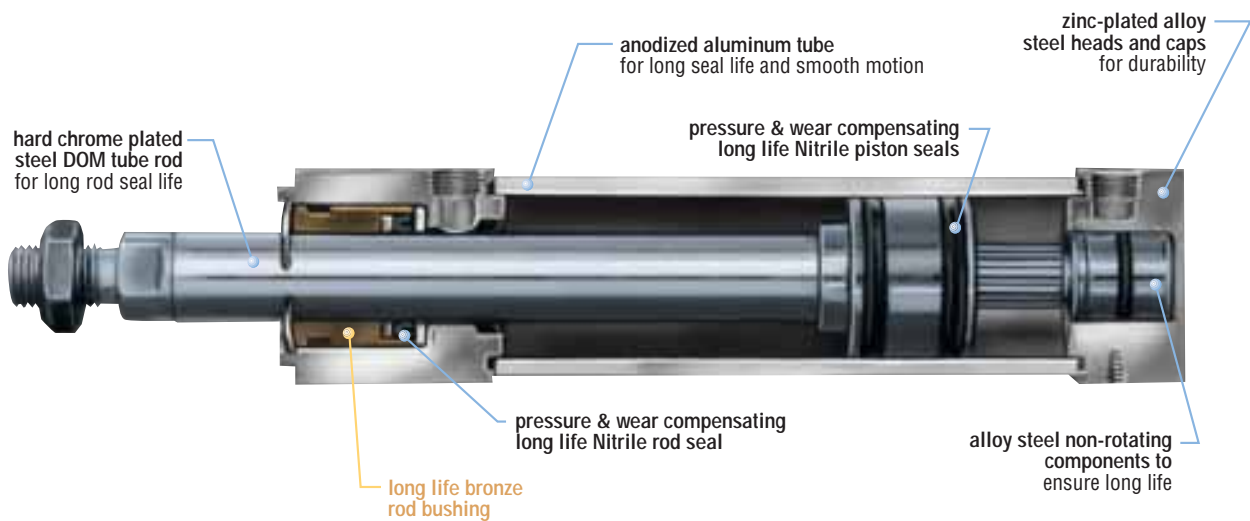
NPG, NHG

## NON-ROTATING ROD CYLINDERS 1-1/8" AND 1-3/8" BORE



### Series NP

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



### 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

### Industry Uses

- Packaging
- Assembly machines
- Machine loading/unloading
- General industrial automation

# ORDERING DATA: SERIES NPG & NHG CYLINDERS

NPG, NHG

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  
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.)

SC

NPG

MF1

1-1/8 x 2

P

B

N-V-Z1

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

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 - Fluoro-Elastomer Seals  
W - Close Tolerance Stroke, ± .005 Stroke Length  
Z1 - Electroless Nickel Plate all ferrous parts

PROXIMITY SWITCH  
MOUNTING BRACKETS

SERIES	BORE	SIZE NO.
NPG, NHG	1-1/8"	-33
	1-3/8"	-36

See Switches and Sensors section  
for complete ordering information.

NOTE: SAE Ports available.  
Consult PHD for sizes.

# ENGINEERING DATA: SERIES NPG & NHG CYLINDERS

NPG, NHG

SPECIFICATIONS	SERIES NPG	SERIES NHG
OPERATING PRESSURE	20 to 150 psi air	40 to 1500 psi hyd*
OPERATING TEMPERATURE	-20° to 180°F [-28° to 82°C]	-20° to 180°F [-28° to 82°C]
STROKE TOLERANCE	±.032 inch	±.032 inch
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

BORE	ROD DIA in	ROD DIRECTION	EFFECTIVE AREA	AIR CONSUMPTION	DISPLACEMENT GAL/in OF STROKE	BASE WEIGHT	ADDER PER 1" OF STROKE
			FORCE lb/psi	at 80 psi CUBIC ft/in OF STROKE			
1-1/8	5/8	EXTEND	0.994	.0037	.0043	1.55	.14
		RETRACT	.687	.0026	.0300		
1-3/8	3/4	EXTEND	1.485	.0055	.0064	2.16	.19
		RETRACT	1.043	.0039	.0045		

## MAXIMUM ALLOWABLE EXTEND STROKE

BORE	ROD DIA in	CYLINDER FORCE						
		100	200	500	1000	1500	2000	3000
1-1/8	5/8	44	44	28	20	16	14	—
1-3/8	3/4	44	44	41	29	23	20	—

## CYLINDER FORCE CALCULATIONS

IMPERIAL

$$F = P \times A$$

F = Cylinder Force      lbs  
 P = Operating Pressure      psi  
 A = Effective Area      in<sup>2</sup>  
 (Extend or Retract)

### SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.  
Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)

## 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.

BORE	C VALUE
1-1/8	470,000
1-3/8	990,000

$$D = \frac{W \times L^3}{C}$$

D = Deflection at rod end  
 L = Distance in inches from bushing to applied side load  
 W = Sideload in pounds

## 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:

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

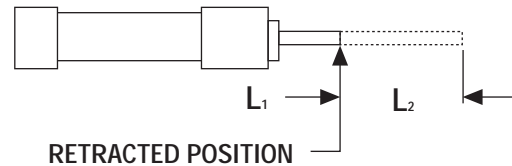
BORE	SERIES	K <sub>1</sub>	K <sub>2</sub>	C
1-1/8	NP	8.7	34.8	.18
1-3/8	NP	15.6	74.8	.10

Where:

θ = Angular deflection in minutes of arc

T = Torque applied (in/lb)

L<sub>1</sub> = Distance that rod is extended



L<sub>2</sub> = Stroke length

K<sub>1</sub> = Constant reflecting the polar moment of inertia and the modulus of rigidity for the spline rod

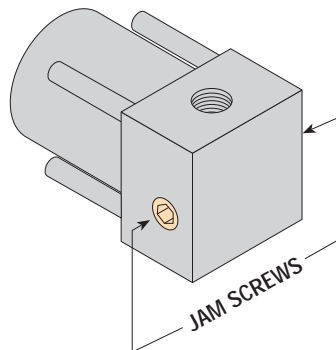
K<sub>2</sub> = Constant reflecting the polar moment of inertia and the modulus of rigidity for the piston rod

C = Constant value of deflection on spline and piston rod regardless of piston position

## 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.

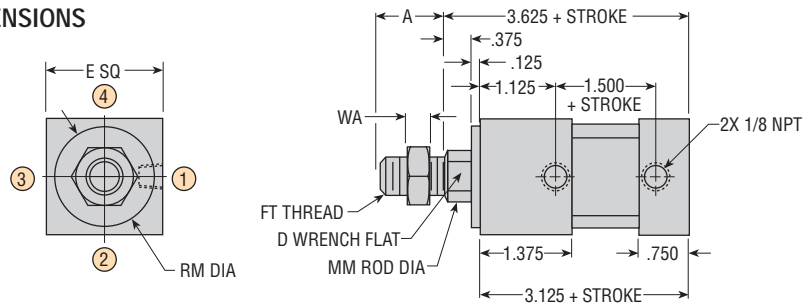
BORE	MAX. TORQUE	TIGHTENING TORQUE
	in-lb	ON JAM SCREWS in-lb
1-1/8	48	85
1-3/8	72	85





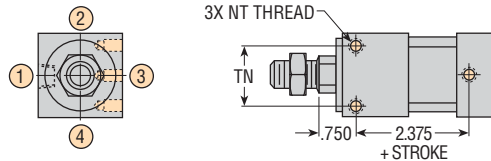
# DIMENSIONS: SERIES NPG & NHG CYLINDERS

## BASIC CYLINDER DIMENSIONS

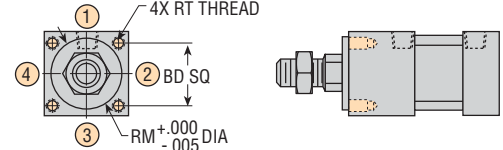


NPG, NHG

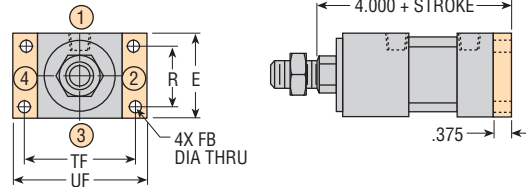
### MS9



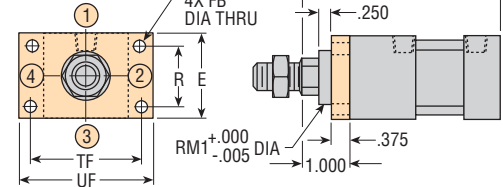
### MR1



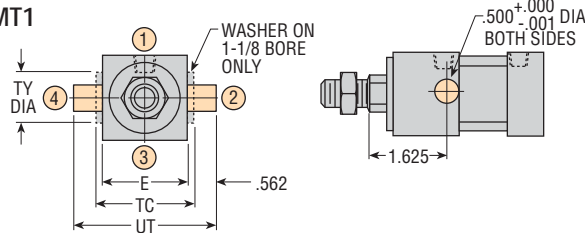
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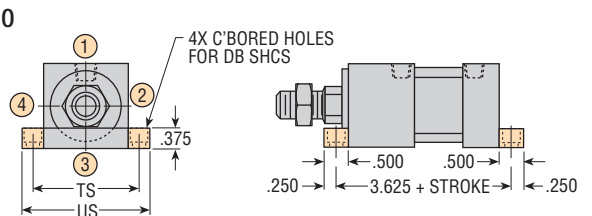
### MF1



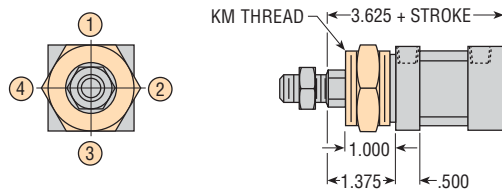
### MT1



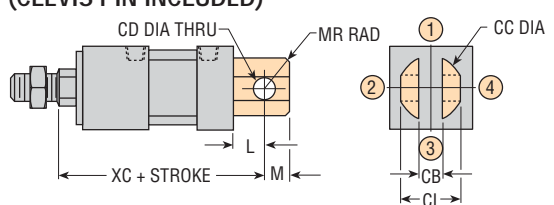
### MS10



### MN1



### MP1 (CLEVIS PIN INCLUDED)



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

BORE	LETTER DIMENSION																
SIZE	A	BD	CB	CC	CD	CL	D	DB	E	FB	FT	KM	L	M	MM	MR	NT
1-1/8	.750	1.125	.375	.875	.375	.875	.500	#10	1.500	.219	7/16-20	1-1/4-12	.750	.375	.625	.440	10-32 x .25 DP
1-3/8	1.000	1.375	.500	1.250	.500	1.125	.625	1/4	1.750	.281	9/16-18	1-1/2-12	.625	.500	.750	.720	1/4-28 x .38 DP

BORE	LETTER DIMENSION													
SIZE	R	RM	RM1	RT	TC	TF	TN	TS	TY	UF	US	UT	WA	XC
1-1/8	1.000	1.250	1.000	10-32 x.25 DP	1.750	2.000	1.000	1.875	1.000	2.500	2.250	2.625	.250	4.375
1-3/8	1.250	1.500	1.125	1/4-28 x.38 DP	N/A	2.250	1.250	2.188	N/A	2.750	2.625	2.875	.312	4.250

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

SHOCK PADS: ADD 1/4" 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 toleranced.

[www.phdinc.com/npg-nhg](http://www.phdinc.com/npg-nhg) • (800) 624-8511

# OPTIONS: SERIES NPG & NHG CYLINDERS

NPG, NHG

## MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

### E HALL EFFECT SWITCHES

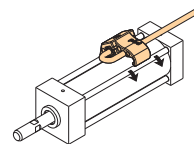
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air cylinder to various logic systems. This option is for use with the following switches.

#### COMPACT HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
17503-2-06	NPN Type 10-30 VDC
17504-2-06	PNP Type 10-30 VDC
17523-2	NPN Type 10-30 VDC, Quick Connect
17524-2	PNP Type 10-30 VDC, Quick Connect

See Switches and Sensors section for magnetic piston ordering 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

PART NO.	DESCRIPTION
17502-2-06	Sink or Source Type 10-30 VDC
17509-3-06	AC Type 110-120 VAC with Current Limit
17522-2	Sink or Source Type 10-30 VDC, Quick Connect
17529-3	AC Type 110-120 VAC, Quick Connect with Current Limit

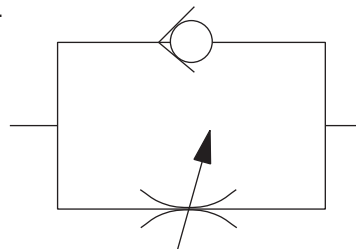
See Switches and Sensors section for magnetic piston ordering information.

### P PC PR 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.



### N PLAIN ROD END

See page 1-111

### S KEYED AND THREADED ROD ENDS

See page 1-111

### V FLUORO-ELASTOMER SEALS

Fluoro-Elastomer 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.

### H PLAIN KEYED ROD ENDS

See page 1-111

### 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  $\pm .005$  will be supplied. Standard stroke tolerance is  $\pm .032$ .

Maximum stroke for cylinders with close tolerance is 18".

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

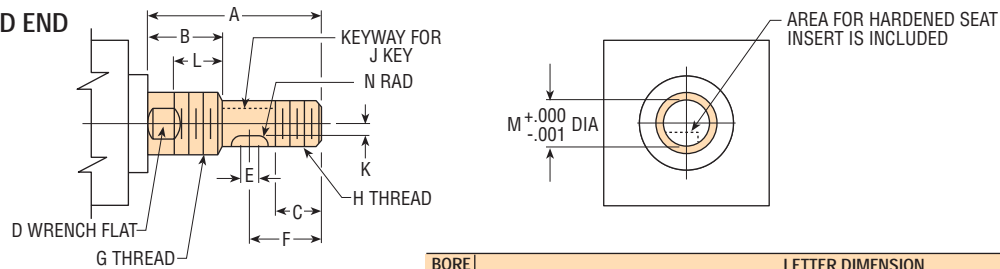
### Z1 ELECTROLESS NICKEL PLATING

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.

# OPTIONS/ACCESSORIES: SERIES NPG & NHG CYLINDERS

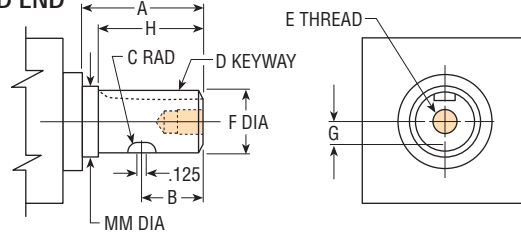
## S ROD END



KEYWAY ORIENTATION: FULLY ADJUSTABLE  
KEY & JAM NUTS: INCLUDED

BORE SIZE	LETTER DIMENSION												
	A	B	C	D	E	F	G	H	J	K	L	M	N
1-1/8	2.187	1.000	.562	1/2	.215	.852	5/8-18	1/2-20	1/8 x 1/8 x 5/8	.125	.625	.500	.093
1-3/8	2.375	1.000	.625	5/8	.242	.977	3/4-16	5/8-18	3/16 x 3/16 x 3/4	.156	.625	.625	.125

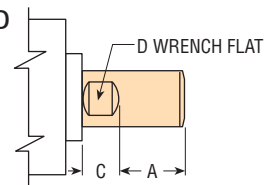
## H ROD END



BORE SIZE	LETTER DIMENSION								
	A	B	C	D	E	F	G	H	MM
1-1/8	1.500	.375	.156	1/8 x 1/16 x 1.00	10-32 x .31 DP	.500	.094	1.375	.625
1-3/8	1.625	.812	.219	3/16 x 3/32 x 1.10	5/16-24 x .44 DP	.750	.156	N/A	N/A

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

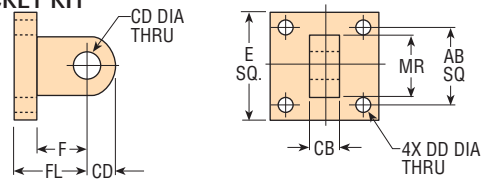
## N ROD END



BORE SIZE	ROD DIA	LETTER DIMENSION		
		A	C	D
1-1/8	.625	.970	.530	1/2
1-3/8	.750	1.095	.530	5/8

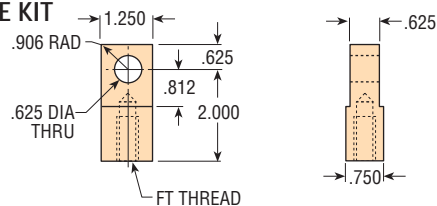
All standard rod ends have four wrench flats.

## EYE BRACKET KIT



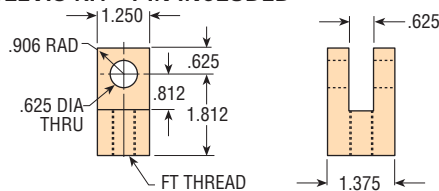
BORE SIZE	CYL SERIES	PART NO.	LETTER DIMENSION							
			AB	CB	CD	DD	E	F	FL	MR
1-1/8	NPG, NHG	2412-01	1.000	.375	.375	.219	1.375	.812	1.125	.750
1-3/8	NPG, NHG	1330	1.375	.500	.500	.281	1.875	.875	1.250	1.000

## ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION
		FT
1-1/8	2414-02	7/16-20 X 1.00 DP
1-3/8	2414-03	9/16-18 X 1.00 DP

## ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	KIT NO	LETTER DIMENSION
		FT
1-1/8	12914	7/16-20
1-3/8	12915	9/16-18

All dimensions are reference only unless specifically toleranced.



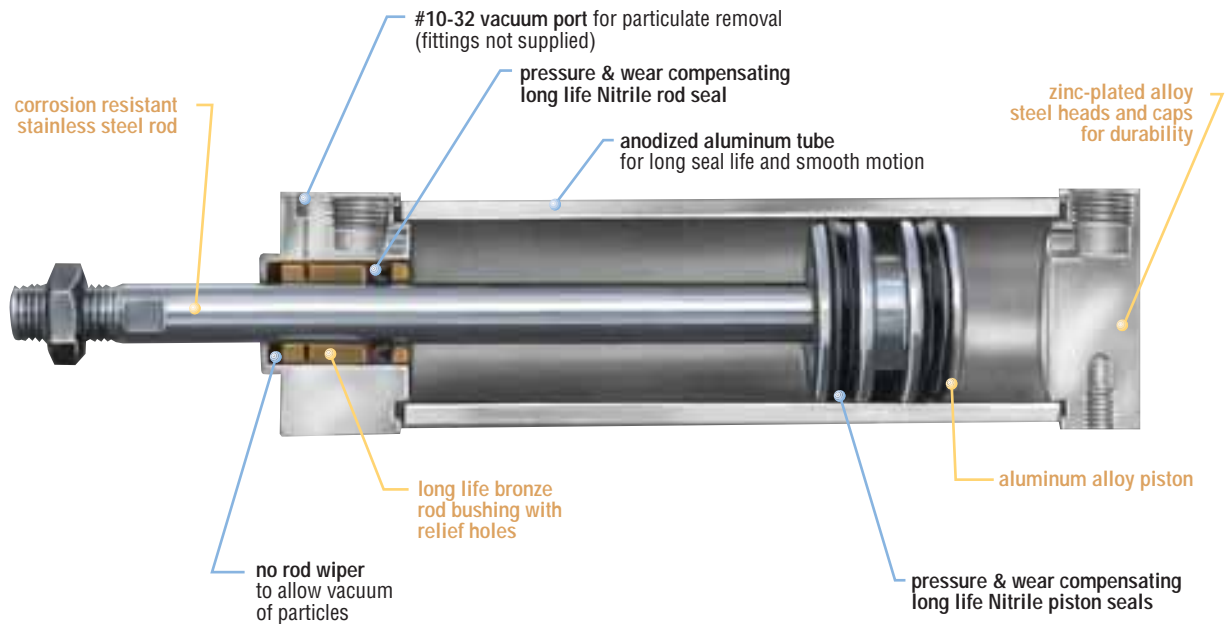
# cleanroom



**SERIES AV & A 3/4", 1", & 1-1/8" BORE  
CLASS 100 CLEANROOM  
APPLICATIONS (REQUIRES -O)**

**tom thumb®**

CLEANROOM



## 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

## Industry Uses

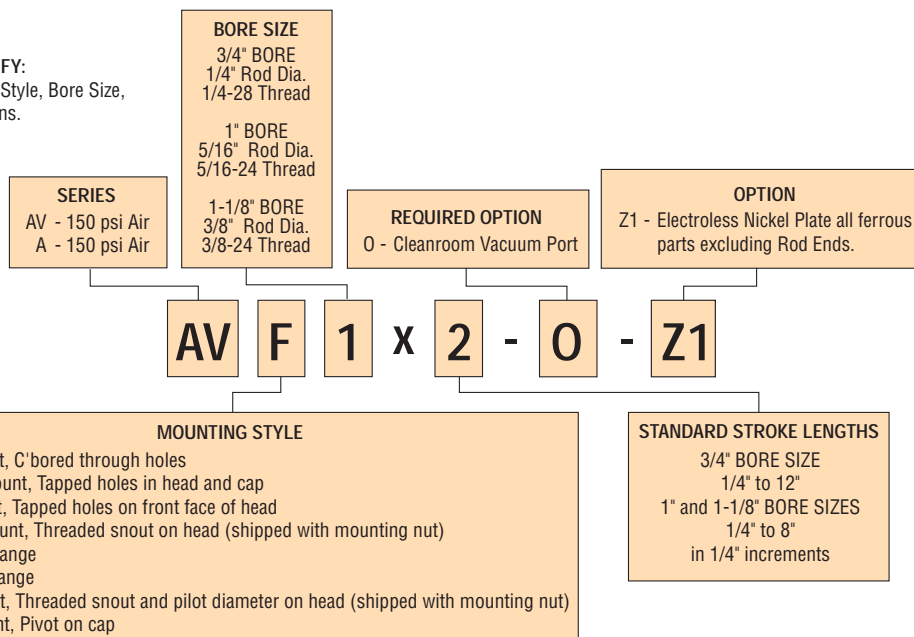
- Class 100 cleanroom
- Food processing
- Medical
- Assembly machines
- Machine loading/unloading
- Semi-conductor
- Laboratory

# ORDERING DATA: CLEANROOM

CLEANROOM

## TO ORDER SPECIFY:

Series, Mounting Style, Bore Size, Stroke, and Options.

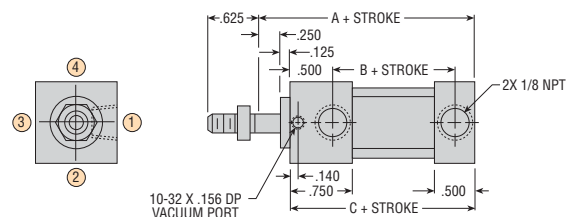


## NOTES:

- 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:

SPECIFICATIONS	SERIES AV	SERIES A
OPERATING PRESSURE	20 to 150 psi air	20 to 150 psi air
STANDARD CYLINDER		
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	± .032	± .032
LUBRICATION	Permanently lubricated	Permanently lubricated
MAINTENANCE	Field repairable	Field repairable



CYLINDER FORCE TABLE

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal./in OF STROKE
AV, A	3/4	1/4	EXTEND	.442	.0016	.0019
			RETRACT	.393	.0014	.0017
	1	5/16	EXTEND	.785	.0029	.0034
			RETRACT	.709	.0026	.0031
	1-1/8	3/8	EXTEND	.994	.0037	.0043
			RETRACT	.883	.0032	.0038

BORE SIZE 3/4", 1", 1-1/8"	LETTER DIMENSION		
	A	B	C
SERIES AV	2.625	1.500	2.250
SERIES A	2.125	1.000	1.750

See Cylinder A, AV, HV section of catalog for complete cylinder dimensions and mounting styles.

## MAX. ALLOWABLE EXTEND STROKE

SERIES	ROD DIAMETER	CYLINDER FORCE 100 lb
3/4", 1", 1-1/8" AV, HV, A	1/4	12"
	5/16	18"
	3/8	26"

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
PLAIN UNIT	3/4	.42	.04
	1	.87	.07
	1-1/8	.95	.10

## 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.

## CYLINDER FORCE CALCULATIONS

### IMPERIAL

$$F = P \times A$$

F = Cylinder Force

lbs

P = Operating Pressure

psi

A = Effective Area

in<sup>2</sup>

(Extend or Retract)

## SIZING AND APPLICATION ASSISTANCE

See PHD Product Sizing Catalog for specific and complete sizing information.

Online sizing assistance is available at: [www.phdinc.com/apps/sizing](http://www.phdinc.com/apps/sizing)