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AV, HV, A

tom thumb®

3/4", 1", 1-1/8" BORE TIE ROD HYDRAULIC & PNEUMATIC NFPA CYLINDERS

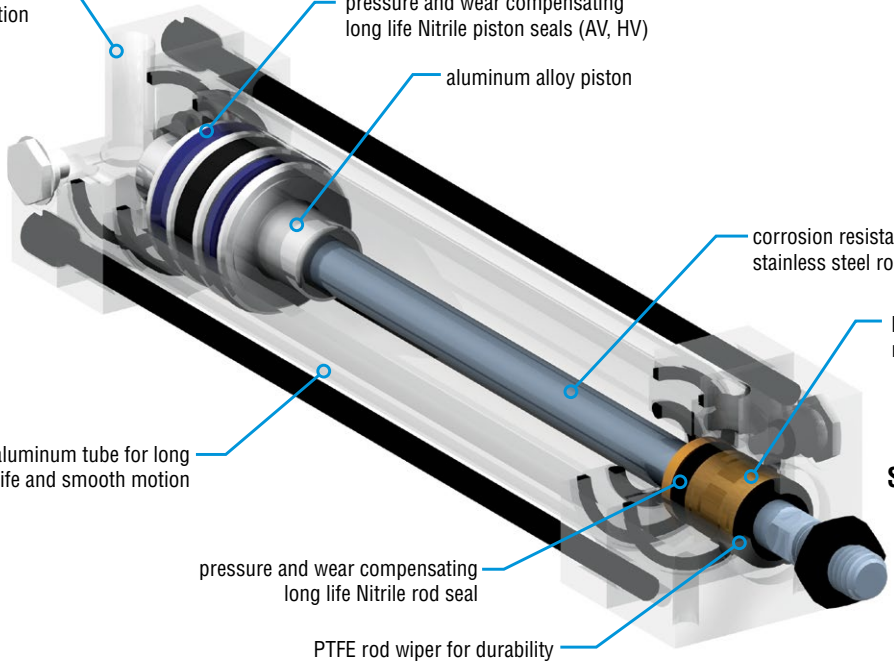


Major Benefits

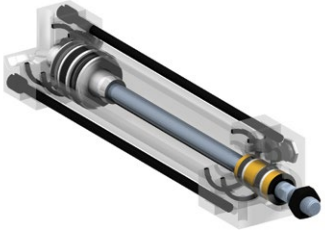
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation



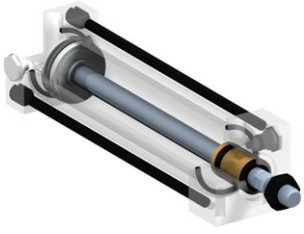
Cleanroom option available on Series AV and A Cylinders. See page 1-69.



SERIES AV



SERIES HV
Hydraulic Service



SERIES A
Shortest Length

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

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

⚠ Options may affect unit length. See dimensional pages and option information details.

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

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

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

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

STANDARD STROKE LENGTHS
3/4" BORE
1/4" to 12"

1" BORE
1/4" to 18"

1-1/8" BORE
1/4" to 18"

All in 1/4" increments
Consult PHD for longer lengths.

CUSHION OR SHOCK PAD
D - Cushions on both ends
DR - Cushion on rod end
DC - Cushion on cap end
B - Shock Pads on both ends
BR - Shock Pad on rod end
BC - Shock Pad on cap end
(Cushions, Shock Pads, and Spring Return are not available on the same end of cylinder. Shock Pads and 3/4", 1", and 1-1/8" Cushions not available on Series HV.)

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

SC AV F 1 x 2 - P - D - 3/8 ROD - G-M-V

SPRING RETURN
SC - Spring on cap end
SR - Spring on rod end (Strokes available in 1/4" increments up to 6".) ⊕ See option pages.
and/or
DOUBLE ROD END
D - Double Rod End Cylinders
Leave blank if not needed.

MOUNTING STYLE
F - Foot Mount, c'bored thru holes
B - Bottom Mount, tapped holes in head and cap
R - Rod Mount, tapped holes on front face of head
T - Thread Mount, threaded snout on head (shipped with mounting nut)
RF - Rod End Flange
CF - Cap End Flange
L - Pilot Mount, threaded snout and pilot diameter on head (shipped with mounting nut)
P - Pivot Mount, pivot on cap
RR - Tierod Mount, tierods extend out rod end
RC - Tierod Mount, tierods extend out cap end
RRC - Tierod Mount, tierods extend out both ends

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

OPTIONS
A - Stroke Adjustment, 1/2" of adjustment standard (not available on Series HV)
E - Magnetic Piston for PHD Hall Effect Switches (not available on Series A)
G - #2 Rod End (see page 1-67 for dimensions) (see note 1)
I - #4 Rod End, Female thread on rod (see page 1-67 for dimensions) (see note 1)
H47 - Rodlok (Rod clamping device installed. Not available with Z1 or on HV. See option page.) ⊕
J - #2X Rod End, twice as long as standard thread (see page 1-67 for dimensions)
_K - Extra Rod Extension, in 1/8" increments (see page 1-65) (see note 2)
L - Coarse Thread Rod End (see page 1-67 for dimensions) (see note 1)
M - Magnetic Piston for PHD Reed Switches (not applicable on Series A)
N - Plain Rod End (see page 1-67 for dimensions) (see note 1)
Q - Port in Position #1, must be specified if required with mounting style "F" ("F" mounting tab on cap end)
R - Ports in Position #2
T - Ports in Position #3 ("F" mounting tab on cap end)
U - Ports in Position #4
V - Fluoroelastomer Seals
W - Close Tolerance Stroke, ±0.005" stroke length
Y - SAE Ports (Series HV Only) 3/4, 1, 1-1/8" bore
Z1 - Electroless Nickel Plate all ferrous parts excluding Rod Ends

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

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.

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

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

Switches are ordered separately

Designer's Resource myphd®

CAD & Sizing Assistance

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

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	±0.032	±0.032	±0.032
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	0.442	0.0016	0.0019
			RETRACT	0.393	0.0014	0.0017
		5/16	EXTEND	0.442	0.0016	0.0019
			RETRACT	0.365	0.0013	0.0016
	1	5/16	EXTEND	0.785	0.0029	0.0034
			RETRACT	0.709	0.0026	0.0031
		3/8	EXTEND	0.785	0.0029	0.0034
			RETRACT	0.676	0.0025	0.0029
	1-1/8	3/8	EXTEND	0.994	0.0037	0.0043
			RETRACT	0.883	0.0032	0.0038
		1/2	EXTEND	0.994	0.0037	0.0043
			RETRACT	0.799	0.0029	0.0034

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	0.42	0.04
	1	0.87	0.07
	1-1/8	0.95	0.10

CYLINDER FORCE CALCULATIONS	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2

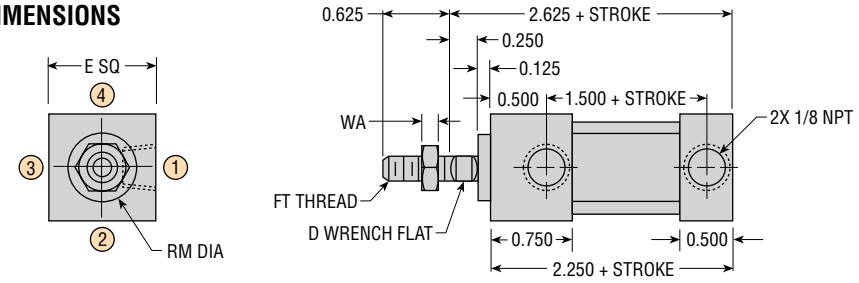


Application & Sizing Assistance

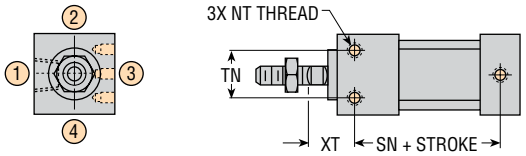
Use PHD's free online Product Sizing Application at **www.phdinc.com/apps/sizing**

DIMENSIONS: SERIES AV CYLINDERS; 3/4", 1", 1-1/8" BORE

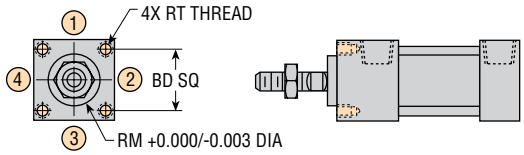
BASIC CYLINDER DIMENSIONS



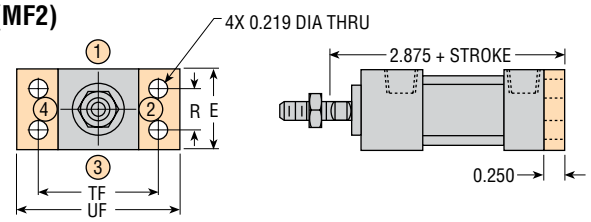
B (MS9)



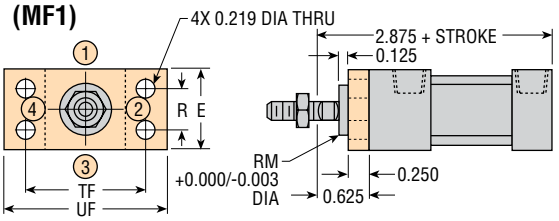
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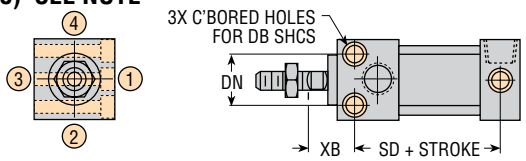
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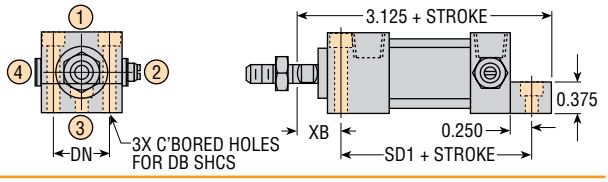
RF (MF1)



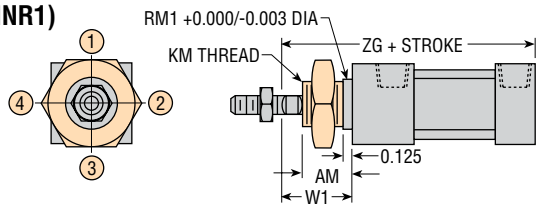
F (MS8) SEE NOTE



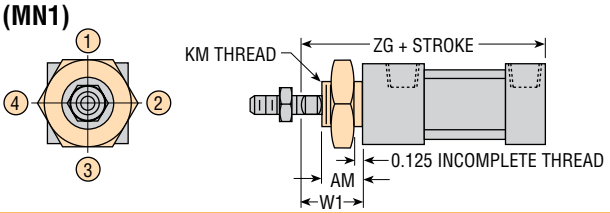
F (MS8) - WITH PORT CONTROL® ON CAP END (-Q or -T without Port Control)



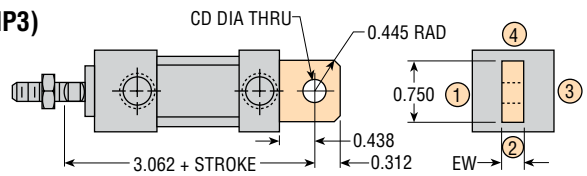
L (MNR1)



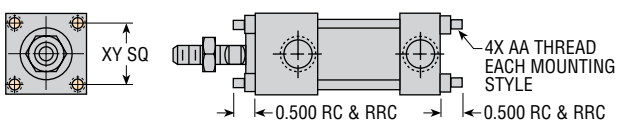
T (MN1)



P (MP3)



RC, RR, RRC (Includes RR & RC)



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

BORE SIZE	LETTER DIMENSION																		
	AA	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN
3/4	#6-32	0.625	0.750	0.250	3/16	#8	0.625	1.000	0.250	1/4-28	5/8-18	8-32 x 0.18 DP	0.500	0.625	0.687	8-32 x 0.25 DP	1.812	2.312	1.812
1	#8-32	0.625	1.000	0.375	1/4	#10	0.875	1.375	0.375	5/16-24	3/4-16	10-32 x 0.25 DP	0.875	0.750	0.812	8-32 x 0.25 DP	1.750	2.250	1.750
1-1/8	#10-32	0.875	1.125	0.375	5/16	#10	1.000	1.500	0.375	3/8-24	1-14	10-32 x 0.25 DP	1.000	0.750	1.062	10-32 x 0.25 DP	1.750	2.250	1.750

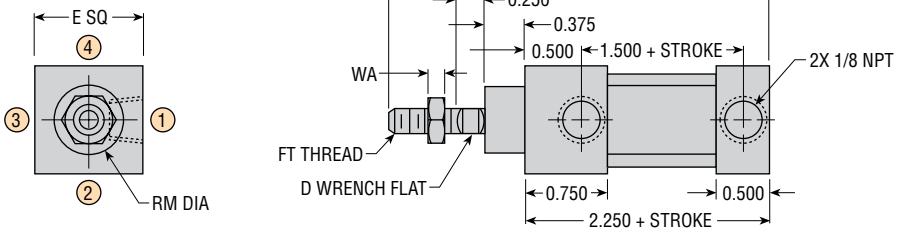
BORE SIZE	LETTER DIMENSION								
	TF	TN	UF	WA	W1	XB	XT	ZG	XY
3/4	1.500	0.625	2.000	0.156	0.875	0.562	0.562	3.125	0.750
1	1.875	0.875	2.375	0.188	0.875	0.625	0.625	3.125	1.030
1-1/8	2.000	1.000	2.500	0.219	1.125	0.625	0.625	3.375	1.125

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

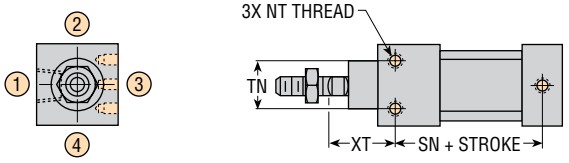
All dimensions are reference only unless specifically toleranced.

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

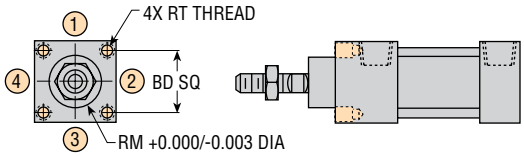
BASIC CYLINDER DIMENSIONS



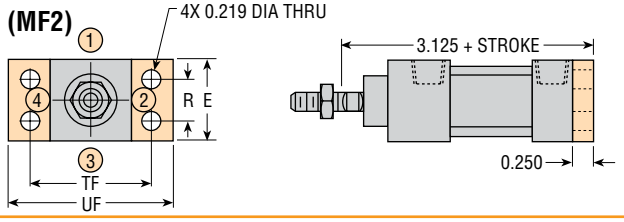
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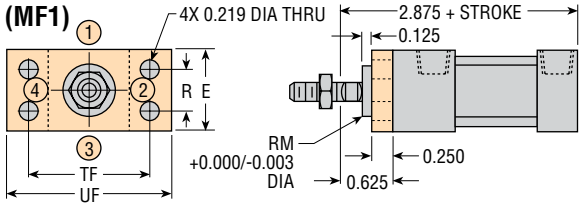
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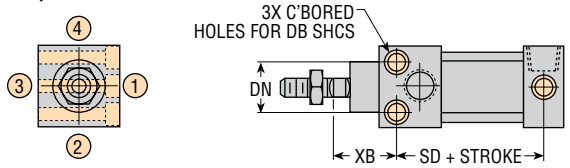
CF (MF2)



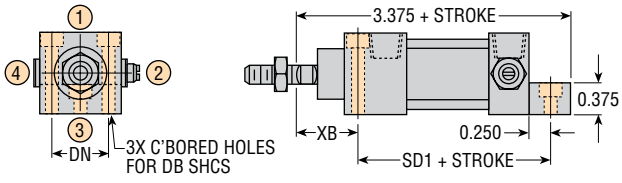
RF (MF1)



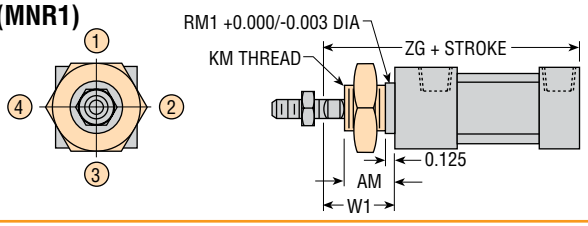
F (MS8) SEE NOTE



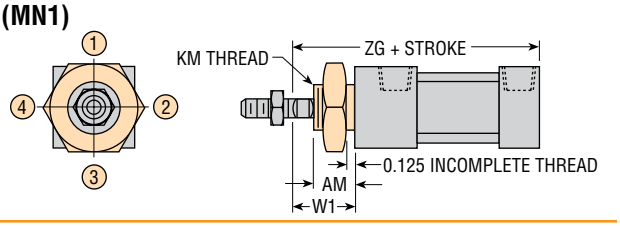
F (MS8) - WITH PORT CONTROL ON CAP END



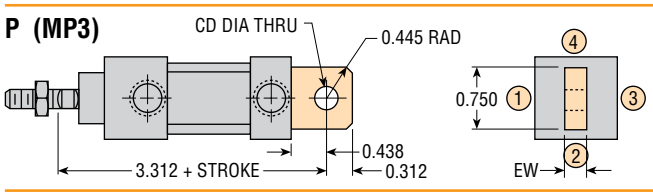
L (MNR1)



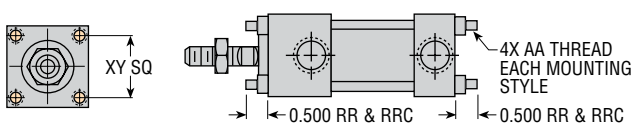
T (MN1)



P (MP3)



RC, RR, RRC (Includes RR & RC)



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	AA	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN
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1	#8-32	0.625	1.000	0.375	1/4	#10	0.875	1.375	0.375	5/16-24	3/4-16	10-32 x 0.25 DP	0.875	0.750	0.812	8-32 x 0.25 DP	1.750	2.250	1.750
1-1/8	#10-32	0.875	1.125	0.375	5/16	#10	1.000	1.500	0.375	3/8-24	1-14	10-32 x 0.25 DP	1.000	0.750	1.062	10-32 x 0.25 DP	1.750	2.250	1.750

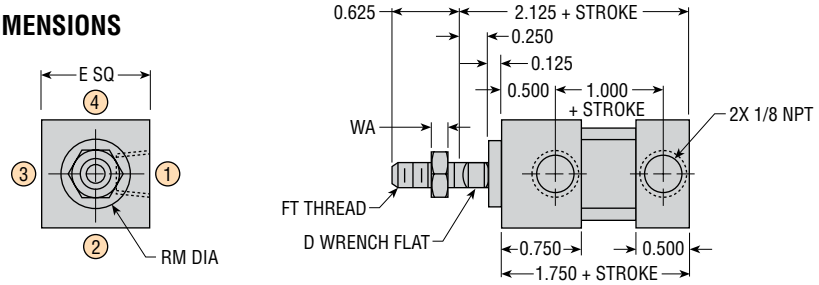
BORE SIZE	LETTER DIMENSION								
	TF	TN	UF	WA	W1	XB	XT	ZG	XY
3/4	1.500	0.625	2.000	0.156	0.875	0.812	0.812	3.125	0.750
1	1.875	0.875	2.375	0.188	0.875	0.875	0.875	3.125	1.030
1-1/8	2.000	1.000	2.500	0.219	1.125	0.875	0.875	3.375	1.125

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
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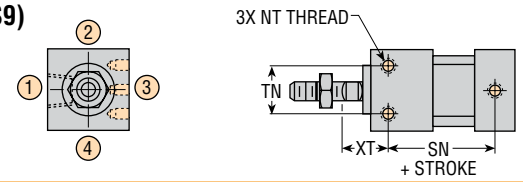
All dimensions are reference only unless specifically toleranced.

DIMENSIONS: SERIES A CYLINDERS; 3/4", 1", 1-1/8" BORE

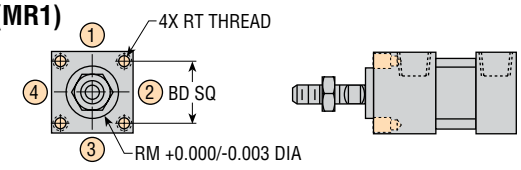
BASIC CYLINDER DIMENSIONS



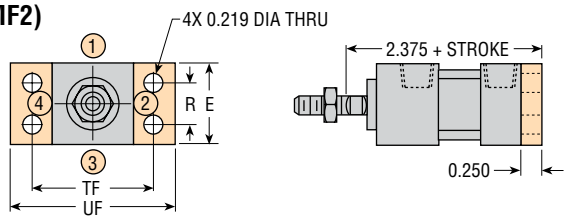
B (MS9)



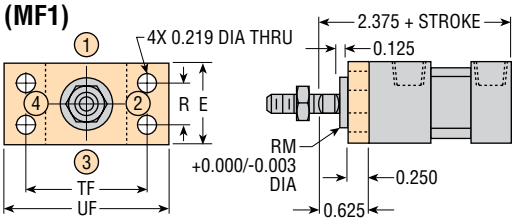
R (MR1)



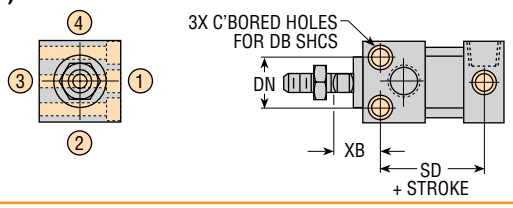
CF (MF2)



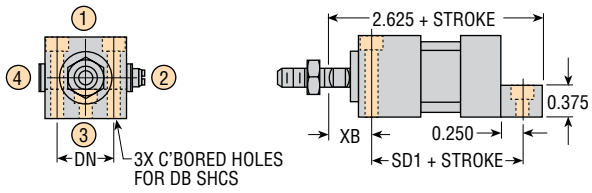
RF (MF1)



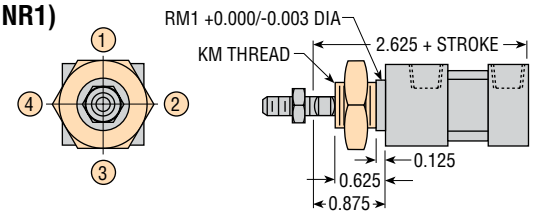
F (MS8) SEE NOTES



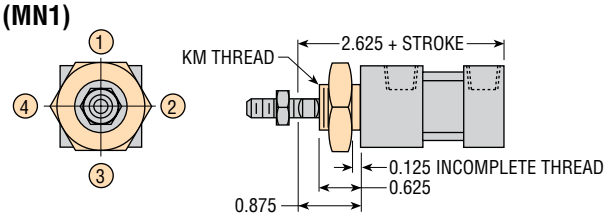
F (MS8) - WITH PORT CONTROL ON CAP END



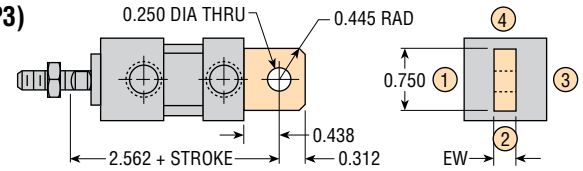
L (MNR1)



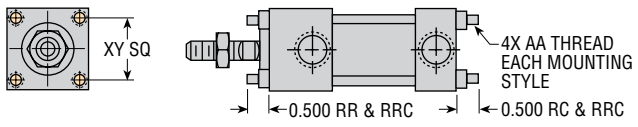
T (MN1)



P (MP3)



RC, RR, RRC (Includes RR & RC)



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

BORE SIZE	LETTER DIMENSION																			
	AA	BD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SD1	SN	TF	TN
3/4	#6-32	0.750	3/16	#8	0.625	1.000	0.250	1/4-28	5/8-18	8-32 x 0.18 DP	0.500	0.625	0.687	8-32 x 0.25 DP	1.312	1.812	1.312	1.500	0.625
1	#8-32	1.000	1/4	#10	0.875	1.375	0.375	5/16-24	3/4-16	10-32 x 0.25 DP	0.875	0.750	0.812	8-32 x 0.25 DP	1.250	1.750	1.250	1.875	0.875
1-1/8	#10-32	1.125	5/16	#10	1.000	1.500	0.375	3/8-24	3/4-16	10-32 x 0.25 DP	1.000	0.750	0.812	10-32 x 0.25 DP	1.250	1.750	1.250	2.000	1.000

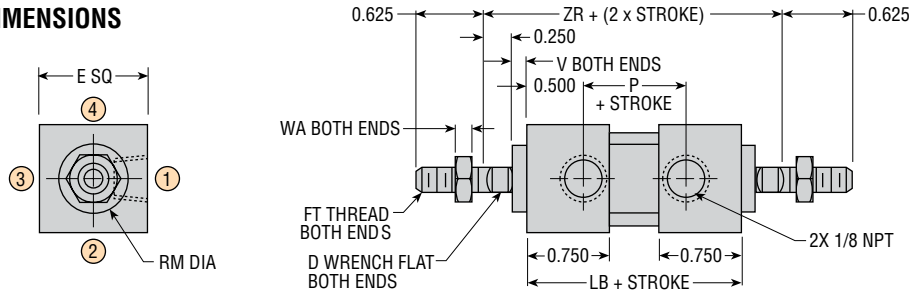
BORE SIZE	LETTER DIMENSION				
	UF	WA	XB	XT	XY
3/4	2.000	0.156	0.562	0.562	0.750
1	2.375	0.188	0.625	0.625	1.030
1-1/8	2.500	0.219	0.625	0.625	1.125

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

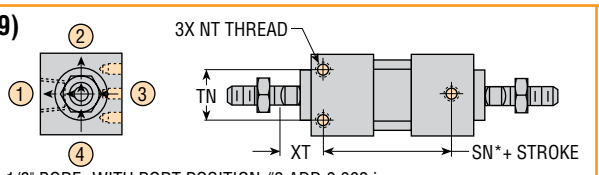
All dimensions are reference only unless specifically toleranced.

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

BASIC CYLINDER DIMENSIONS

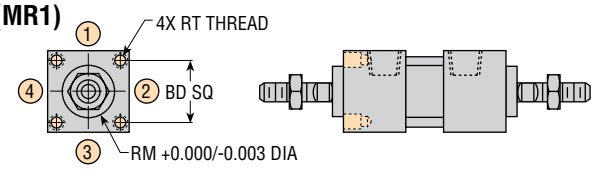


B (MS9)

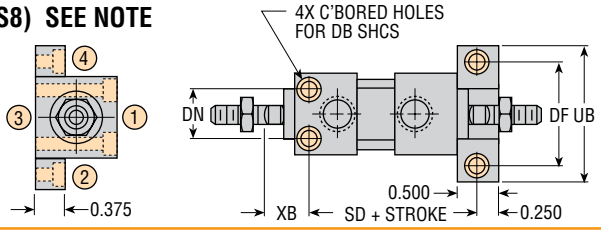


*1" AND 1-1/8" BORE: WITH PORT POSITION #3 ADD 0.062 in
WITH PORT POSITION #2 OR #4 & PORT CONTROLS ADD 0.062 in

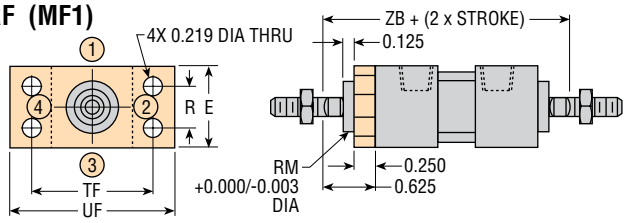
R (MR1)



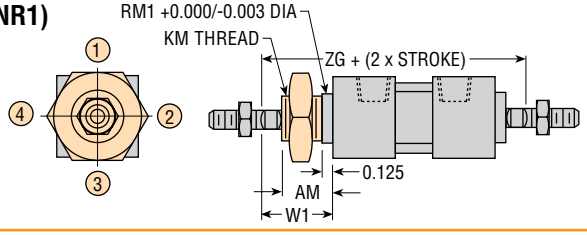
F (MS8) SEE NOTE



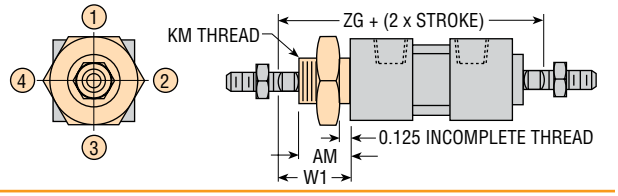
RF (MF1)



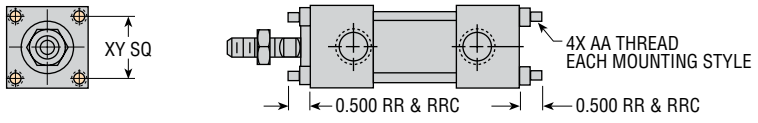
L (MNR1)



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	UB	UF	WA	XY
3/4	#6-32	0.750	3/16	#8	1.375	0.625	1.000	1/4-28	8-32 x 0.18 DP	0.500	0.625	8-32 x 0.25 DP	1.500	0.625	1.750	2.000	0.156	0.750
1	#8-32	1.000	1/4	#10	1.750	0.875	1.375	5/16-24	10-32 x 0.25 DP	0.875	0.750	8-32 x 0.25 DP	1.875	0.875	2.125	2.375	0.188	1.030
1-1/8	#10-32	1.125	5/16	#10	1.875	1.000	1.500	3/8-24	10-32 x 0.25 DP	1.000	0.750	10-32 x 0.25 DP	2.000	1.000	2.250	2.500	0.219	1.125

SERIES DA CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	0.625	5/8-18	2.000	1.000	0.687	2.063	1.562	0.125	0.875	0.562	0.562	3.000	3.250	2.750
1	0.625	3/4-16	2.000	1.000	0.812	2.000	1.500	0.125	0.875	0.625	0.625	3.000	3.250	2.750
1-1/8	0.625	3/4-16	2.000	1.000	0.812	2.000	1.500	0.125	0.875	0.625	0.625	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	0.625	5/8-18	2.500	1.500	0.687	2.562	2.062	0.375	0.875	0.812	0.812	3.750	4.000	3.750
1	0.625	3/4-16	2.500	1.500	0.812	2.500	2.000	0.375	0.875	0.875	0.875	3.750	4.000	3.750
1-1/8	0.875	1-14	2.500	1.500	1.062	2.500	2.000	0.375	1.125	0.875	0.875	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	0.625	5/8-18	2.500	1.500	0.687	2.562	2.062	0.125	0.875	0.562	0.562	3.500	3.750	3.250
1	0.625	3/4-16	2.500	1.500	0.812	2.500	2.000	0.125	0.875	0.625	0.625	3.500	3.750	3.250
1-1/8	0.875	1-14	2.500	1.500	1.062	2.500	2.000	0.125	1.125	0.625	0.625	3.500	4.000	3.250

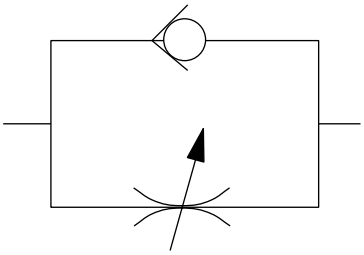
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION
SHOCK PADS: ADD 0.250 in TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)
F (MS8) MTG: 3/4" BORE UNITS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

All dimensions are reference only unless specifically toleranced.

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.

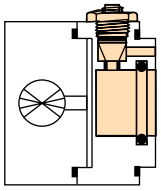
D DC DR ADJUSTABLE CUSHION

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.

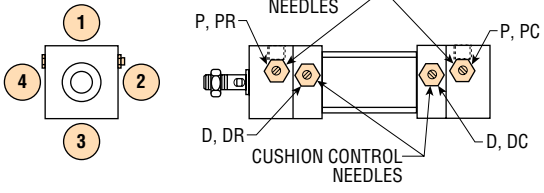
Effective cushion length 1/2"

CUSHION BLOCK



STANDARD PORT CONTROL® AND CUSHION NEEDLE POSITIONS

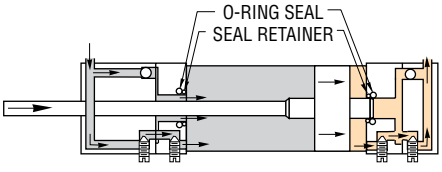
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A, AV, and HV.



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



H47 RODLOK CYLINDER & RODLOK

Available on single rod Series A and AV units only. (Preassembled) ⊕

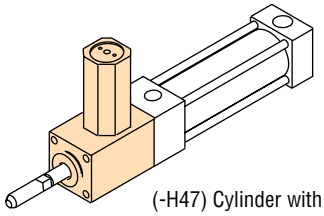
PHD's Rodlok is ideal for locking the piston rod while in a static/ stationary position. When the pressure is removed from the port of the Rodlok, the mechanism will grip the rod and prevent it from moving. The loads are held indefinitely without power. Rodlok performance is application and environment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

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

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

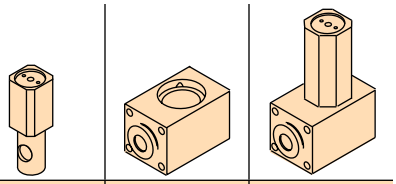
-H47 available on B, R, P, and RC only.

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



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

REPLACEMENT RODLOK KITS

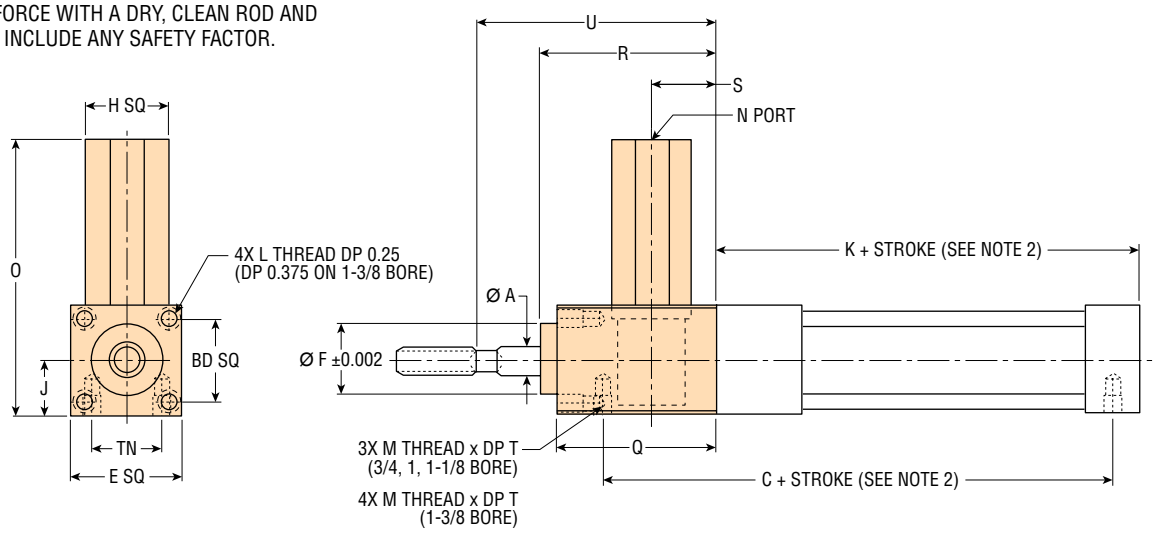


BORE in	LOCKING DEVICE KIT	ADAPTOR KIT	COMPLETE RODLOK
3/4	63932-01	63931-01	63935-01
1	63932-02	63931-02	63935-02
1-1/8	63932-03	63931-03	63935-03

PART NUMBERS LISTED ABOVE ARE INTENDED FOR REPLACEMENT PURPOSES ONLY.

BORE in	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.



BORE in	LETTER DIMENSION																	
	A	C	E	F	H	J	K	L	M	N	O	Q	R	S	T	U	BD	TN
3/4	0.250 [6.4]	3.063 [77.8]	1.000 [25.4]	0.622 [15.8]	0.728 [18.5]	0.500 [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]	0.625 [15.9]	0.187 [4.7]	1.875 [47.6]	0.750 [19.1]	0.625 [15.9]
1	0.312 [7.9]	3.000 [76.2]	1.375 [34.9]	0.747 [19.0]	0.787 [20.0]	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]	0.625 [15.9]	0.250 [6.4]	1.875 [47.6]	1.000 [25.4]	0.875 [22.2]
1-1/8	0.375 [9.5]	3.000 [76.2]	1.500 [38.1]	0.747 [19.0]	0.787 [20.0]	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]	0.625 [15.9]	0.250 [6.4]	1.875 [47.6]	1.125 [28.6]	1.000 [25.4]

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

All dimensions are reference only unless specifically toleranced.

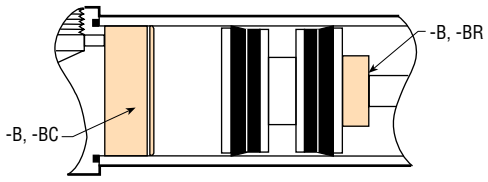
OPTIONS: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

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

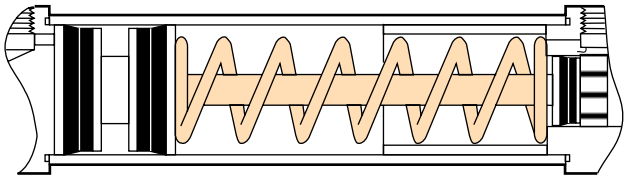
Available in 1/4" increments

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)**



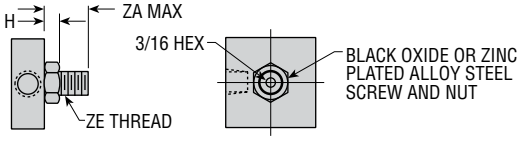
A CYLINDER STROKE ADJUSTMENT

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	0.370	1.031	3/8-24	5/16-24
1	0.462	1.156	1/2-20	3/8-24
1-1/8	0.462	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**

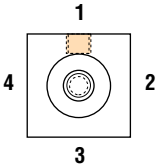


PORT POSITIONS

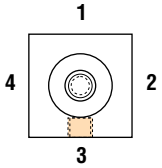
Port position 1 is standard on all cylinders except mounting style -F without port controls. The cap end port will be in position 4 standard.

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.

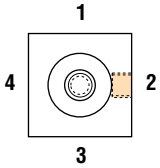
STANDARD PORT POSITION 1



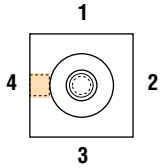
T PORT POSITION 3



R PORT POSITION 2



U PORT POSITION 4



All dimensions are reference only unless specifically toleranced.

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES

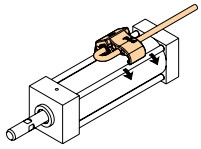
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

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

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

M REED SWITCHES



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

COMPACT REED SWITCHES

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

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

V FLUOROELASTOMER SEALS

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

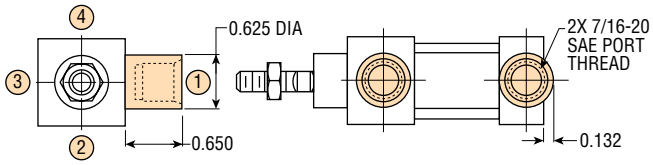
Z1 ELECTROLESS NICKEL PLATING

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

Y SAE PORTS FOR SERIES HV

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

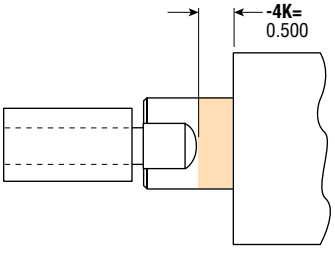
Dimensions for this boss are shown below. This option is not available on cylinders with an "F" mounting style. Consult PHD for optional port position or **units with Port Controls®**. Oversize rods are available except on T and L mounting styles on 3/4" bore cylinders.



_K EXTRA ROD EXTENSION

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

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



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

W CLOSE TOLERANCE STROKE

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

Maximum stroke for cylinders with close tolerance is 18".

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

All dimensions are reference only unless specifically toleranced.

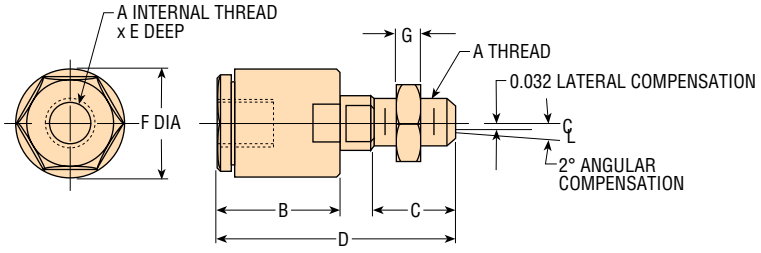
SELF-ALIGNING PISTON ROD COUPLERS

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

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

MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	0.625	1.875	0.500	0.875	0.156
312	5/16-24	1.000	0.625	1.875	0.500	0.875	0.187
375	3/8-24	1.000	0.625	1.875	0.500	0.875	0.219
437	7/16-20	1.125	0.650	2.187	0.500	1.000	0.250
500	1/2-20	1.125	0.650	2.187	0.500	1.000	0.312
625	5/8-18	1.750	1.125	3.312	0.812	1.562	0.375
750	3/4-16	1.750	1.125	3.312	0.812	1.562	0.421

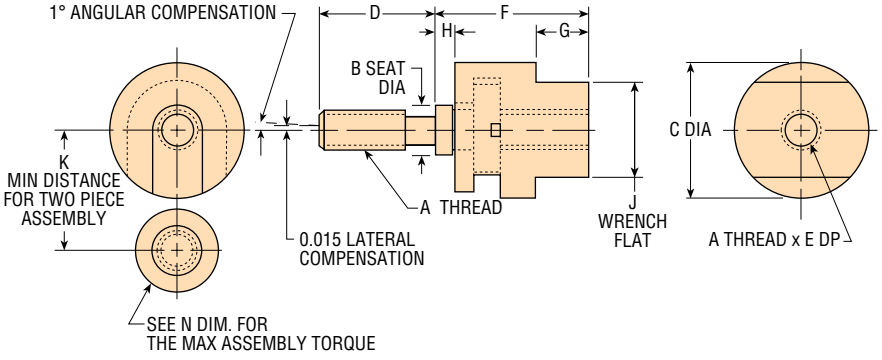
To order, specify the model number.



MINIATURE COUPLERS

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

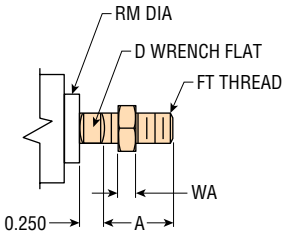
Rod Couplers are manufactured from high tensile and hardened steel components.



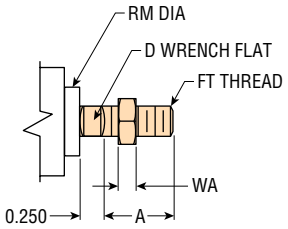
MODEL NO.	LETTER DIMENSION										
	A	B	C	D	E	F	G	H	J	K	N
19300-01	5-40	0.160	0.440	0.375	0.250	0.500	0.170	0.066	5/16	0.390	20 in-lbs
19300-02	10-32	0.250	0.560	0.500	0.281	0.558	0.200	0.058	3/8	0.490	70 in-lbs

All dimensions are reference only unless specifically toleranced.

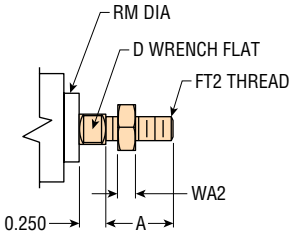
STANDARD
(#1 ROD END)



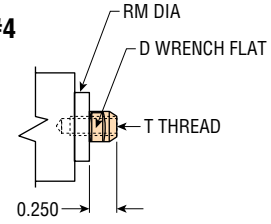
L
COARSE THREAD ROD END



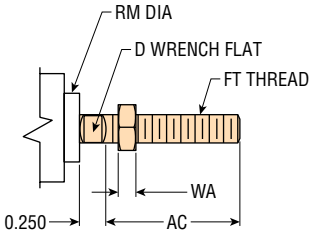
G
ROD END STYLE #2



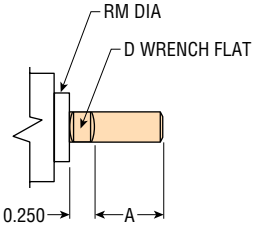
I
ROD END STYLE #4



J
ROD END STYLE #2X



N
PLAIN ROD END



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

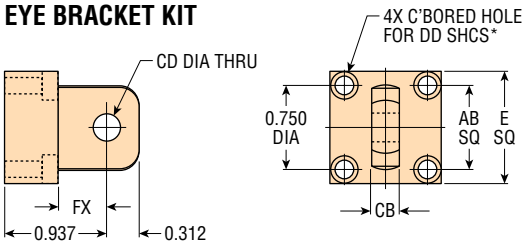
BORE SIZE	ROD TYPE	ROD DIAMETER	LETTER DIMENSION									
			A	AC	CT	D	FT	FT2	RM	T	WA	WA2
3/4	STANDARD	0.250	0.625	1.250	1/4-20	7/32	1/4-28	10-32	0.625	6-32 x 0.437 DP	0.156	0.130
	OVERSIZE	0.312	0.625	1.250	5/16-18	1/4	5/16-24	1/4-28	0.625	10-32 x 0.625 DP	0.187	0.156
1	STANDARD	0.312	0.625	1.250	5/16-18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

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

All dimensions are reference only unless specifically toleranced.

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

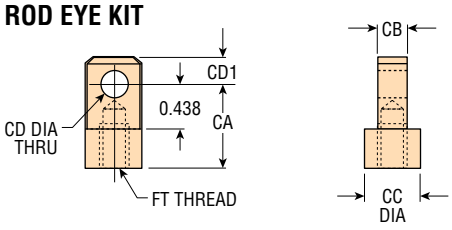
EYE BRACKET KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			AB	CB	CD	DD*	E	FX
3/4	A, AV, HV	1077-01	0.750	0.248	0.250	#6	1.000	0.577
1 & 1-1/8	A	1077-02	1.000	0.373	0.250	#10	1.375	0.437
	AV, HV	1077-03	1.000	0.373	0.375	#10	1.375	0.437

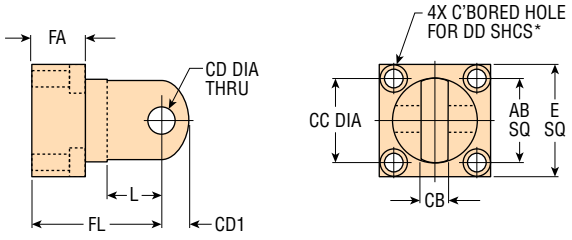
*For 3/4 bore thru hole only.

ROD EYE KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			CA	CB	CC	CD	CD1	FT
3/4	A, AV, HV	1075-01	0.750	0.248	0.500	0.250	0.250	1/4-28 x 0.375 DP
1	A	1075-02	0.875	0.373	0.750	0.250	0.375	5/16-24 x 0.375 DP
	AV, HV	1075-04	0.875	0.373	0.750	0.375	0.375	5/16-24 x 0.375 DP
1-1/8	A	1075-03	0.875	0.373	0.750	0.250	0.375	3/8-24 x 0.312 DP
	AV, HV	1075-05	0.875	0.373	0.750	0.375	0.375	3/8-24 x 0.312 DP

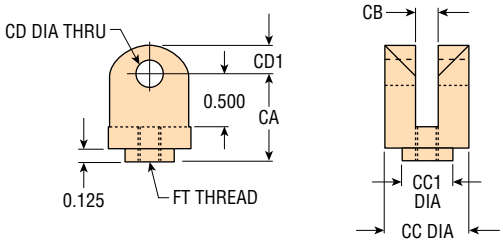
CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION								
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A, AV, HV	12901	0.750	0.254	0.750	0.250	0.250	#6	1.000	0.360	1.187	0.500
1 & 1-1/8	A	12902	1.000	0.379	0.875	0.250	0.375	#10	1.375	0.500	1.250	0.531
	AV, HV	12903	1.000	0.379	0.875	0.375	0.375	#10	1.375	0.500	1.250	0.531

*For 3/4 bore thru hole only.

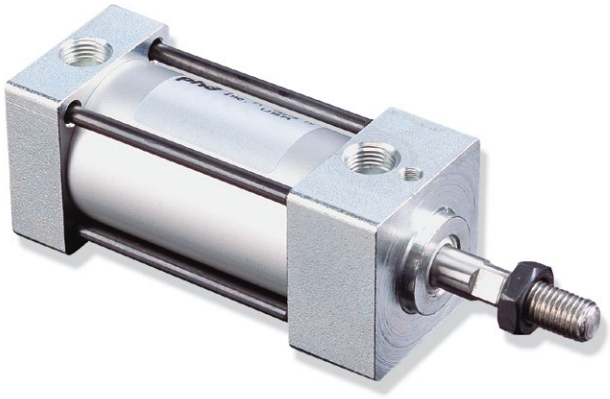
ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CC1	CD	CD1	FT
3/4	A, AV, HV	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	A	12905	0.875	0.379	0.875	0.562	0.250	0.375	5/16-24 TO SLOT
	AV, HV	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	A	12907	0.875	0.379	0.875	0.562	0.250	0.375	3/8-24 TO SLOT
	AV, HV	12908	0.875	0.379	0.875	0.562	0.375	0.375	3/8-24 TO SLOT

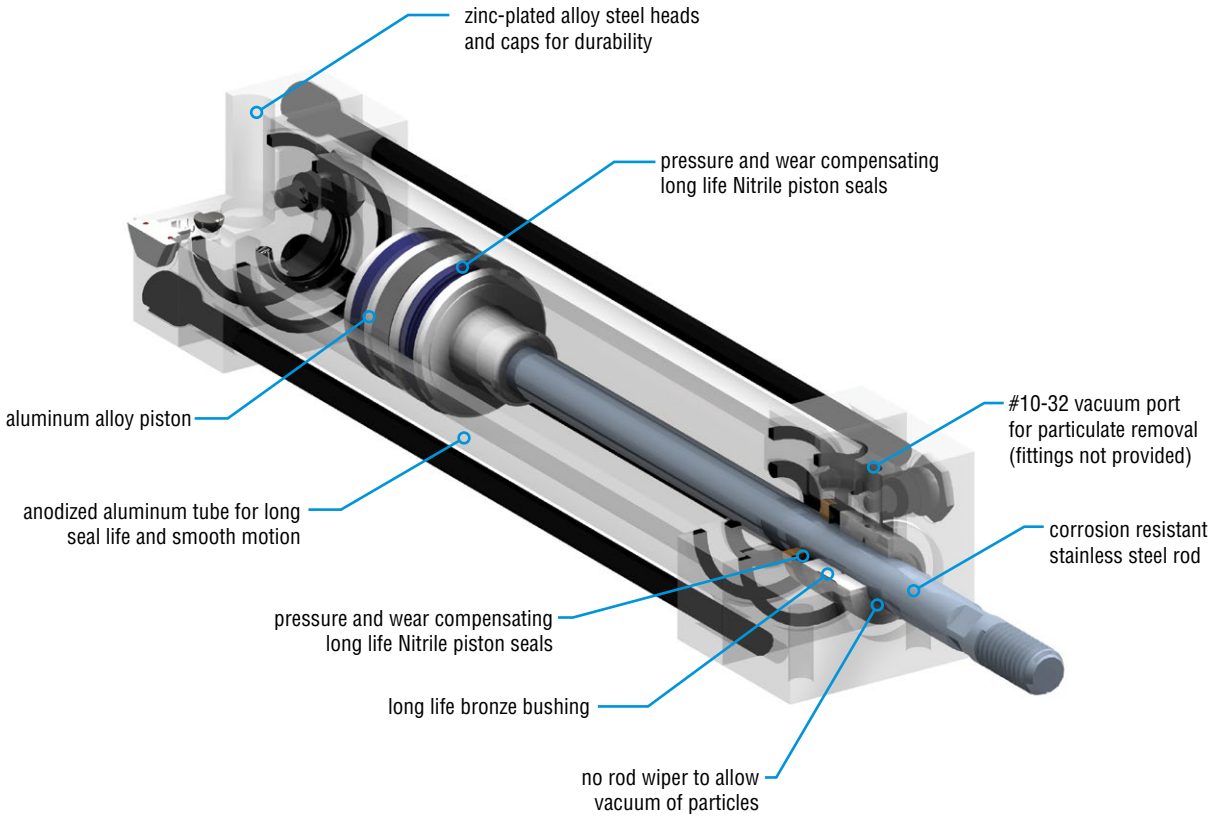
All dimensions are reference only unless specifically toleranced.

SERIES A, AV 3/4", 1", 1-1/8" BORE CLASS 100 CLEANROOM CYLINDERS (REQUIRES -0)



Major Benefits

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



ORDERING DATA: CLEANROOM CYLINDERS

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

SERIES
AV - 150 psi Air
A - 150 psi Air

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

REQUIRED OPTION
O - Cleanroom Vacuum Port

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

AV F 1 x 2 - O - Z1

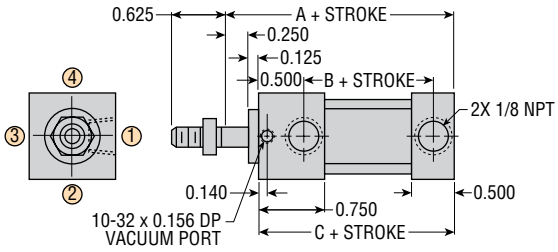
MOUNTING STYLE
F - Foot Mount, C'bored through holes
B - Bottom Mount, Tapped holes in head and cap
R - Rod Mount, Tapped holes on front face of head
T - Thread Mount, Threaded snout on head (shipped with mounting nut)
RF - Rod End Flange
CF - Cap End Flange
L - Pilot Mount, Threaded snout and pilot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

STANDARD STROKE LENGTHS
3/4" BORE SIZE
1/4" to 12"
1" and 1-1/8" BORE SIZES
1/4" to 8"
in 1/4" increments

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

ENGINEERING DATA & DIMENSIONS: CLEANROOM CYLINDERS

SPECIFICATIONS	SERIES AV	SERIES A
OPERATING PRESSURE STANDARD CYLINDER	20 to 150 psi air	20 to 150 psi air
OPERATING TEMPERATURE	-20° to 180°F [-29° to 82°C]	-20° to 180°F [-29° to 82°C]
STROKE TOLERANCE	±0.032	±0.032
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	0.442	0.0016	0.0019
			RETRACT	0.393	0.0014	0.0017
	1	5/16	EXTEND	0.785	0.0029	0.0034
			RETRACT	0.709	0.0026	0.0031
	1-1/8	3/8	EXTEND	0.994	0.0037	0.0043
			RETRACT	0.883	0.0032	0.0038

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
PLAIN UNIT	3/4	0.42	0.04
	1	0.87	0.07
	1-1/8	0.95	0.10

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"

CYLINDER FORCE CALCULATIONS	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2

VACUUM RATING
Vacuum Port - up to 25 In. Hg.

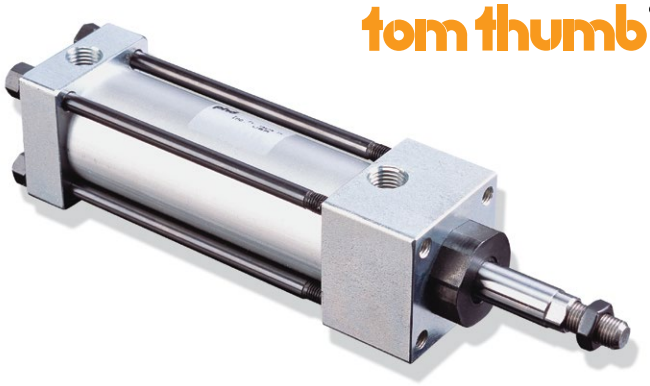
VACUUM CONNECTIONS
Manufacturer fittings differ. Due to close proximity of vacuum port to cylinder head port, the 10-32 vacuum port may require the use of a 10-32 barb fitting depending on fitting manufacturer used.

All dimensions are reference only unless specifically toleranced.

AV, HV

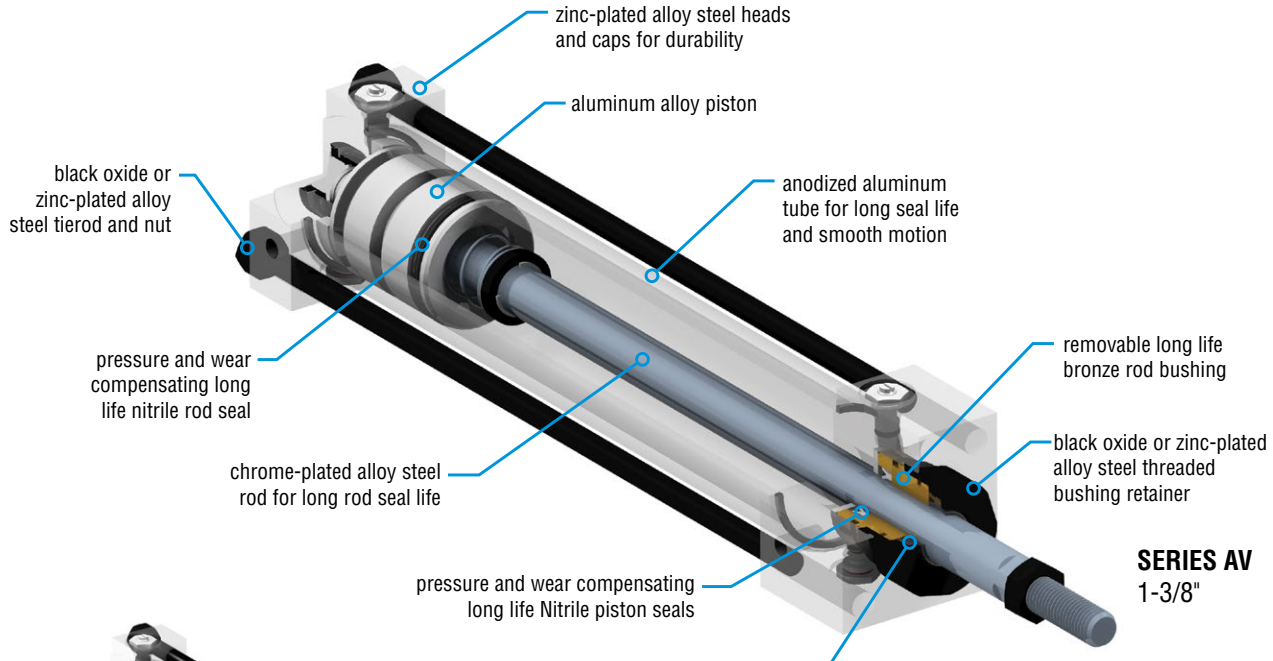
1-3/8" BORE TIE ROD HYDRAULIC & PNEUMATIC NFPA CYLINDERS

tom thumb®

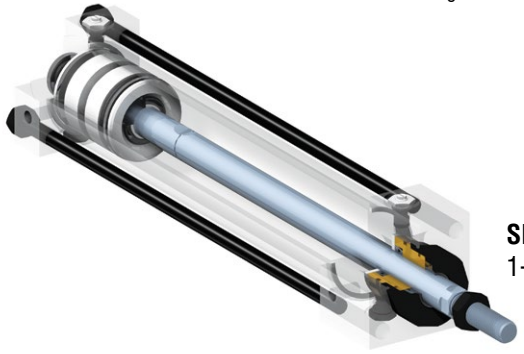


Major Benefits

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



SERIES AV
1-3/8"



SERIES HV
1-3/8"

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

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

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

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

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

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

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

SC AV F 1-3/8 x 2 - P - D - 5/8 ROD - M-V

SPRING RETURN
SC - Spring on cap end
SR - Spring on rod end (Strokes available in 1/4" increments up to 6".) ⊕ See option pages.
and/or
DOUBLE ROD END
D - Double Rod End Cylinders
Leave blank if not needed.

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

PORT CONTROL®

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

OPTIONS
A - Stroke Adjustment, 1/2" of adjustment standard (not available on Series HV)
E - Magnetic Piston for PHD Hall Effect Switches
F - #1 Rod End (see page 1-80 for dimensions) (see note 1)
I - #4 Rod End, Female thread on rod (see page 1-80 for dimensions) (see note 1)
H47 - Rodlok (Rod clamping device installed. Not available with Z1 or on HV. See option page.) ⊕
J - #2X Rod End, twice as long as standard thread (see page 1-80 for dimensions)
_K - Extra Rod Extension, in 1/8" increments (see page 1-78) (see note 2)
L - Coarse Thread Rod End (see page 1-80 for dimensions) (see note 1)
M - Magnetic Piston for PHD Reed Switches
N - Plain Rod End (see page 1-80 for dimensions) (see note 1)
R - Ports in Position #2
T - Ports in Position #3
U - Ports in Position #4
V - Fluoroelastomer Seals
W - Close Tolerance Stroke, ±0.005" stroke length
Z1 - Electroless Nickel Plate all ferrous parts excluding Rod Ends

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

PROXIMITY SWITCH MOUNTING BRACKETS

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

See Switches and Sensors section for complete ordering information.

⚠ Options may affect unit length. See dimensional pages and option information details.

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

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

Switches are ordered separately

Designer's Resource myphd®

CAD & Sizing Assistance

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

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	±0.032	±0.032
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	0.0055	0.0064
			RETRACT	1.289	0.0048	0.0056
		5/8	EXTEND	1.485	0.0055	0.0064
			RETRACT	1.178	0.0044	0.0051

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"	—	—	—
	5/8	74"	53"	33"	24"	19"	—	—	—

SERIES	UNIT WEIGHTS (lb)	
	ZERO STROKE	ADDER PER INCH OF STROKE
PLAIN UNIT	2.56	0.12

CYLINDER FORCE CALCULATIONS	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2

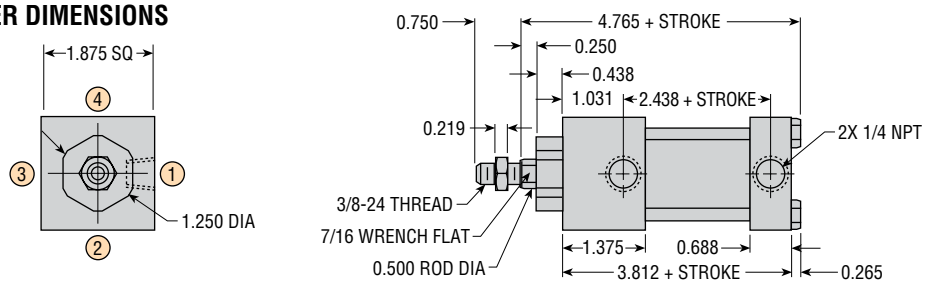


Application & Sizing Assistance

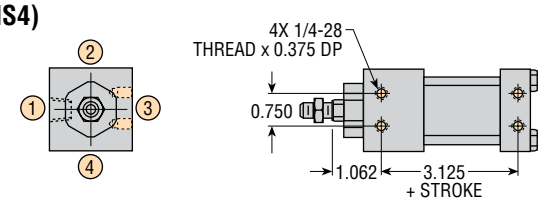
Use PHD's free online Product Sizing Application at **www.phdinc.com/apps/sizing**

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

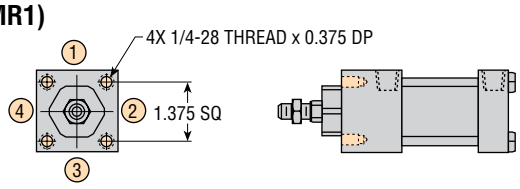
BASIC CYLINDER DIMENSIONS



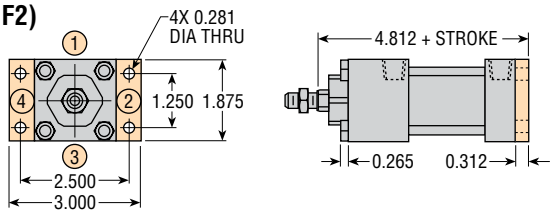
B (MS4)



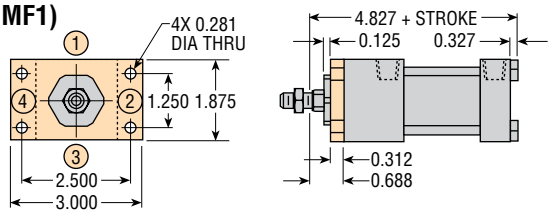
R (MR1)



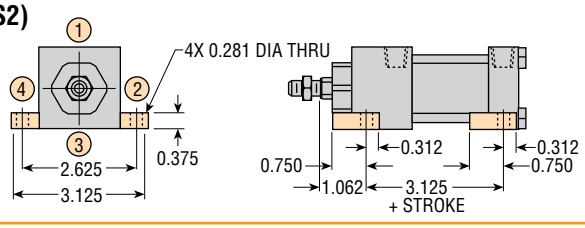
CF (MF2)



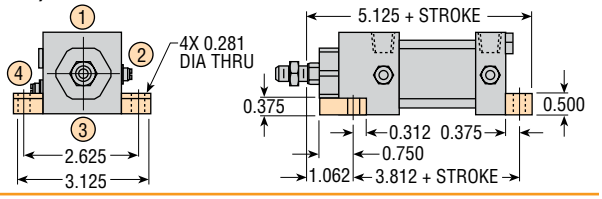
RF (MF1)



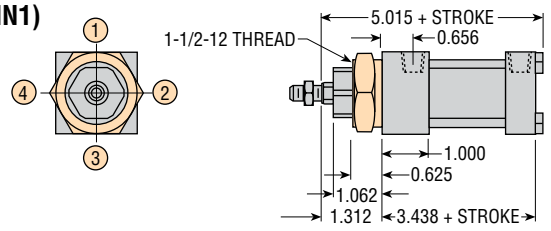
F (MS2)



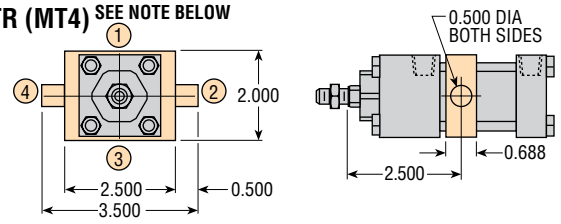
F (MS2) - WITH PORT CONTROL & CUSHION ON CAP END



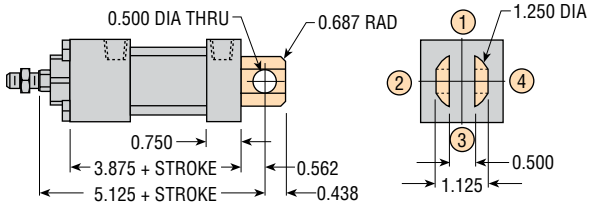
T (MN1)



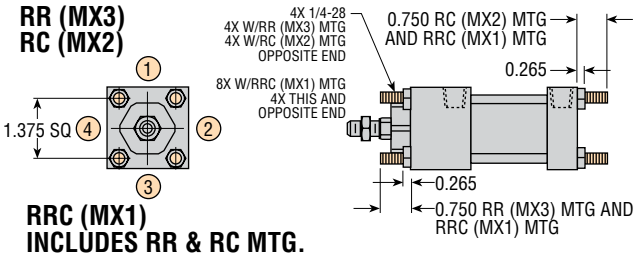
TR (MT4) SEE NOTE BELOW



K (MP1)



RR (MX3) RC (MX2)



RRC (MX1)
INCLUDES RR & RC MTG.

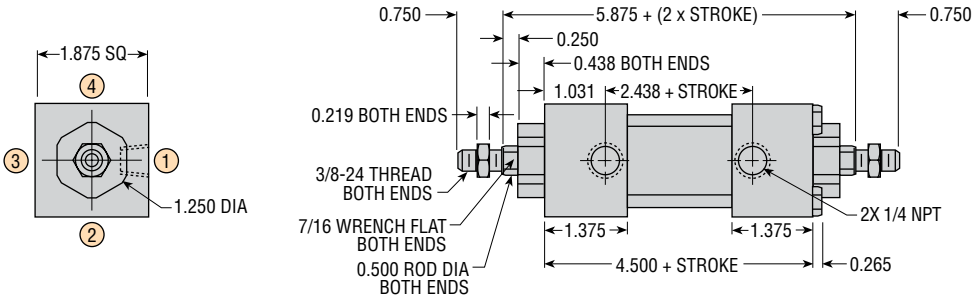
All standard rod ends have four wrench flats (two wrench flats with "I" option).

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

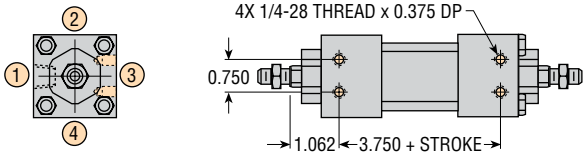
All dimensions are reference only unless specifically toleranced.

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

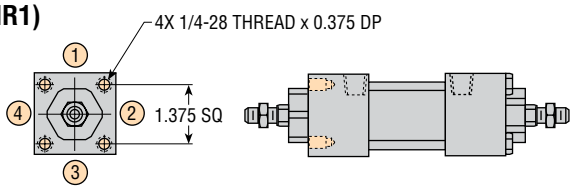
BASIC CYLINDER DIMENSIONS



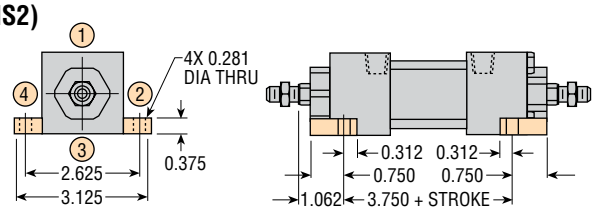
B (MS4)



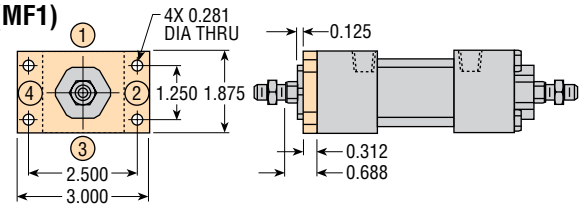
R (MR1)



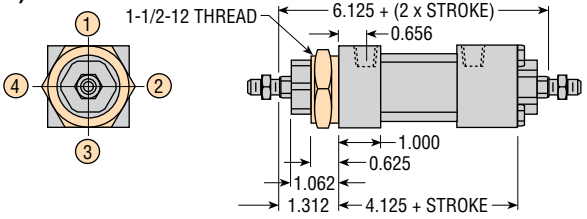
F (MS2)



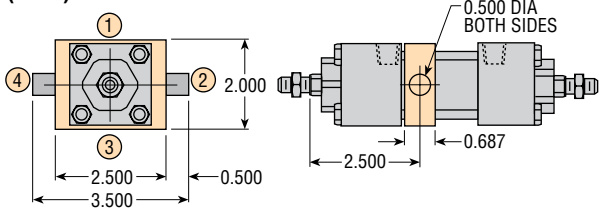
RF (MF1)



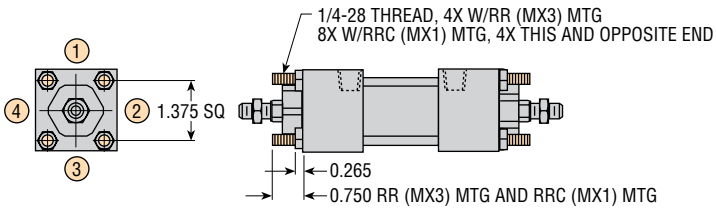
T (MN1)



TR (MT4) SEE NOTE BELOW



RR (MX3)



RRC (MX1)
THREADED TIEROD ON BOTH ENDS

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

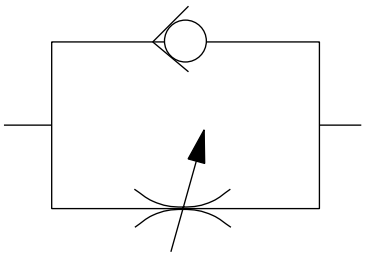
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS
SHOCK PADS: ADD 0.250 in TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD
SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)
OVERSIZE RODS: SEE PAGE 1-80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

All dimensions are reference only unless specifically toleranced.

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.

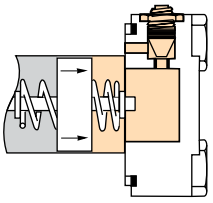


D DC DR ADJUSTABLE CUSHION

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.

Effective cushion length 1/2"

POPPET STYLE

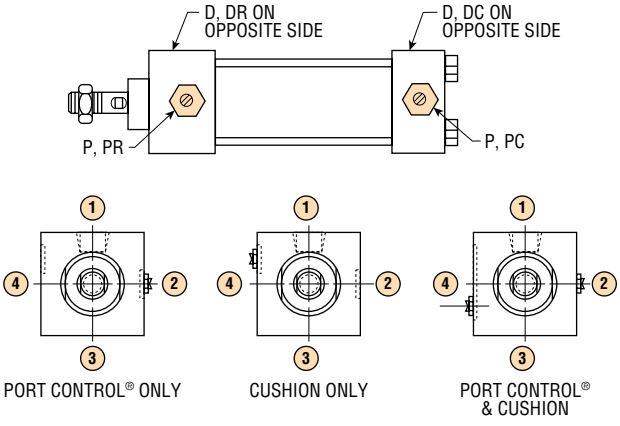


1-3/8" BORE

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.

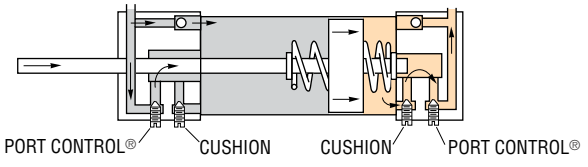
Location may vary depending on mounting and option combinations.



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

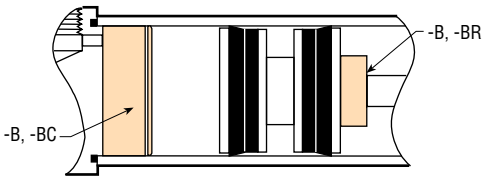


B BC BR SHOCK PADS

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

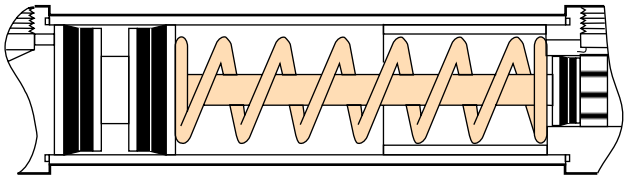
Available in 1/4" increments

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)**



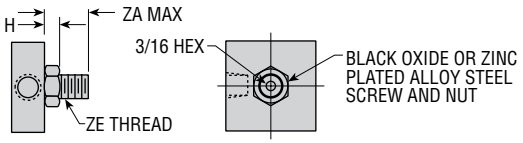
A CYLINDER STROKE ADJUSTMENT (SERIES AV)

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

BORE SIZE	H	ZA	ZE
1-3/8	0.462	1.000	1/2-20

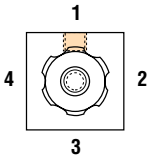
Available with all options EXCEPT:

- **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)**

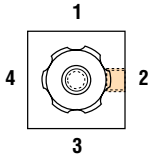


PORT POSITIONS

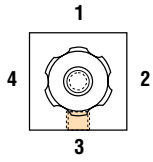
STANDARD PORT POSITION 1



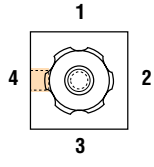
R PORT POSITION 2



T PORT POSITION 3



U PORT POSITION 4



MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES

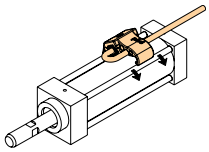
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

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

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

M REED SWITCHES



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

COMPACT REED SWITCHES

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

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

V FLUOROELASTOMER SEALS

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

Z1 ELECTROLESS NICKEL PLATING

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

NOTE: Standard plating is Brite Zinc.

W CLOSE TOLERANCE STROKE

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

Maximum stroke for cylinders with close tolerance is 18".

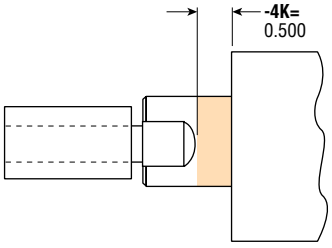
NOTE: This option is not available with shock pads (-B, -BC, or -BR).

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

All dimensions are reference only unless specifically toleranced.

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

H47 RODLOK CYLINDER & RODLOK

Available on single rod Series AV units only. ⊕

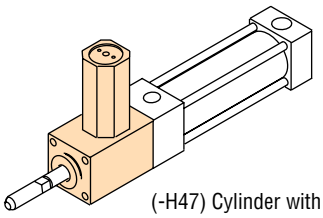
PHD's Rodlok is ideal for locking the piston rod while in a static/ stationary position. When the pressure is removed from the port of the Rodlok, the mechanism will grip the rod and prevent it from moving. The loads are held indefinitely without power. Rodlok performance is application and environment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

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

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

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

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

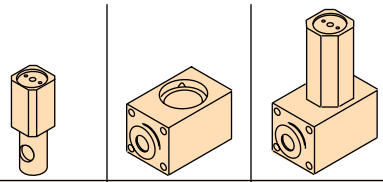


(-H47) Cylinder with rod locking device and adaptor preassembled

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

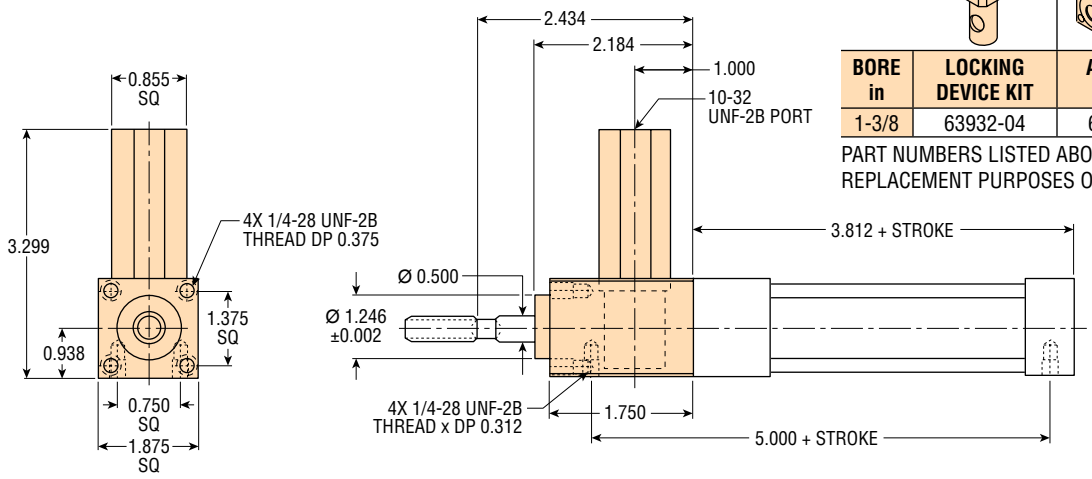
NOTE: *LOCKING FORCE GIVEN IS THE ACTUAL LOCKING FORCE WITH A DRY, CLEAN ROD AND DOES NOT INCLUDE ANY SAFETY FACTOR.

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.



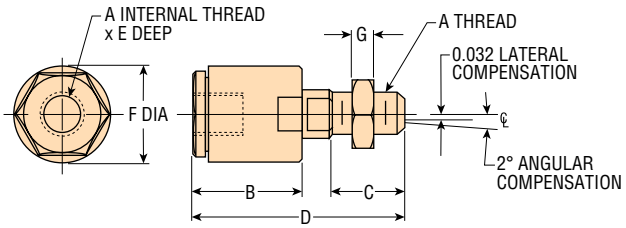
NOTE:
BREAKAWAY FORCE ON CYLINDERS WITH RODLOK APPROXIMATELY 30 psi.

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

SELF-ALIGNING PISTON ROD COUPLERS

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

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



MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
375	3/8-24	1.000	0.625	1.875	0.500	0.875	0.219
437	7/16-20	1.125	0.650	2.187	0.500	1.000	0.250
500	1/2-20	1.125	0.650	2.187	0.500	1.000	0.312

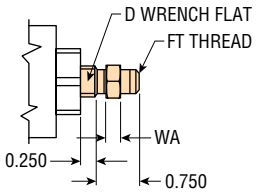
To order, specify the model number.

All dimensions are reference only unless specifically toleranced.

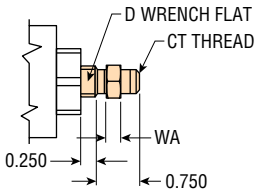
ACCESSORIES: SERIES AV, HV CYLINDERS; 1-3/8" BORE

1-3/8" BORE CYLINDERS

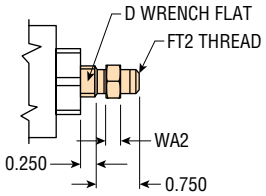
G
ROD END STYLE #2
STANDARD ON:
(1-3/8" BORE)



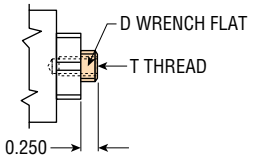
L
COARSE THREAD ROD END



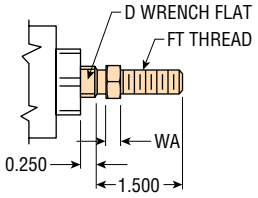
F
ROD END STYLE #1



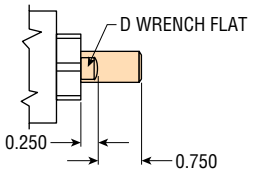
I
ROD END STYLE #4



J
ROD END STYLE #2X



N
PLAIN ROD END

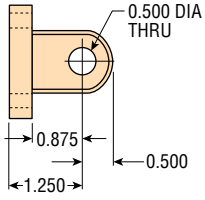


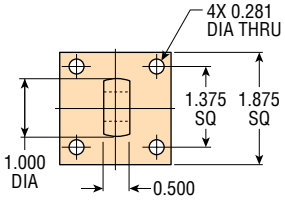
All standard rod ends have four wrench flats (two wrench flats with "I" option).

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

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

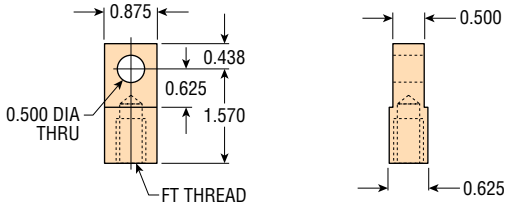
EYE BRACKET KIT





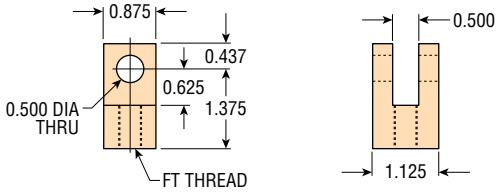
BORE SIZE	PART NO.
1-3/8	1330

ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION FT
1-3/8	1375-01	3/8-24 x 0.750 DP
	1375-02	7/16-20 x 0.750 DP
	1375-03	1/2-20 x 0.750 DP

ROD CLEVIS KIT - PIN INCLUDED

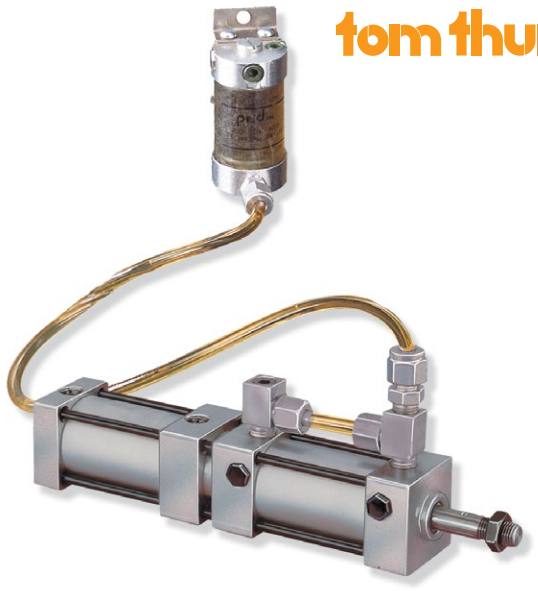


BORE SIZE	KIT NO.	LETTER DIMENSION FT
1-3/8	12909	3/8-24 TO SLOT
	12910	7/16-20 TO SLOT
	12911	1/2-20 TO SLOT

All dimensions are reference only unless specifically toleranced.

3/4", 1", 1-1/8", 1-3/8" BORE AIR/OIL TANDEM CYLINDERS

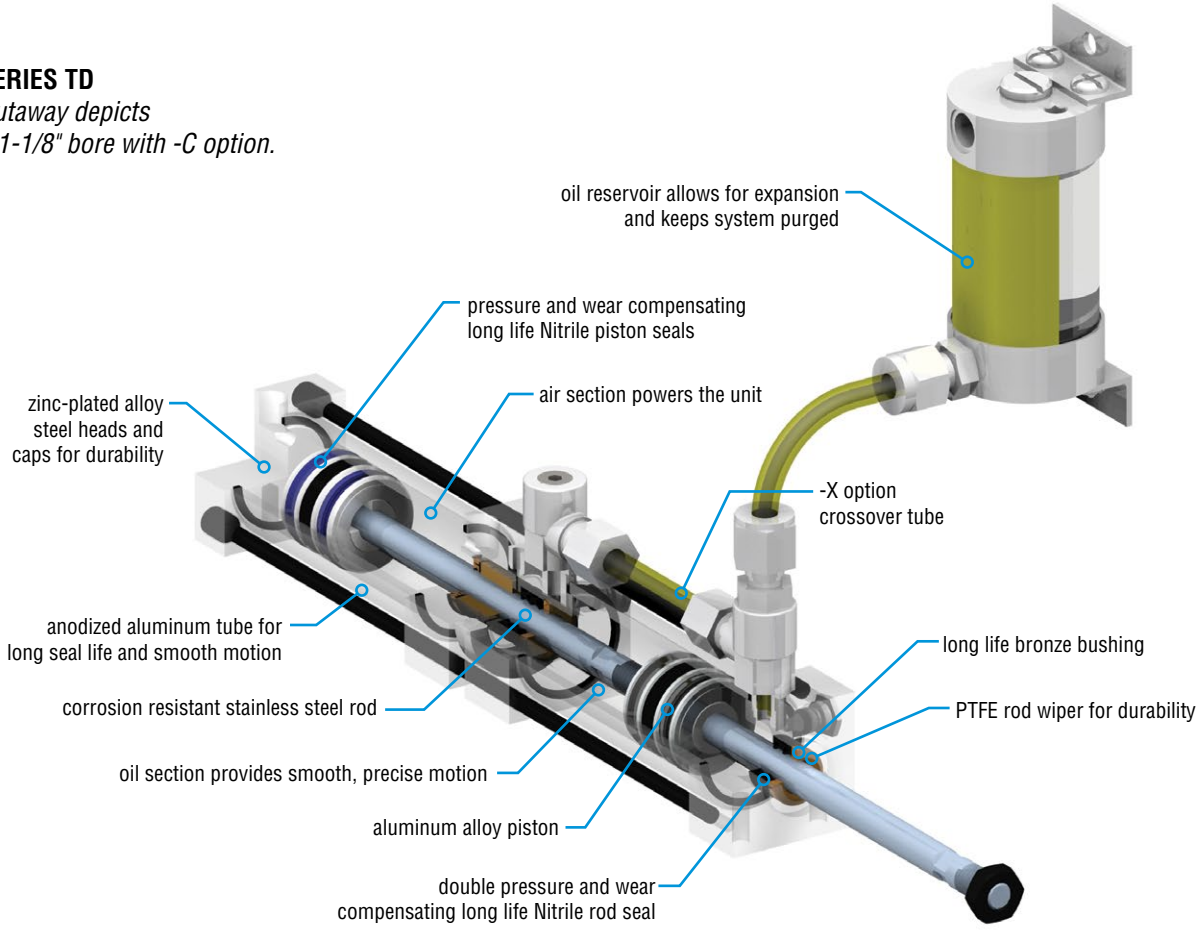
tom thumb®



Major Benefits

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

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



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

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

CYLINDER SERIES
TD - 150 psi air

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

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

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

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

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

TD F 1-1/8 x 3 - X - M

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

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

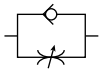
STANDARD STROKE LENGTHS
3/4" BORE SIZE
1/4" to 6"
1" and 1-1/8" BORE SIZES
1/4" to 9"
in 1/4" increments

1-3/8" BORE SIZE
1/2" to 12"
in 1/2" increments

For longer strokes, consult PHD.

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

Standard Feature
PORT CONTROL®



BUILT-IN METER OUT FLOW CONTROL VALVE

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

PROXIMITY SWITCH MOUNTING BRACKETS

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

See Switches and Sensors section for complete ordering information.

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

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

Switches are ordered separately

Designer's Resource myphd®

CAD & Sizing Assistance

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

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

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	W/OUT -C OR -X			
				lb/psi	lb/psi	WITH -C OR -X	W/OUT -C OR -X	
TD	3/4	1/4	EXTEND	0.442	0.835	0.0016	0.0030	0.0019
			RETRACT	0.393	0.786	0.0014	0.0028	0.0017
	1	5/16	EXTEND	0.785	1.494	0.0029	0.0055	0.0034
			RETRACT	0.709	1.418	0.0026	0.0052	0.0031
	1-1/8	3/8	EXTEND	0.994	1.877	0.0037	0.0069	0.0043
			RETRACT	0.883	1.766	0.0032	0.0064	0.0038
	1-3/8	1/2	EXTEND	1.485	2.774	0.0055	0.0103	0.0064
			RETRACT	1.289	2.578	0.0048	0.0096	0.0056

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"	—	—	—	—	—

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 0.133 in/sec.

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

CYLINDER FORCE CALCULATIONS

	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2



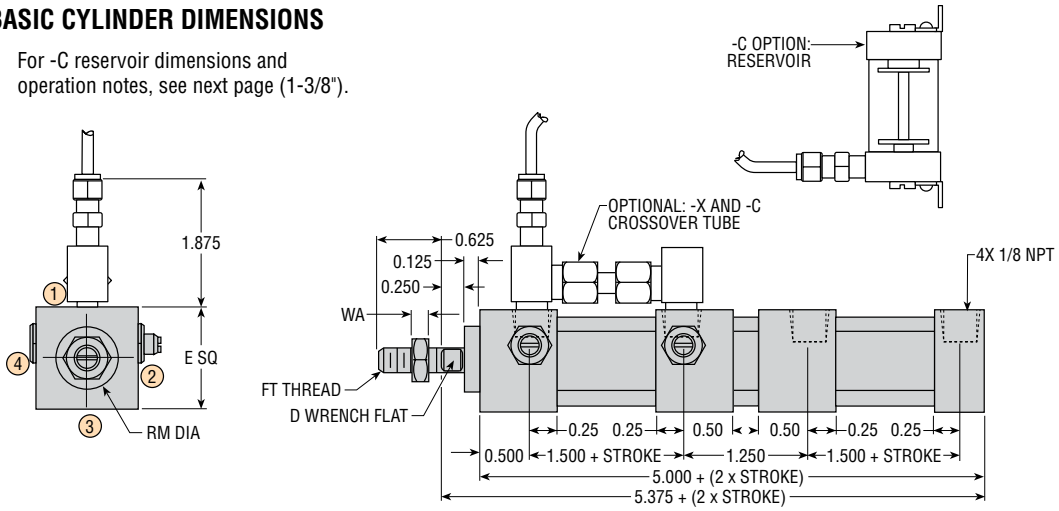
Application & Sizing Assistance

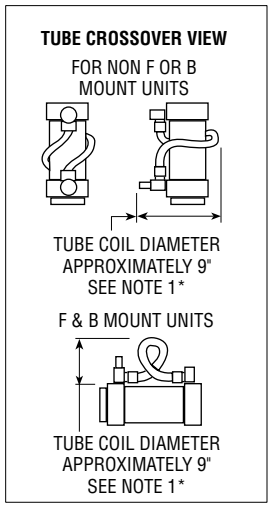
Use PHD's free online Product Sizing Application at **www.phdinc.com/apps/sizing**

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

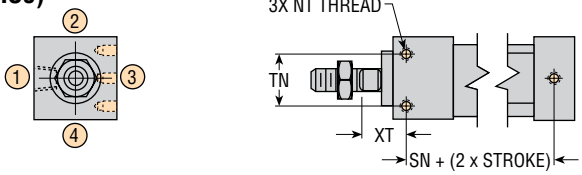
BASIC CYLINDER DIMENSIONS

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

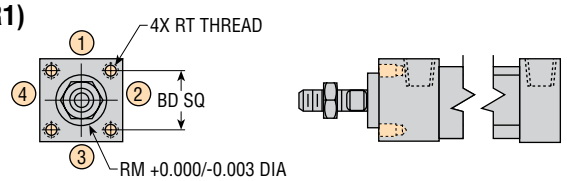




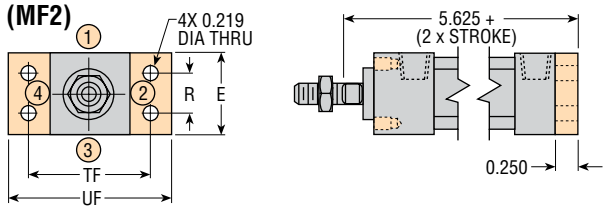
B (MS9)



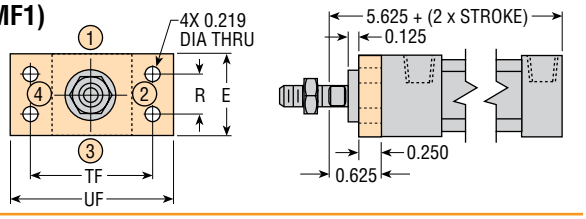
R (MR1)



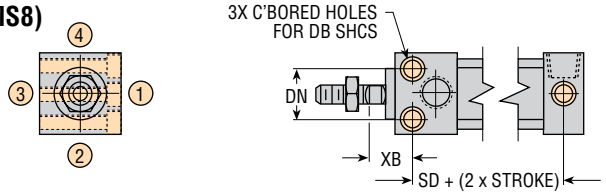
CF (MF2)



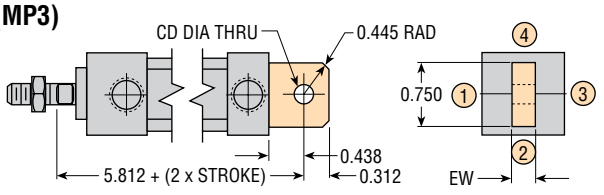
RF (MF1)



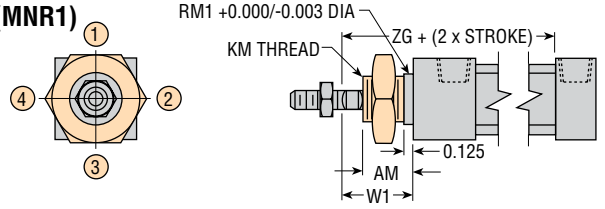
F (MS8)



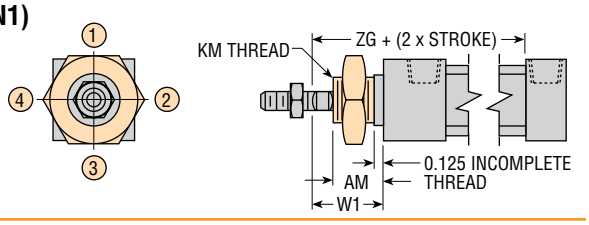
P (MP3)



L (MNR1)



T (MN1)



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

BORE SIZE	LETTER DIMENSION																			
	AM	BD	CD	D	DB	DN	E	EW	FT	KM	NT	R	RM	RM1	RT	SD	SN	TF	TN
3/4	0.625	0.750	0.250	3/16	#8	0.625	1.000	0.250	1/4-28	5/8-18	8-32 x 0.18 DP	0.500	0.625	0.687	8-32 x 0.25 DP	4.562	4.562	1.500	0.625
1	0.625	1.000	0.375	1/4	#10	0.875	1.375	0.375	5/16-24	3/4-16	10-32 x 0.25 DP	0.875	0.750	0.812	8-32 x 0.25 DP	4.500	4.500	1.875	0.875
1-1/8	0.875	1.125	0.375	5/16	#10	1.000	1.500	0.375	3/8-24	1-14	10-32 x 0.25 DP	1.000	0.750	1.062	10-32 x 0.25 DP	4.500	4.500	2.000	1.000

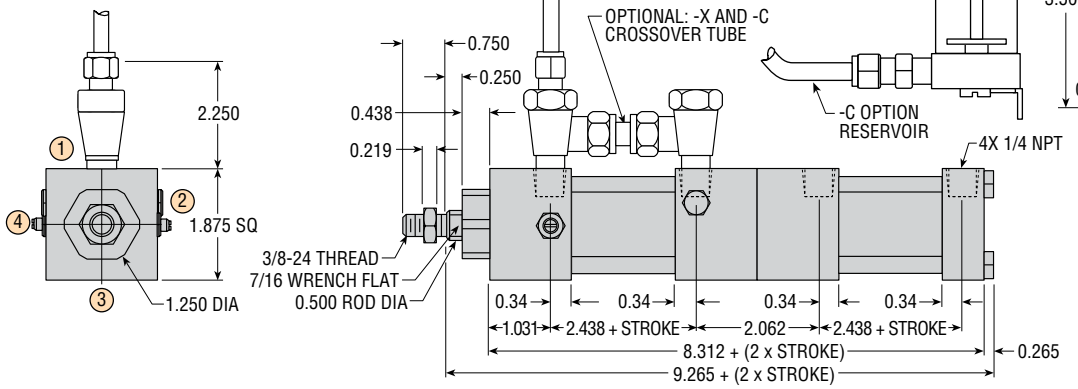
BORE SIZE	LETTER DIMENSION					
	UF	WA	W1	XB	XT	ZG
3/4	2.000	0.156	0.875	0.562	0.562	5.875
1	2.375	0.188	0.875	0.625	0.625	5.875
1-1/8	2.500	0.219	1.125	0.625	0.625	6.125

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

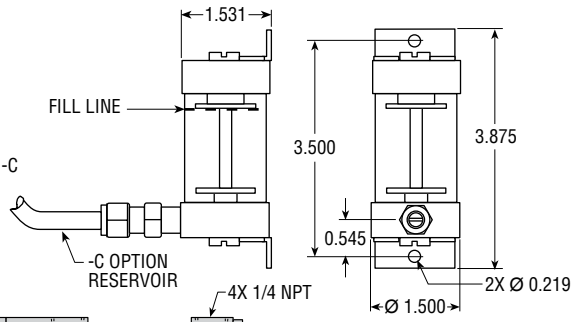
All dimensions are reference only unless specifically toleranced.

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

BASIC CYLINDER DIMENSIONS



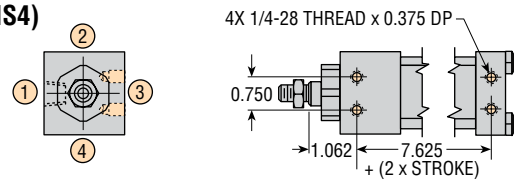
TANK DIMENSIONS



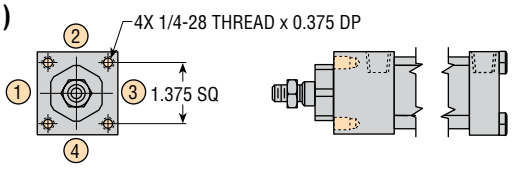
-C Option Air/Oil Tandem Mounting and Operation Notes:

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.

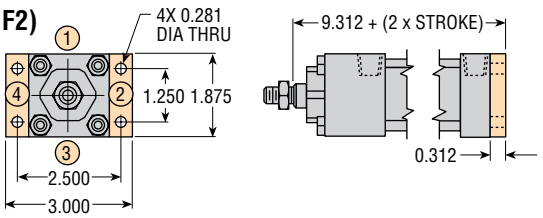
B (MS4)



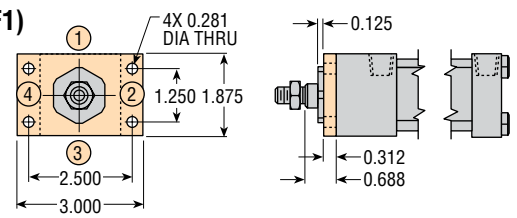
R (MR1)



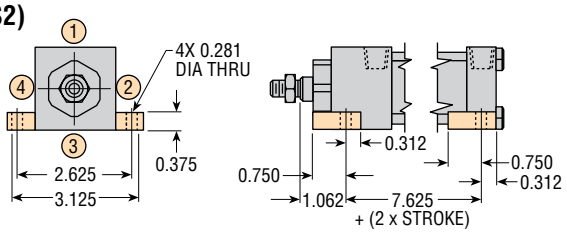
CF (MF2)



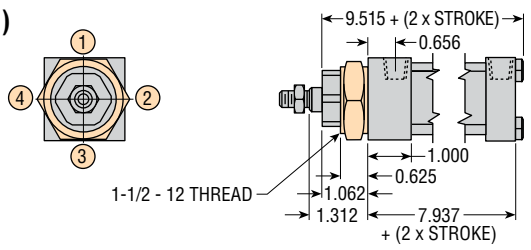
RF (MF1)



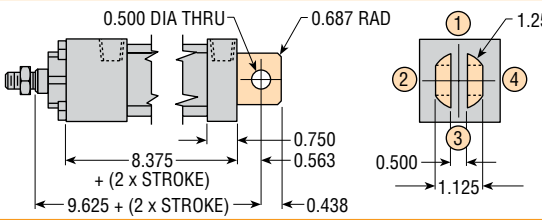
F (MS2)



T (MN1)



K (MP1)

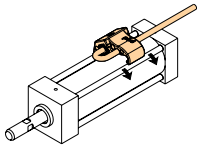


All standard rod ends have four wrench flats (two wrench flats with "I" option).

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

All dimensions are reference only unless specifically toleranced.

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

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

M REED SWITCHES

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

COMPACT REED SWITCHES

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

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

V FLUOROELASTOMER SEALS

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

C RESERVOIR ASSEMBLY PLUMBED
Air/Oil Tandem models only (Series TD)

See previous page for dimensions.

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

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

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

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

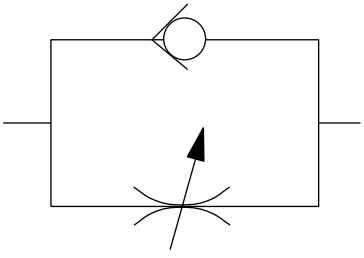
X CROSSOVER TUBE
Air/Oil Tandem models only (Series TD)

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

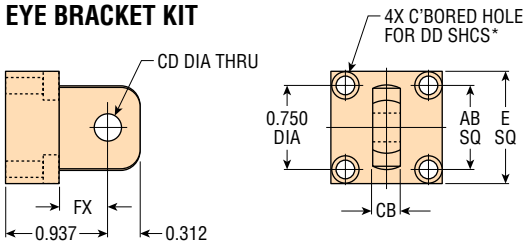
STANDARD PORT CONTROL®

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

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



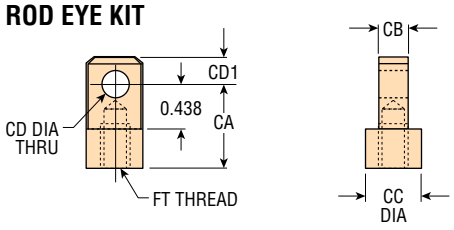
EYE BRACKET KIT



BORE SIZE	PART NO.	LETTER DIMENSION					
		AB	CB	CD	DD*	E	FX
3/4	1077-01	0.750	0.248	0.250	#6	1.000	0.577
1 & 1-1/8	1077-03	1.000	0.373	0.375	#10	1.375	0.437

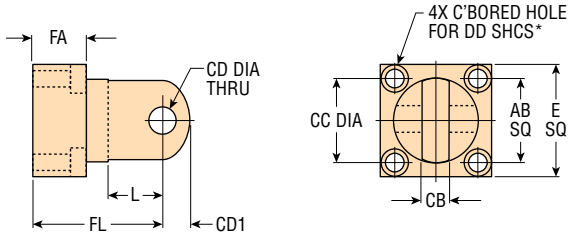
*For 3/4 bore thru hole only.

ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION					
		CA	CB	CC	CD	CD1	FT
3/4	1075-01	0.750	0.248	0.500	0.250	0.250	1/4-28 x 0.375 DP
1	1075-04	0.875	0.373	0.750	0.375	0.375	5/16-24 x 0.375 DP
1-1/8	1075-05	0.875	0.373	0.750	0.375	0.375	3/8-24 x 0.312 DP

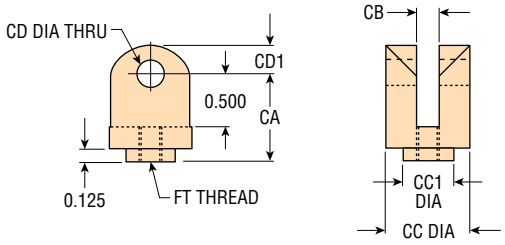
CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	PART NO.	LETTER DIMENSION									
		AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	12901	0.750	0.254	0.750	0.250	0.250	#6	1.000	0.360	1.187	0.500
1 & 1-1/8	12903	1.000	0.379	0.875	0.375	0.375	#10	1.375	0.500	1.250	0.531

*For 3/4 bore thru hole only.

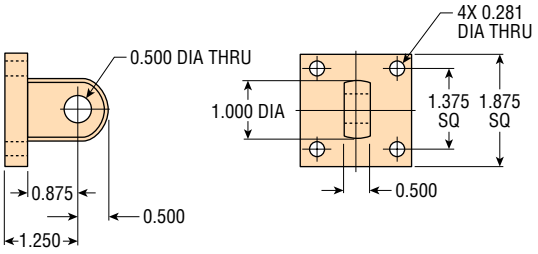
ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	PART NO.	LETTER DIMENSION						
		CA	CB	CC	CC1	CD	CD1	FT
3/4	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	12908	0.875	0.379	0.875	0.562	0.375	0.375	3/8-24 TO SLOT

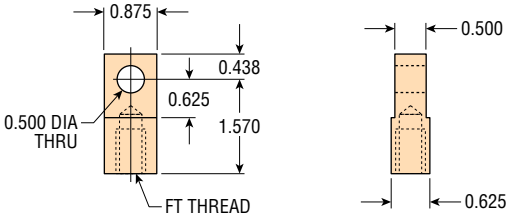
All dimensions are reference only unless specifically toleranced.

EYE BRACKET KIT



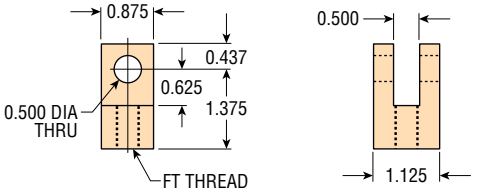
BORE SIZE	PART NO.
1-3/8	1330

ROD EYE KIT



BORE SIZE	PART NO.	LETTER DIMENSION FT
1-3/8	1375-01	3/8-24 x 0.750 DP
1-3/8	1375-02	7/16-20 x 0.750 DP

ROD CLEVIS KIT - PIN INCLUDED



BORE SIZE	PART 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®

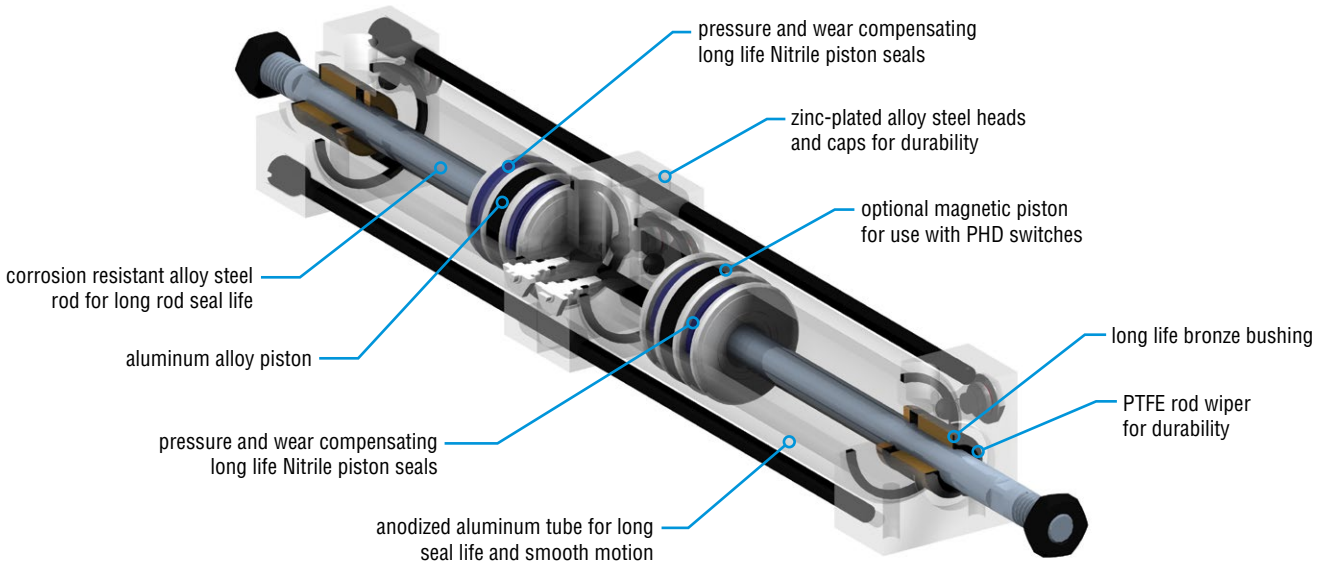
3/4", 1", 1-1/8", 1-3/8" BORE BACK-TO-BACK FOUR-POSITION CYLINDERS



Major Benefits

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

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



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

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

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

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

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

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

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

STANDARD STROKE CYLINDER 1

BORE	STROKE
3/4"	1/4" to 6"
1" & 1-1/8"	1/4" to 9"
1-3/8"	1/2" to 12"

Consult PHD for longer lengths.

STANDARD STROKE CYLINDER 2

BORE	STROKE
3/4"	1/4" to 6"
1" & 1-1/8"	1/4" to 9"
1-3/8"	1/2" to 12"

Consult PHD for longer lengths.

AV 2 B 1-3/8 x 2 x 1 - P-M

TYPE
2 - Back-to-Back Cylinder

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

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

⚠ Options may affect unit length. See dimensional pages and option information details.

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.

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

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

Switches are ordered separately

Designer's Resource myphd®

CAD & Sizing Assistance

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

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	±0.032	±0.032	±0.032
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	0.442	0.0016	0.0019
			RETRACT	0.393	0.0014	0.0017
	1	5/16	EXTEND	0.785	0.0029	0.0034
			RETRACT	0.709	0.0026	0.0031
	1-1/8	3/8	EXTEND	0.994	0.0037	0.0043
			RETRACT	0.883	0.0032	0.0038
	1-3/8	1/2	EXTEND	1.485	0.0055	0.0064
			RETRACT	1.289	0.0048	0.0056

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

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"	—	—	—
	5/16	18"	13"	8"	6"	5"	—	—	—
	3/8	26"	18"	12"	9"	7"	—	—	—
1-3/8" AV2, HV2	1/2	48"	34"	21"	15"	12"	—	—	—

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE*
AV2 PLAIN	3/4	0.84	0.04
	1	1.74	0.07
	1-1/8	1.90	0.10
	1-3/8	5.12	0.12

*Total Stroke = Stroke Cylinder 1 + Stroke Cylinder 2

CYLINDER FORCE CALCULATIONS	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2

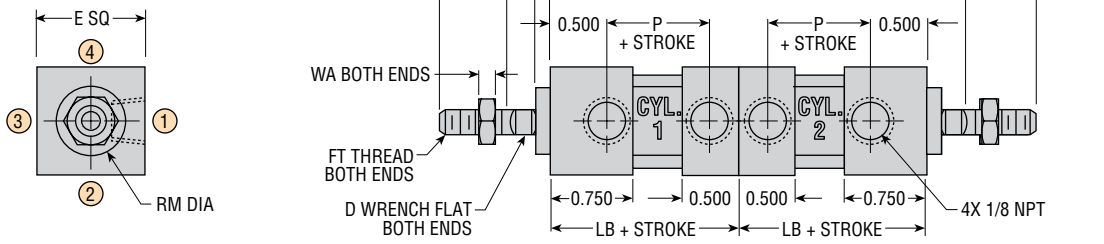
UNIT SIZING ONLINE

Application & Sizing Assistance

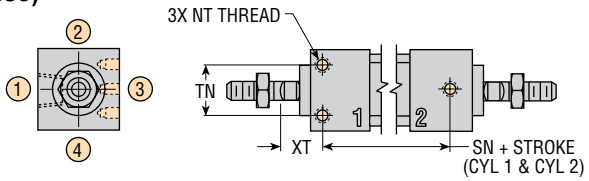
Use PHD's free online Product Sizing Application at **www.phdinc.com/apps/sizing**

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

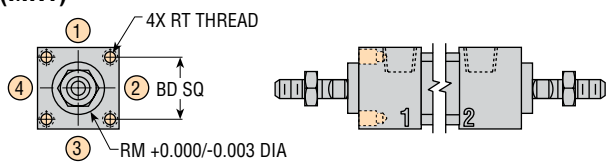
BASIC CYLINDER DIMENSIONS



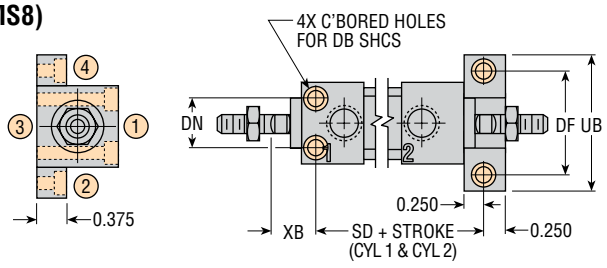
B (MS9)



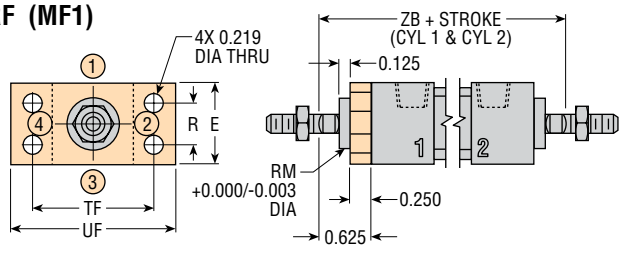
R (MR1)



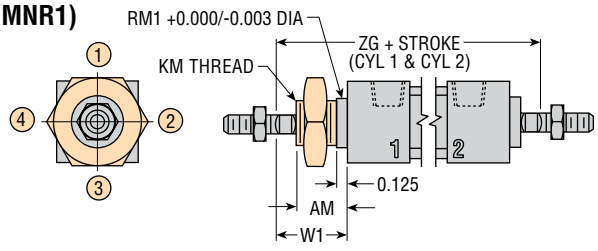
F (MS8)



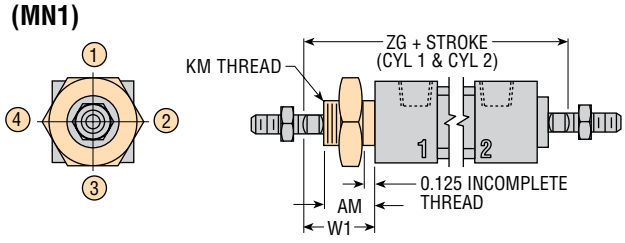
RF (MF1)



L (MNR1)



T (MN1)



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

DIMENSIONS COMMON TO ALL SERIES

BORE SIZE	LETTER DIMENSION															
	BD	D	DB	DF	DN	E	FT	NT	R	RM	RT	TF	TN	UB	UF	WA
3/4	0.750	3/16	#8	1.375	0.625	1.000	1/4-28	8-32 x 0.18 DP	0.500	0.625	8-32 x 0.25 DP	1.500	0.625	1.750	2.000	0.156
1	1.000	1/4	#10	1.750	0.875	1.375	5/16-24	10-32 x 0.25 DP	0.875	0.750	8-32 x 0.25 DP	1.875	0.875	2.125	2.375	0.188
1-1/8	1.125	5/16	#10	1.875	1.000	1.500	3/8-24	10-32 x 0.25 DP	1.000	0.750	10-32 x 0.25 DP	2.000	1.000	2.250	2.500	0.219

SERIES A2 CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	0.625	5/8-18	1.750	1.000	0.687	3.562	3.062	0.125	0.875	0.562	0.562	4.500	4.750	4.250
1	0.625	3/4-16	1.750	1.000	0.812	3.500	3.000	0.125	0.875	0.625	0.625	4.500	4.750	4.250
1-1/8	0.625	3/4-16	1.750	1.000	0.812	3.500	3.000	0.125	0.875	0.625	0.625	4.500	4.750	4.250

SERIES HV2 CYLINDERS

BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	0.625	5/8-18	2.250	1.500	0.687	4.562	4.062	0.375	0.875	0.812	0.812	5.750	6.000	5.750
1	0.625	3/4-16	2.250	1.500	0.812	4.500	4.000	0.375	0.875	0.875	0.875	5.750	6.000	5.750
1-1/8	0.875	1-14	2.250	1.500	1.062	4.500	4.000	0.375	1.125	0.875	0.875	5.750	6.250	5.750

SERIES AV2 CYLINDERS

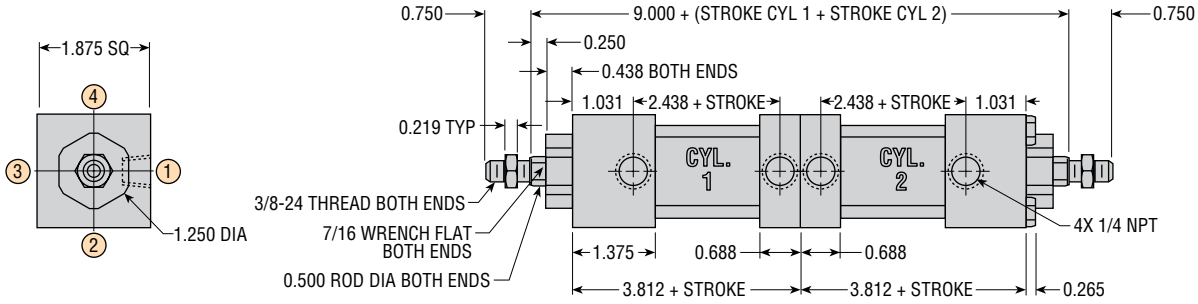
BORE SIZE	LETTER DIMENSION													
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	ZG	ZR
3/4	0.625	5/8-18	2.250	1.500	0.687	4.562	4.062	0.125	0.875	0.562	0.562	5.500	5.750	5.250
1	0.625	3/4-16	2.250	1.500	0.812	4.500	4.000	0.125	0.875	0.625	0.625	5.500	5.750	5.250
1-1/8	0.875	1-14	2.250	1.500	1.062	4.500	4.000	0.125	1.125	0.625	0.625	5.500	6.000	5.250

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

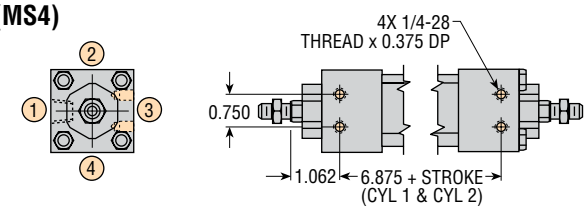
All dimensions are reference only unless specifically toleranced.

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

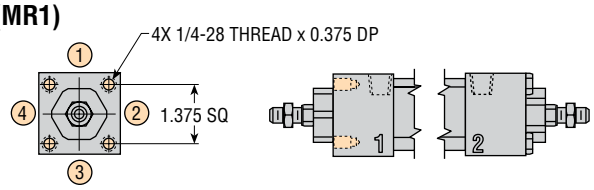
BASIC CYLINDER DIMENSIONS



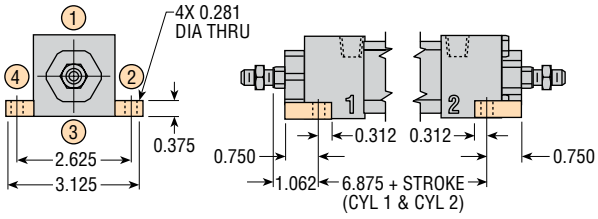
B (MS4)



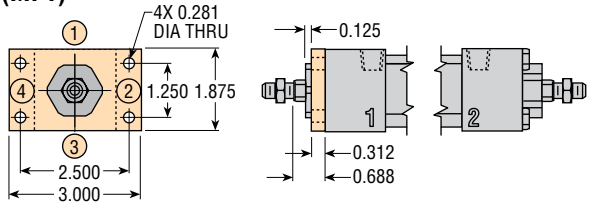
R (MR1)



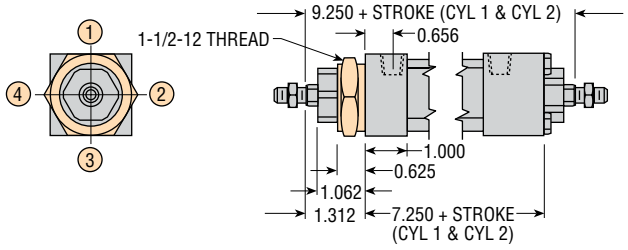
F (MS2)



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

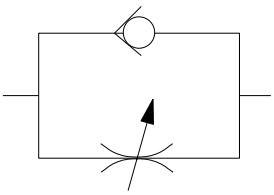
All dimensions are reference only unless specifically toleranced.

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

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

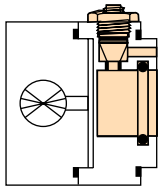
PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.

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

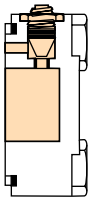
Effective cushion length 1/2"

CUSHION BLOCK



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

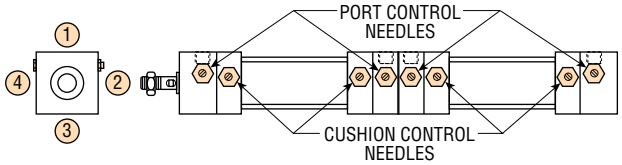
POPPET STYLE



1-3/8" BORE

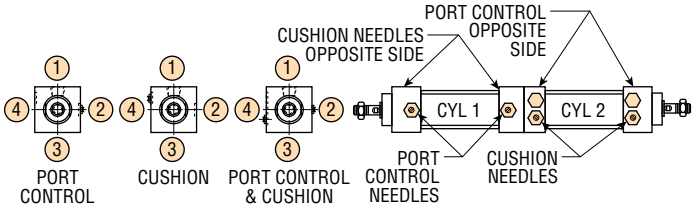
STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS
(3/4", 1", 1-1/8" Bore Series A2, AV2, and HV2 Cylinders)

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)

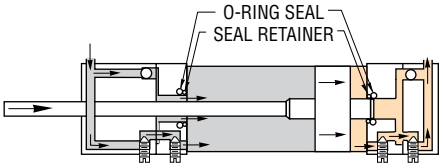
Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.



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.

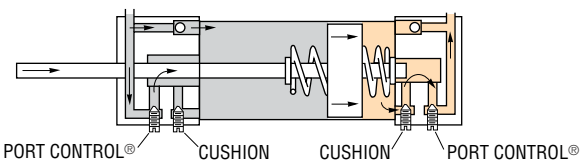
CUSHION BLOCK STYLE



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



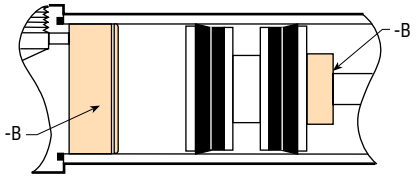
OPTIONS: SERIES AV2, HV2, A2 BACK-TO-BACK; 3/4", 1", 1-1/8", 1-3/8" BORE

B SHOCK PADS

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

Available together with all options EXCEPT:

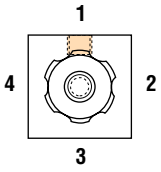
- **Same end as Cushion (-D)**
- **Both ends of both cylinders**



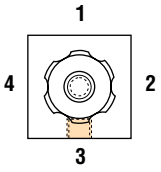
PORT POSITIONS

Port position 1 is standard on all cylinders.

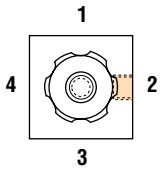
PORT POSITION 1 (STANDARD)



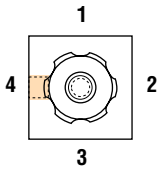
T PORT POSITION 3



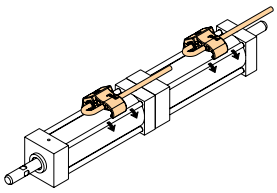
R PORT POSITION 2



U PORT POSITION 4



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

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

M REED SWITCHES

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

COMPACT REED SWITCHES

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

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

V FLUOROELASTOMER SEALS

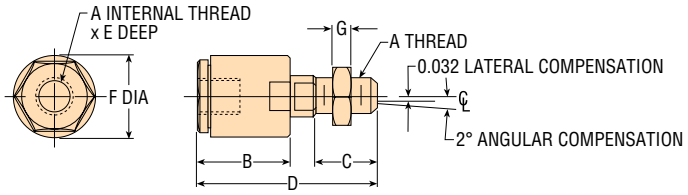
Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

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

SELF-ALIGNING PISTON ROD COUPLERS

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

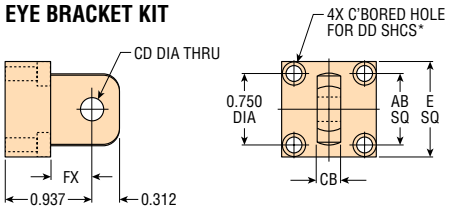
Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.



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

To order, specify the model number.

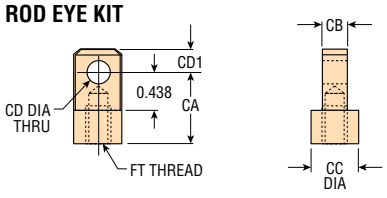
EYE BRACKET KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			AB	CB	CD	DD*	E	FX
3/4	A2, AV2, HV2	1077-01	0.750	0.248	0.250	#6	1.000	0.577
1 & 1-1/8	A2	1077-02	1.000	0.373	0.250	#10	1.375	0.437
	AV2, HV2	1077-03	1.000	0.373	0.375	#10	1.375	0.437

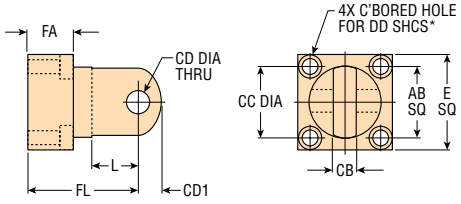
*For 3/4 bore thru hole only.

ROD EYE KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			CA	CB	CC	CD	CD1	FT
3/4	A2, AV2	1075-01	0.750	0.248	0.500	0.250	0.250	1/4-28 x 0.375 DP
1	A2	1075-02	0.875	0.373	0.750	0.250	0.375	5/16-24 x 0.375 DP
	AV2	1075-04	0.875	0.373	0.750	0.375	0.375	5/16-24 x 0.375 DP
1-1/8	A2	1075-03	0.875	0.373	0.750	0.250	0.375	3/8-24 x 0.312 DP
	AV2	1075-05	0.875	0.373	0.750	0.375	0.375	3/8-24 x 0.312 DP

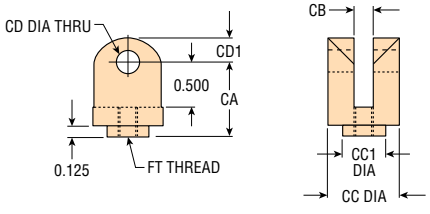
CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION								
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A2, AV2	12901	0.750	0.254	0.750	0.250	0.250	#6	1.000	0.360	1.187	0.500
1 & 1-1/8	A2	12902	1.000	0.379	0.875	0.250	0.375	#10	1.375	0.500	1.250	0.531
	AV2	12903	1.000	0.379	0.875	0.375	0.375	#10	1.375	0.500	1.250	0.531

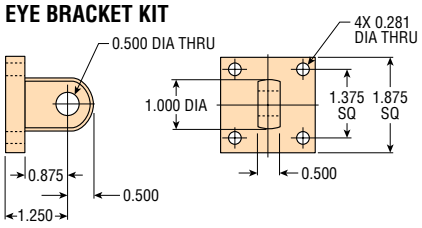
*For 3/4 bore thru hole only.

ROD CLEVIS KIT - PIN INCLUDED



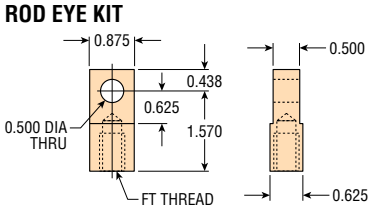
BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CC1	CD	CD1	FT
3/4	A2, AV2	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	A2	12905	0.875	0.379	0.875	0.562	0.250	0.375	5/16-24 TO SLOT
	AV2	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	A2	12907	0.875	0.379	0.875	0.562	0.250	0.375	3/8-24 TO SLOT
	AV2	12908	0.875	0.379	0.875	0.562	0.375	0.375	3/8-24 TO SLOT

EYE BRACKET KIT



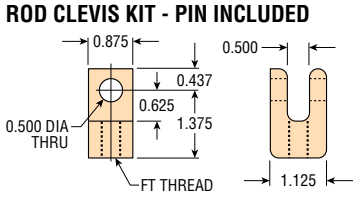
BORE SIZE	CYLINDER SERIES	PART NO.
1-3/8	AV2, HV2	1330

ROD EYE KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION
			FT
1-3/8	AV2, HV2	1375-01	3/8-24 x 0.750 DP

ROD CLEVIS KIT - PIN INCLUDED



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

All dimensions are reference only unless specifically toleranced.

A3V, H3V, A3

tom thumb®

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

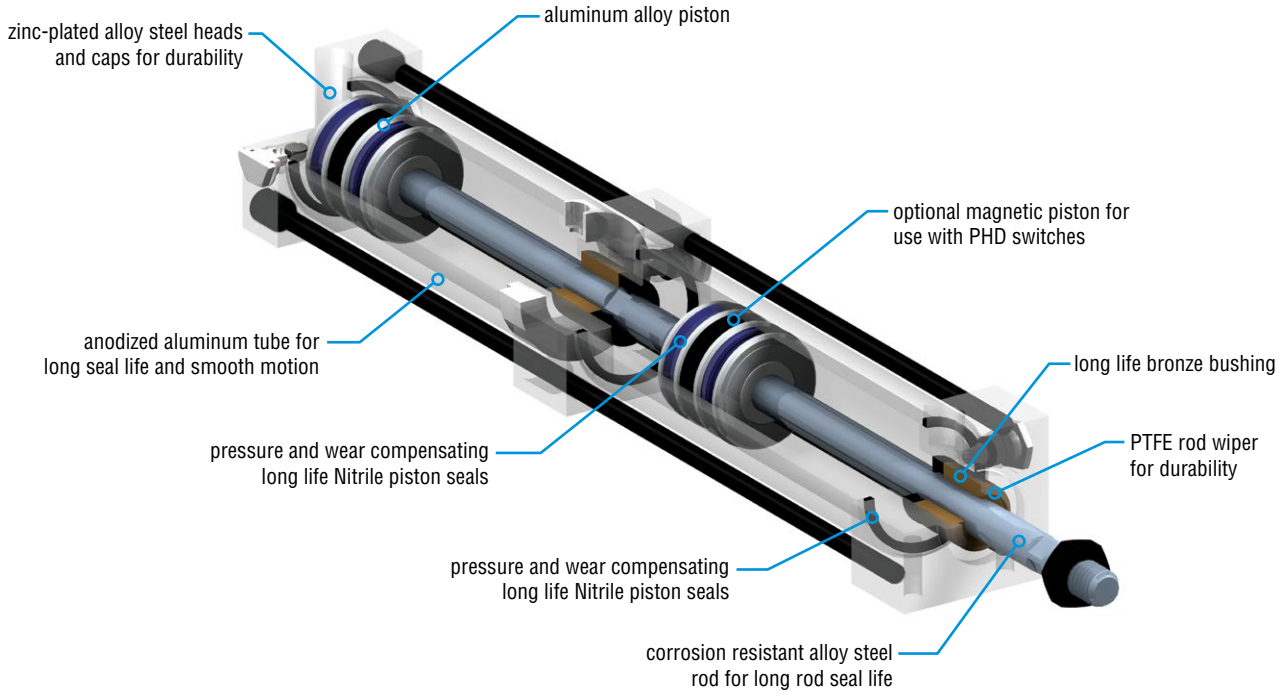


Major Benefits

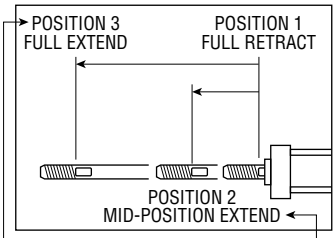
- Four linear positions from piston rod
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation
- Simple three position operation

SERIES A3V

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



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



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

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

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

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

STANDARD STROKE CYLINDER 1 (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.

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

PROXIMITY SWITCH MOUNTING BRACKETS

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 dimensional pages and option information details.

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

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

Switches are ordered separately

Designer's Resource myphd®

CAD & Sizing Assistance

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

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	±0.032	±0.032	±0.032
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	0.442	0.0016	0.0019
			RETRACT	0.393	0.0014	0.0017
	1	5/16	EXTEND	0.785	0.0029	0.0034
			RETRACT	0.709	0.0026	0.0031
	1-1/8	3/8	EXTEND	0.994	0.0037	0.0043
			RETRACT	0.883	0.0032	0.0038
	1-3/8	1/2	EXTEND	1.485	0.0055	0.0064
			RETRACT	1.289	0.0048	0.0056

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

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	0.67	0.04
	1	1.39	0.07
	1-1/8	1.52	0.10
	1-3/8	4.12	0.12

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

CYLINDER FORCE CALCULATIONS	Imperial F = P x A
F = Cylinder Force	lbs
P = Operating Pressure	psi
A = Effective Area (Extend or Retract)	in^2

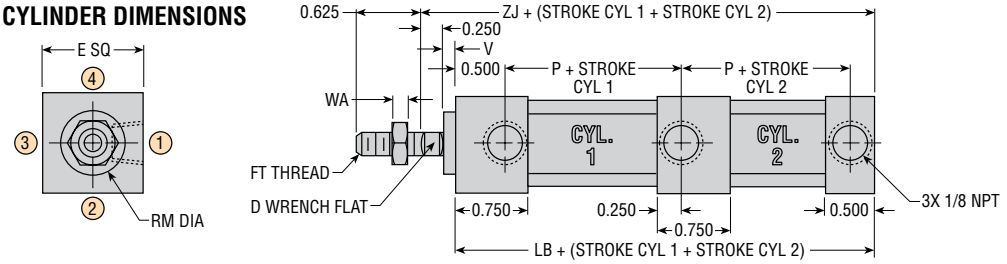


Application & Sizing Assistance

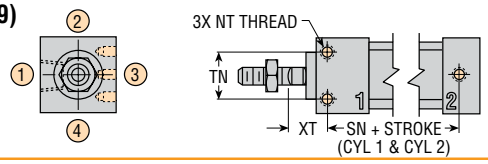
Use PHD's free online Product Sizing Application at **www.phdinc.com/apps/sizing**

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

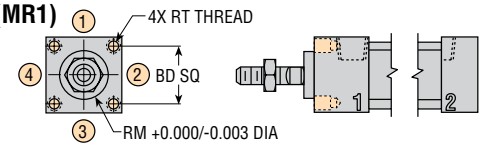
BASIC CYLINDER DIMENSIONS



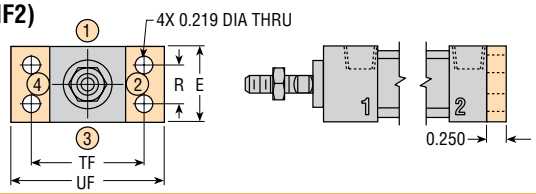
B (MS9)



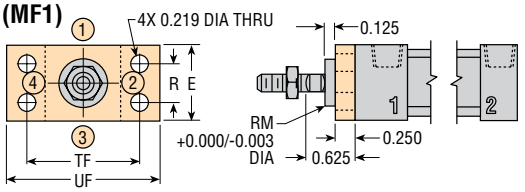
R (MR1)



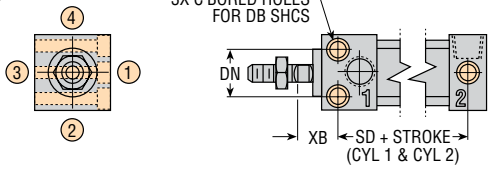
CF (MF2)



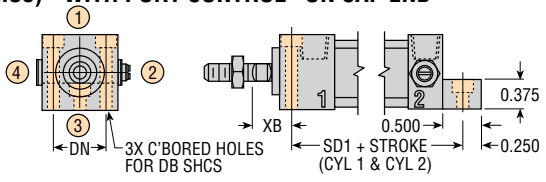
RF (MF1)



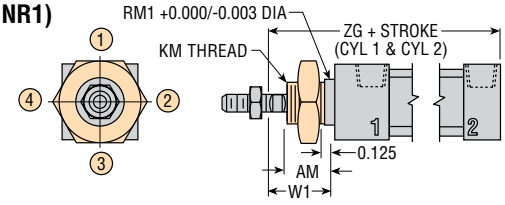
F (MS8)



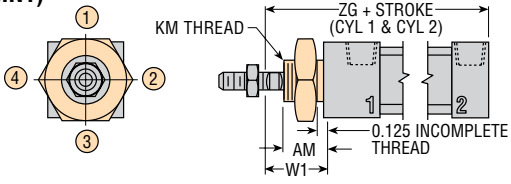
F (MS8) - WITH PORT CONTROL® ON CAP END



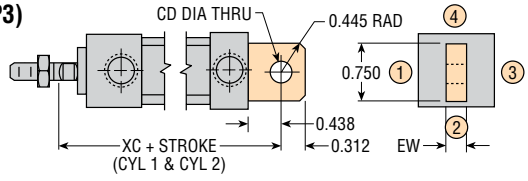
L (MNR1)



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 0.500 in TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR CUSHIONS (ADD TOTAL OF 1.000 in TO OVERALL LENGTH)
SHOCK PADS: ADD 0.250 in TO (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 FOR SHOCK PADS (ADD TOTAL OF 0.500 in TO OVERALL LENGTH)

DIMENSIONS COMMON TO ALL SERIES

BORE SIZE	LETTER DIMENSION								
	BD	D	DB	DF	DN	E	EW	FT	NT
3/4	0.750	3/16	#8	1.375	0.625	1.000	0.250	1/4-28	8-32 x 0.18 DP
1	1.000	1/4	#10	1.750	0.875	1.375	0.375	5/16-24	10-32 x 0.25 DP
1-1/8	1.125	5/16	#10	1.875	1.000	1.500	0.375	3/8-24	10-32 x 0.25 DP

DIMENSIONS COMMON TO ALL SERIES

BORE SIZE	LETTER DIMENSION							
	R	RM	RT	TF	TN	UB	UF	WA
3/4	0.500	0.625	8-32 x 0.25 DP	1.500	0.625	1.750	2.000	0.156
1	0.875	0.750	8-32 x 0.25 DP	1.875	0.875	2.125	2.375	0.188
1-1/8	1.000	0.750	10-32 x 0.25 DP	2.000	1.000	2.250	2.500	0.219

SERIES A3 CYLINDERS

BORE SIZE	LETTER DIMENSION															
	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	0.625	0.250	5/8-18	3.312	1.000	1.562	0.687	2.875	3.375	2.875	0.125	0.875	0.562	4.125	0.562	4.187	3.687
1	0.625	0.250	3/4-16	3.312	1.000	1.562	0.812	2.812	3.312	2.812	0.125	0.875	0.625	4.125	0.625	4.187	3.687
1-1/8	0.625	0.250	3/4-16	3.312	1.000	1.562	0.812	2.812	3.312	2.812	0.125	0.875	0.625	4.125	0.625	4.187	3.687

SERIES A3V CYLINDERS

BORE SIZE	LETTER DIMENSION															
	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	0.625	0.250	5/8-18	4.312	1.500	2.062	0.687	3.875	4.375	3.875	0.125	0.875	0.562	5.125	0.562	5.187	4.687
1	0.625	0.375	3/4-16	4.312	1.500	2.062	0.812	3.812	4.312	3.812	0.125	0.875	0.625	5.125	0.625	5.187	4.687
1-1/8	0.875	0.375	1-14	4.312	1.500	2.062	1.062	3.812	4.312	3.812	0.125	1.125	0.625	5.125	0.625	5.437	4.687

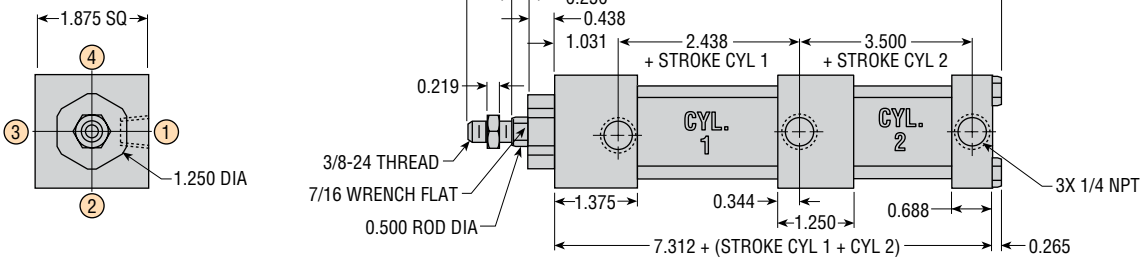
SERIES H3V CYLINDERS

BORE SIZE	LETTER DIMENSION															
	AM	CD	KM	LB	P	P1	RM1	SD	SD1	SN	V	W1	XB	XC	XT	ZG	ZJ
3/4	0.625	0.250	5/8-18	4.312	1.500	2.062	0.687	3.875	4.375	3.875	0.375	0.875	0.812	5.375	0.812	5.187	4.937
1	0.625	0.375	3/4-16	4.312	1.500	2.062	0.812	3.812	4.312	3.812	0.375	0.875	0.875	5.375	0.875	5.187	4.937
1-1/8	0.875	0.375	1-14	4.312	1.500	2.062	1.062	3.812	4.312	3.812	0.375	1.125	0.875	5.375	0.875	5.437	4.937

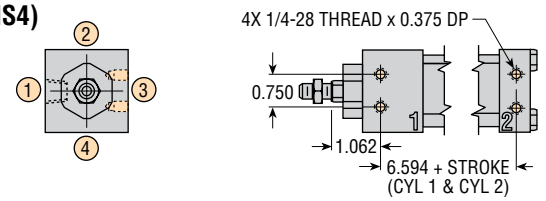
All dimensions are reference only unless specifically toleranced.

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

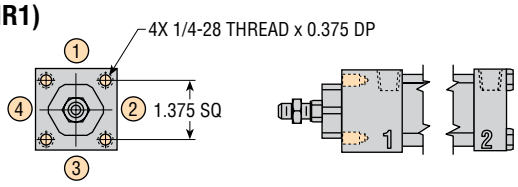
BASIC CYLINDER DIMENSIONS



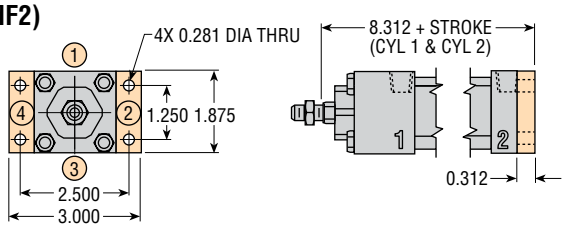
B (MS4)



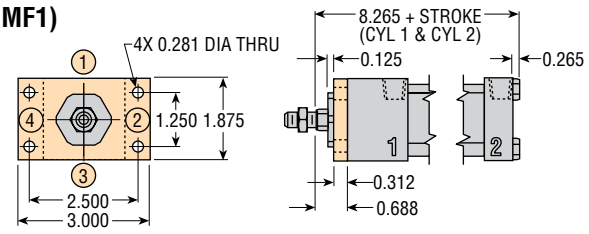
R (MR1)



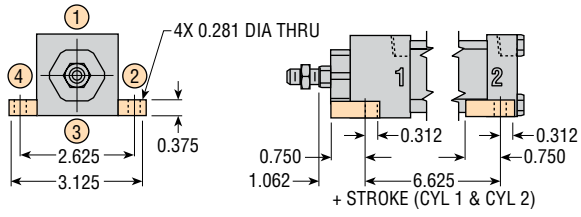
CF (MF2)



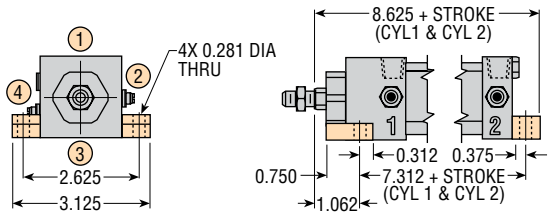
RF (MF1)



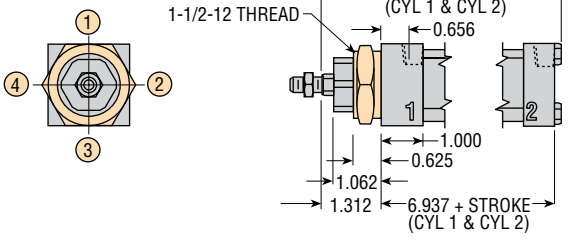
F (MS2)



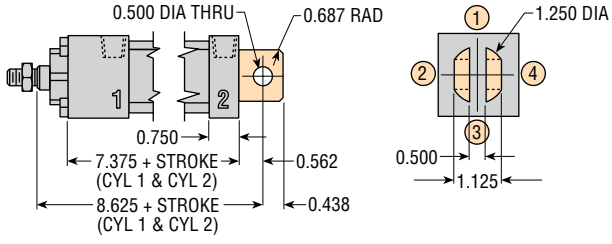
F (MS2)-WITH PORT CONTROL® & CUSHION ON CAP END



T (MN1)



K (MP1)



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

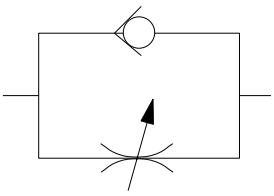
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS
SHOCK PADS: ADD 0.250 in TO (+ STROKE) DIMENSIONS OF EACH CYLINDER 1 AND CYLINDER 2 (ADD A TOTAL OF 0.500 in TO OVERALL LENGTH)

All dimensions are reference only unless specifically toleranced.

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

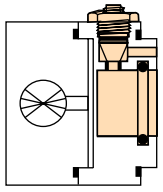
PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

See dimension pages for dimensional information.

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

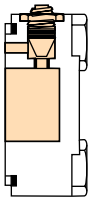
Effective cushion length 1/2"

CUSHION BLOCK



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

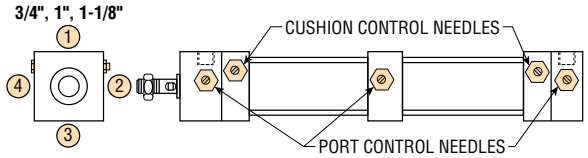
POPPET STYLE



1-3/8" BORE

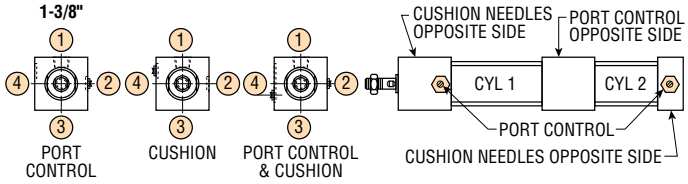
STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS
(3/4", 1", 1-1/8" Bore Series A3, AV3, and HV3 Cylinders)

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)

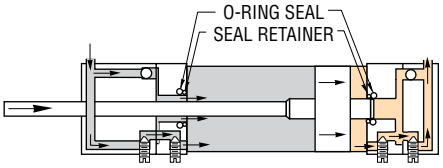
Port Control® and cushion needles are located on opposite sides adjacent to port. Please consult distributor or PHD to check availability of special Port Control® or cushion needle positions.



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

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

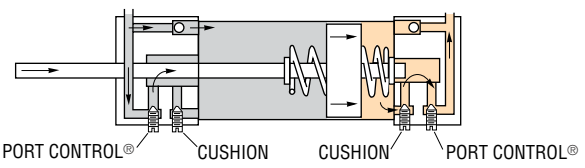
CUSHION BLOCK STYLE



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



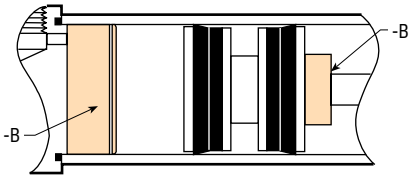
OPTIONS: SERIES A3, A3V, H3V CYLINDERS; 3/4", 1", 1-1/8", 1-3/8" BORE

B SHOCK PADS

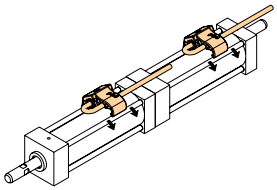
Polyurethane pads for absorption of shock and noise (not available on hydraulic units). Reducing shock permits higher piston velocities for shorter cycle times. Reducing noise levels provides improved environment for increased productivity. Eliminates metal to metal contact between piston and end caps.

Available together with all options EXCEPT:

- **Same end as Cushion (-D)**



MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES



E HALL EFFECT SWITCHES

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

COMPACT HALL EFFECT SWITCHES

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

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

M REED SWITCHES

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

COMPACT REED SWITCHES

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

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

V FLUOROELASTOMER SEALS

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

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

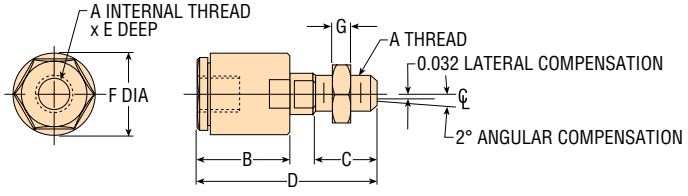
SELF-ALIGNING PISTON ROD COUPLERS

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

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

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

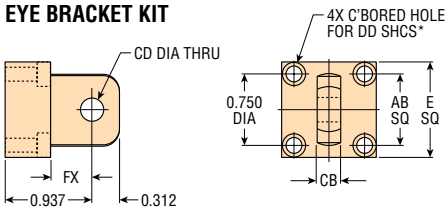
To order, specify the model number.



All dimensions are reference only unless specifically toleranced.

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

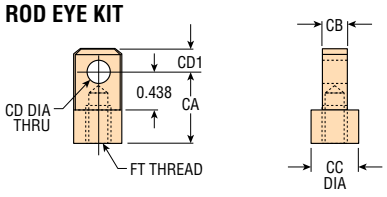
EYE BRACKET KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			AB	CB	CD	DD*	E	FX
3/4	A3, A3V, H3V	1077-01	0.750	0.248	0.250	#6	1.000	0.577
1 & 1-1/8	A3	1077-02	1.000	0.373	0.250	#10	1.375	0.437
	A3V, H3V	1077-03	1.000	0.373	0.375	#10	1.375	0.437

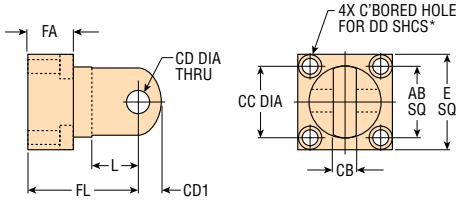
*For 3/4 bore thru hole only.

ROD EYE KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION					
			CA	CB	CC	CD	CD1	FT
3/4	A3, A3V, H3V	1075-01	0.750	0.248	0.500	0.250	0.250	1/4-28 x 0.375 DP
1	A3	1075-02	0.875	0.373	0.750	0.250	0.375	5/16-24 x 0.375 DP
	A3V, H3V	1075-04	0.875	0.373	0.750	0.375	0.375	5/16-24 x 0.375 DP
1-1/8	A3	1075-03	0.875	0.373	0.750	0.250	0.375	3/8-24 x 0.312 DP
	A3V, H3V	1075-05	0.875	0.373	0.750	0.375	0.375	3/8-24 x 0.312 DP

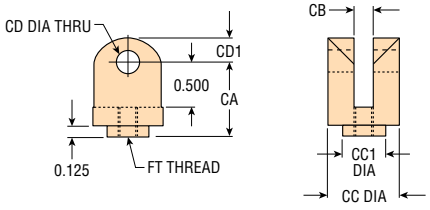
CLEVIS BRACKET KIT - PIN INCLUDED



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION								
			AB	CB	CC	CD	CD1	DD*	E	FA	FL	L
3/4	A3, A3V, H3V	12901	0.750	0.254	0.750	0.250	0.250	#6	1.000	0.360	1.187	0.500
1 & 1-1/8	A3	12902	1.000	0.379	0.875	0.250	0.375	#10	1.375	0.500	1.250	0.531
	A3V, H3V	12903	1.000	0.379	0.875	0.375	0.375	#10	1.375	0.500	1.250	0.531

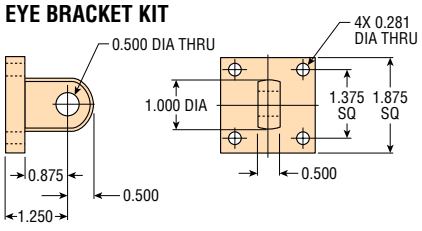
*For 3/4 bore thru hole only.

ROD CLEVIS KIT - PIN INCLUDED



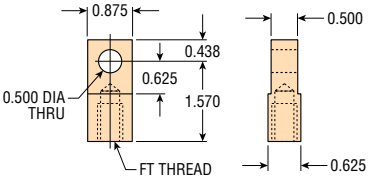
BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CC1	CD	CD1	FT
3/4	A3, A3V, H3V	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	A3	12905	0.875	0.379	0.875	0.562	0.250	0.375	5/16-24 TO SLOT
	A3V, H3V	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	A3	12907	0.875	0.379	0.875	0.562	0.250	0.375	3/8-24 TO SLOT
	A3V, H3V	12908	0.875	0.379	0.875	0.562	0.375	0.375	3/8-24 TO SLOT

EYE BRACKET KIT



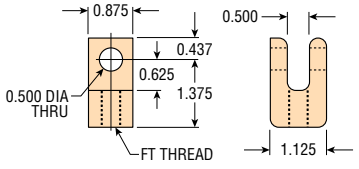
BORE SIZE	CYLINDER SERIES	PART NO.
1-3/8	A3V, H3V	1330

ROD EYE KIT



BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION
			FT
1-3/8	A3V, H3V	1375-01	3/8-24 x 0.750 DP

ROD CLEVIS KIT - PIN INCLUDED



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

All dimensions are reference only unless specifically toleranced.

EA, EL, EH, ES

tom thumb®

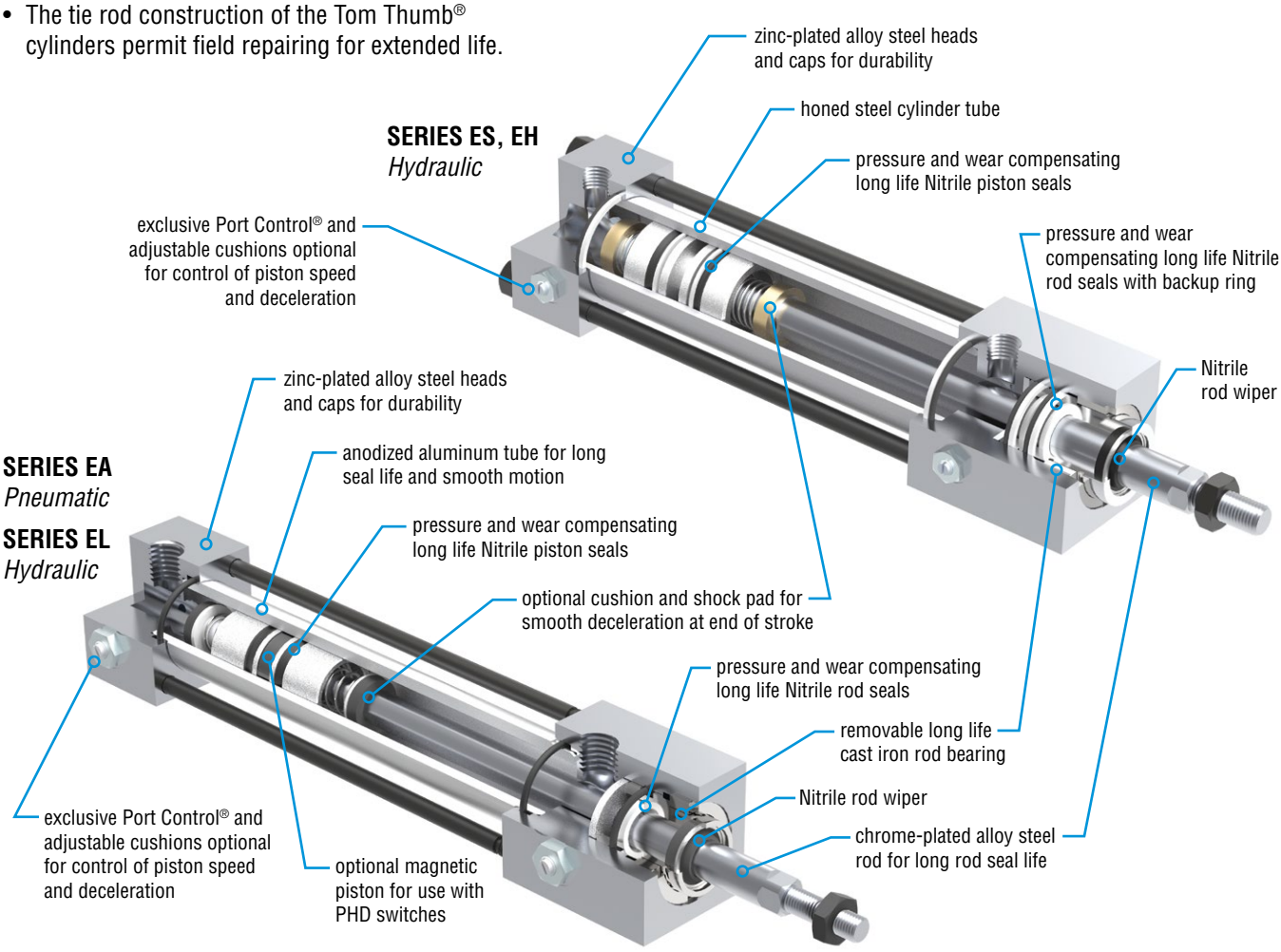
HEAVY DUTY CYLINDERS



Major Benefits

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

SERIES ES, EH
Hydraulic



ORDERING DATA: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

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

DOUBLE ROD END

SERIES
EA - 150 psi Air
EL - 500 psi Hyd.
EH - 3000 psi Hyd.
ES - 5000 psi Hyd.

BORE SIZE
3/4" BORE
3/8" Std. Rod Dia.
1/4-28 Thread

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

1-3/8" BORE
5/8" Std. Rod Dia.
7/16-20 Thread

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

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

D EA MS4 1-1/8 x 2 - P - D - 5/8 ROD - F-M-V

MOUNTING STYLE
MS2 - Foot Mount through holes (Not available on 1-1/8" and 1-3/8" Series ES.)
MS4 - Bottom Mount, tapped holes in head and cap
MF1 - Rod End Flange
MF2 - Cap End Flange
MT1 - Head Trunnion
MT2 - Cap Trunnion
MP1 - Clevis Mount, cap end with pin
MR1 - Rod Mount, tapped holes on front face of head

STANDARD STROKE LENGTHS
STOCK STROKE LENGTHS
1/2" to 6"
In 1/2" increments

Consult PHD for longer lengths.

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

(Cushions and Shock Pads are not available on the same end of cylinder. Shock Pads are not available for hydraulic use.)

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

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

⚠ Options may affect unit length. See dimensional pages and option information details.

PROXIMITY SWITCH MOUNTING BRACKETS

SERIES	BORE	SIZE NO.
EA, EL	3/4"	-35
	1-1/8"	-36
	1-3/8"	-37

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

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

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

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

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

Designer's Resource myphd®

CAD & Sizing Assistance

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

SPECIFICATIONS	SERIES EA	SERIES EL	SERIES EH	SERIES ES
ROD SEALS	Single block vee	(2) Block vee with back-up ring		
PISTON SEALS	(2) Block vee		(2) Block vee with back-up ring	
TUBE SEALS	O-ring		O-ring with back-up ring	
ROD WIPER	Nitrile rod wiper			
PISTON ROD	Hardchrome plated high strength steel 100,000 psi min. yield			
ROD BUSHING	Cast iron rod cartridge			
CYLINDER BARREL	Hardcoated aluminum		Honed steel	
END CAPS	Zinc-plated steel			
TIERODS	High tensile steel			Heat treated stainless steel
PORTS	NPT			
LUBRICATION	Permanently lubricated for non-lube air			
WORKING PRESSURE	150 psi air max.	500 psi hyd. max.	3000 psi hyd. max.	5000 psi hyd. max.
STANDARD STROKES	1/2" to 6" in 1/2" increments (longer strokes available, consult PHD)			

DIRECTION	FORCE (lb)/psi		
	3/4" BORE	1-1/8" BORE	1-3/8" BORE
PUSH	0.442	0.994	1.485
PULL	0.332	0.798	1.178

CYLINDER FORCE (TABLE 1)

SERIES	CYLINDER BORE	ROD DIAMETER	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	FREE AIR CONSUMPTION 80 lbs CUBIC ft/in OF STROKE	DISPLACEMENT gal/in OF STROKE
EA, EL, EH, ES	3/4	3/8	Push	0.442	0.0016	0.0019
			Pull	0.332	0.0012	0.0015
	1-1/8	1/2	Push	0.994	0.0037	0.0043
			Pull	0.798	0.0030	0.0034
	1-1/8	5/8	Push	0.994	0.0037	0.0043
			Pull	0.687	0.0026	0.0030
	1-3/8	5/8	Push	1.485	0.0055	0.0065
			Pull	1.178	0.0044	0.0051
	1-3/8	3/4	Push	1.485	0.0055	0.0065
			Pull	1.043	0.039	0.0045

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

SERIES	CYLINDER BORE	UNIT WEIGHTS (lb)	
		ZERO STROKE	ADDER PER INCH OF STROKE
EAMR1	3/4	1.42	0.96
	1-1/8	2.70	0.15
	1-3/8	5.05	0.22

MAXIMUM ALLOWABLE PUSH FORCE (TABLE 2)

SERIES	ROD DIAMETER	CYLINDER FORCE (lb)							
		100	200	500	1000	1500	2000	3000	5000
1-3/8" AV, HV EA, EL, EH, ES	3/8	27"	19"	12"	8"	7"	6"	5"	4"
	1/2	48"	34"	21"	15"	12"	11"	9"	7"
	5/8	74"	53"	33"	24"	19"	17"	14"	11"
	3/4	107"	76"	48"	34"	28"	24"	20"	15"



Application & Sizing Assistance

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

LUBRICATION - HYDRAULIC FLUIDS

All air units are permanently lubricated at the factory and can be used for non-lubricated air service. Static and dynamic seals are compatible with standard petroleum-based oil used for lubrication of air cylinders or as a power source for hydraulic cylinders. For service with other lubricants or hydraulic media, please specify to insure proper seals are supplied.

TEMPERATURE LIMITS - SEALS

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

HOW TO DETERMINE BORE AND PISTON SIZE

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

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

For mounting style MP1; divide table value by 2.

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

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

3/4" Bore x 8" 1-1/8" Bore x 12" 1-3/8" Bore x 18"

BREAKAWAY

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

MAXIMUM WORKING PRESSURES

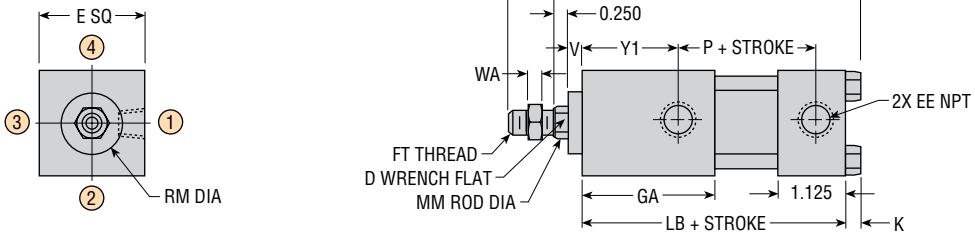
SERIES	AIR MAX. psi	HYDRAULIC	
		MAX. psi	WITH -E OR -M OPTION
EA	150	—	—
EL	—	500	500
EH	—	3000	—
ES	—	5000	—

STROKE TOLERANCE

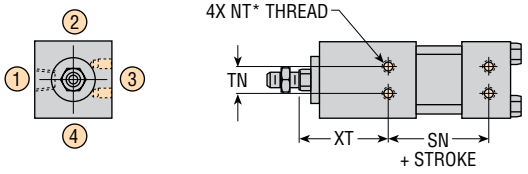
Tolerance on the nominal stroke length is ±0.032 for all cylinders.

DIMENSIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

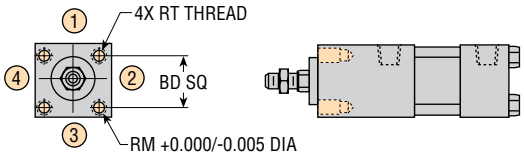
BASIC CYLINDER DIMENSIONS



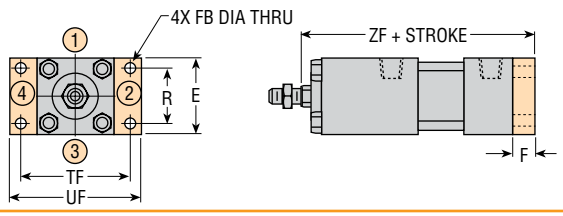
MS4



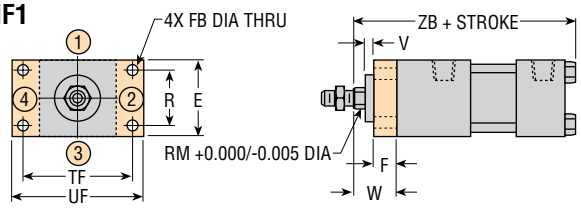
MR1



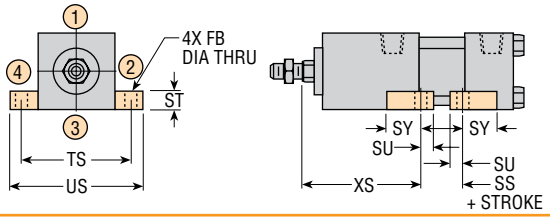
MF2



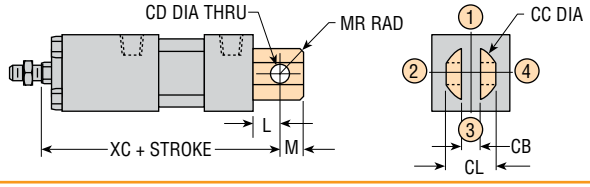
MF1



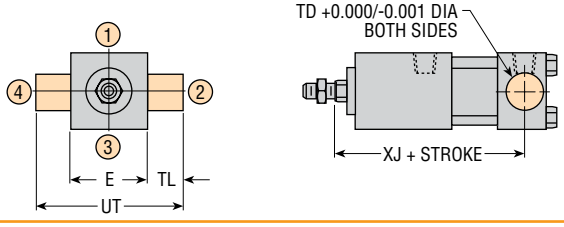
MS2



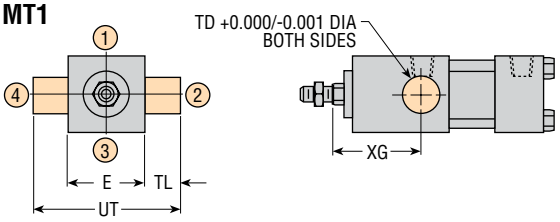
MP1 (CLEVIS PIN INCLUDED)



MT2



MT1



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

BORE SIZE	LETTER DIMENSION																							
	A	BD	CB	CC	CD	CL	D	E	EE	F	FB	FT	GA	K	L	LB	M	MM	MR	NT*	P	R	RM
3/4	0.750	1.000	0.375	1.000	0.375	0.875	0.312	1.375	1/4	0.312	0.219	1/4-28	1.812	0.00	0.500	4.000	0.375	0.375	0.570	10-32 x 0.25 DP	2.188	0.938	0.750
1-1/8	0.750	1.250	0.500	1.250	0.500	1.125	0.438	1.750	1/4	0.500	0.281	3/8-24	2.188	0.250	0.625	4.375	0.500	0.500	0.720	1/4-28 x 0.31 DP	2.312	1.250	1.000
1-3/8	0.750	1.625	0.625	1.750	0.625	1.500	0.562	2.250	3/8	0.500	0.344	7/16-20	2.625	0.312	0.750	4.812	0.625	0.625	0.910	5/16-24 x 0.50 DP	2.438	1.625	1.250

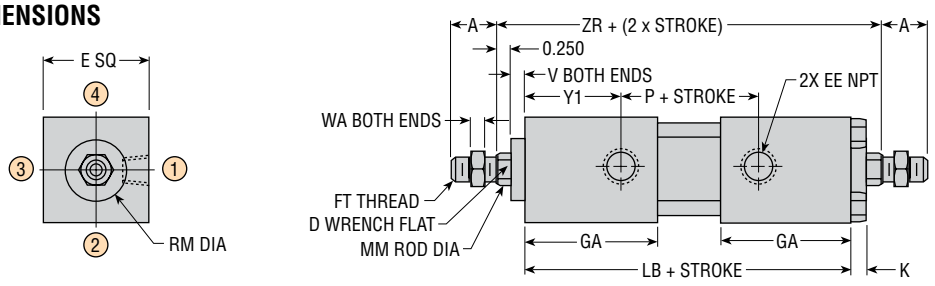
BORE SIZE	LETTER DIMENSION																							
	RT	SN	SS	ST	SU	SY	TD	TF	TL	TN	TS	UF	US	UT	V	W	WA	XC	XG	XJ	XS	XT	Y1	ZB	ZF
3/4	10-32 x 0.25 DP	2.188	1.062	0.281	0.250	0.500	0.500	1.938	0.500	0.562	1.938	2.375	2.375	2.375	0.125	0.688	0.156	4.875	1.625	3.812	2.188	1.625	1.250	4.375	4.688
1-1/8	1/4-28 x 0.50 DP	2.312	0.938	0.344	0.312	0.812	0.750	2.500	0.750	0.625	2.500	3.000	3.000	3.250	0.250	1.000	0.219	5.500	2.062	4.375	2.750	2.062	1.562	5.125	5.375
1-3/8	5/16-24 x 0.62 DP	2.438	0.938	0.469	0.438	1.062	0.875	3.000	0.875	0.875	3.000	3.750	3.750	4.000	0.250	1.000	0.250	6.062	2.438	4.875	3.188	2.438	1.938	5.625	5.812

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS.
CUSHIONS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF CUSHIONS. MT1 (-DR) & MT2 (-DC) CUSHION NEEDLES ARE IN POSITION 3.
SHOCK PADS: CYLINDER LENGTH IS NOT AFFECTED BY ADDITION OF SHOCK PADS
MS2 MTG. STYLE: NOT AVAILABLE ON 1-1/8" & 1-3/8" SERIES ES CYLINDERS
***MS4 MTG. STYLE:** UNITS WITH OPTION -R OR -U WITH/-P. THE NT THREAD SIZE AND DEPTH WILL BE REDUCED AS FOLLOWS: 3/4" BORE NOT AVAILABLE WITH -R OR -U WITH/-P. 1-1/8" BORE NT=10-32 x 0.19, 1-3/8" BORE NT=1/4-28 x 0.25

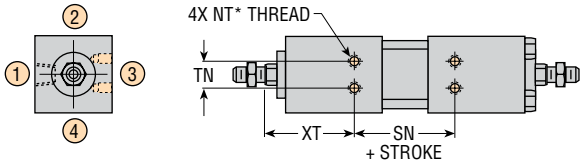
All dimensions are reference only unless specifically toleranced.

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

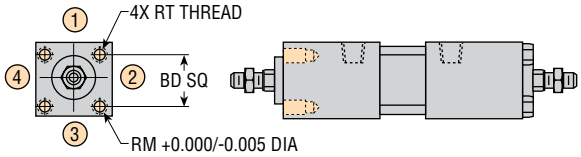
BASIC CYLINDER DIMENSIONS



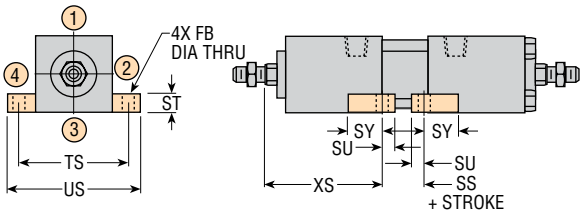
MS4



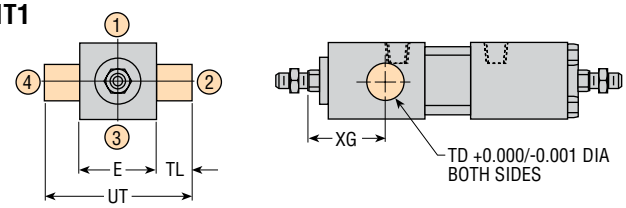
MR1



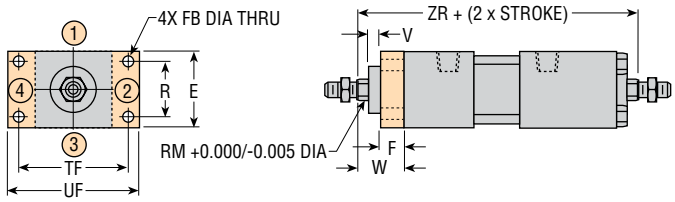
MS2



MT1



MF1



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

BORE SIZE	LETTER DIMENSION																	
	A	BD	D	E	EE	F	FB	FT	GA	K	LB	MM	NT*	P	R	RM	RT
3/4	0.750	1.000	0.312	1.375	1/4	0.312	0.219	1/4-28	1.812	0.00	4.687	0.375	10-32 x 0.25 DP	2.188	0.938	0.750	10-32 x 0.25 DP
1-1/8	0.750	1.250	0.438	1.750	1/4	0.500	0.281	3/8-24	2.188	0.250	5.437	0.500	1/4-28 x 0.31 DP	2.312	1.250	1.000	1/4-28 x 0.50 DP
1-3/8	0.750	1.625	0.562	2.250	3/8	0.500	0.344	7/16-20	2.625	0.312	6.312	0.625	5/16-24 x 0.50 DP	2.438	1.625	1.250	5/16-24 x 0.62 DP

BORE SIZE	LETTER DIMENSION																				
	SN	SS	ST	SU	SY	TD	TF	TL	TN	TS	UF	US	UT	V	W	WA	XG	XS	XT	Y1	ZR
3/4	2.188	1.062	0.281	0.250	0.500	0.500	1.938	0.500	0.562	1.938	2.375	2.375	2.375	0.125	0.688	0.156	1.625	2.188	1.625	1.250	5.438
1-1/8	2.312	0.938	0.344	0.312	0.812	0.750	2.500	0.750	0.625	2.500	3.000	3.000	3.250	0.250	1.000	0.219	2.062	2.750	2.062	1.562	6.438
1-3/8	2.438	0.938	0.469	0.438	1.062	0.875	3.000	0.875	0.875	3.000	3.750	3.750	4.000	0.250	1.000	0.250	2.438	3.188	2.438	1.938	7.312

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

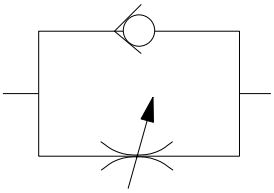
All dimensions are reference only unless specifically toleranced.

P PORT CONTROL®

Not available with -Y SAE ports option

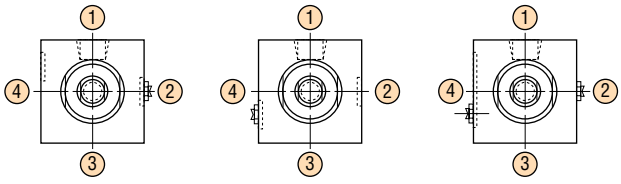
The exclusive PHD Port Control®, based on the "meter-out" principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

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



STANDARD PORT CONTROL AND CUSHION NEEDLE POSITIONS

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



D ADJUSTABLE CUSHION

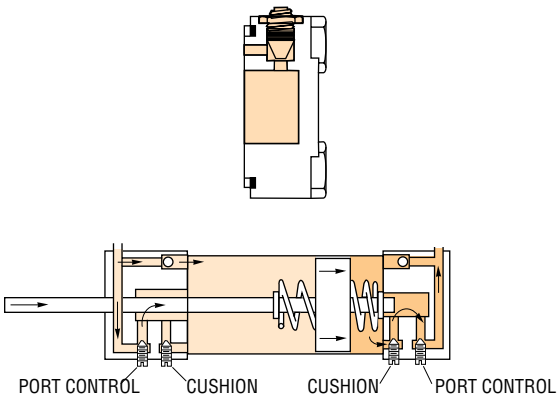
PHD Cushions are designed for smooth deceleration at the end of stroke. When the cushion is activated the remaining volume in the cylinder must exhaust past an adjustable needle which controls the amount of deceleration.

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

PORT CONTROL AND ADJUSTABLE CUSHION COMBINATION

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

POPPET STYLE

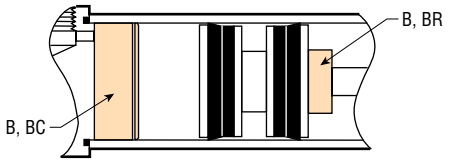


B SHOCK PADS

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

Available together with all options EXCEPT:

- **Same end as Cushion**
- **Same end as Stroke Adjustment**



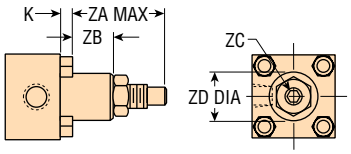
OPTIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

A CYLINDER STROKE ADJUSTMENT

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

Available with all options EXCEPT:

- **Cushion on the cap end**
- **Shock pad on the cap end**
- **Pivot Mount**

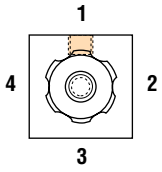


BORE SIZE	LETTER DIMENSION				
	K	ZA	ZB	ZC	ZD
3/4	0.000	2.219	1.125	1/8 HEX	0.750
1-1/8	0.250	2.125	0.875	1/4 HEX	1.000
1-3/8	0.312	2.125	0.812	1/4 HEX	1.250

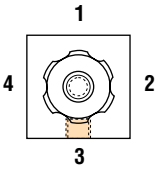
PORT POSITIONS

Port position 1 is standard on all cylinders.

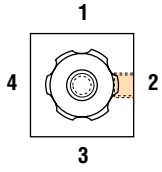
PORT POSITION 1 (STANDARD)



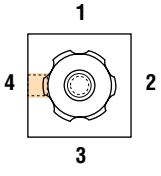
T PORT POSITION 3



R PORT POSITION 2



U PORT POSITION 4

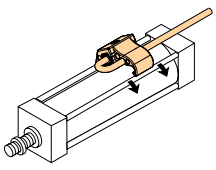


Y SAE PORTS FOR SERIES EH AND ES 3/4", 1-1/8", 1-3/8" BORE

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

BORE SIZE	3/4"	1-1/8"	1-3/8"
SAE PORT	7/16 - 20	7/16 - 20	9/16 - 18

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES



E HALL EFFECT SWITCHES
AVAILABLE ON SERIES EA & EL ONLY

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

COMPACT HALL EFFECT SWITCHES

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

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

M REED SWITCHES
AVAILABLE ON SERIES EA & EL ONLY

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

COMPACT REED SWITCHES

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

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

All dimensions are reference only unless specifically toleranced.

OPTIONS: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

V FLUOROELASTOMER SEALS

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

Z1 ELECTROLESS NICKEL PLATING

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

NOTE: Standard plating is Brite Zinc.

W CLOSE TOLERANCE STROKE

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

Maximum stroke for cylinders with close tolerance is 18".

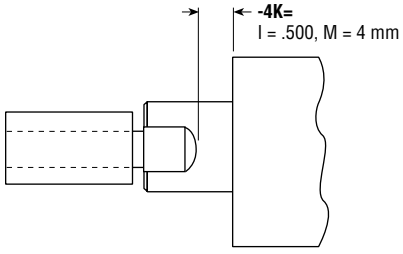
NOTE: This option is not available with shock pads (-B).

_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.



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

SELF-ALIGNING PISTON ROD COUPLERS

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

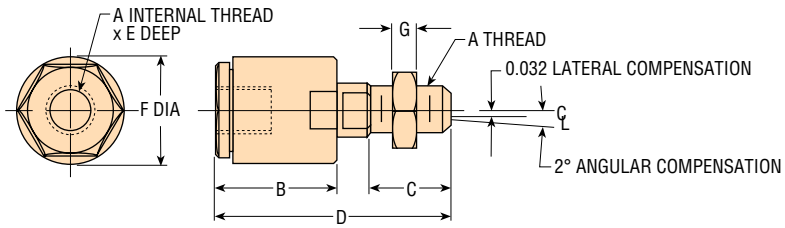
Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke. (Miniature Couplers compensate for 1° of angular error.)

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

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

To order, specify the model number.

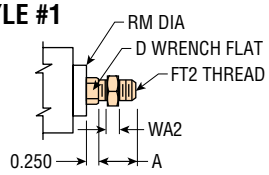
MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	0.625	1.875	0.500	0.875	0.156
312	5/16-24	1.000	0.625	1.875	0.500	0.875	0.187
375	3/8-24	1.000	0.625	1.875	0.500	0.875	0.219
437	7/16-20	1.125	0.750	2.187	0.500	1.000	0.250
500	1/2-20	1.125	0.750	2.187	0.500	1.000	0.312
625	5/8-18	1.750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



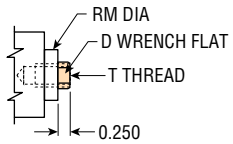
All dimensions are reference only unless specifically toleranced.

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

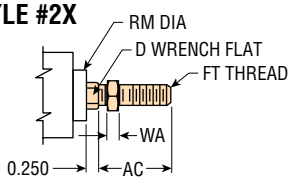
F
ROD END STYLE #1



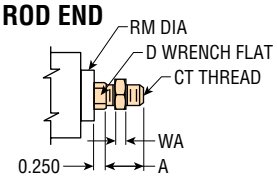
I
ROD END STYLE #4



J
ROD END STYLE #2X



L
COARSE THREAD ROD END

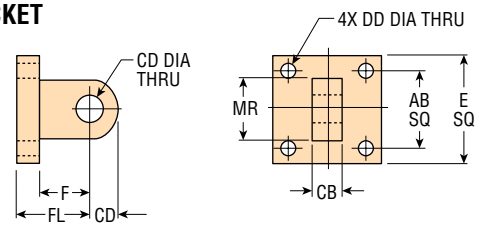


CLEVIS BRACKET - PIN INCLUDED

BORE SIZE	ROD TYPE	ROD DIAMETER	LETTER DIMENSION									
			A	AC	CT	D	FT	FT2	RM	T	WA	WA2
3/4	STANDARD	0.375	0.750	1.500	1/4-20	0.312	1/4-28	5/16-24	0.750	1/4-28 x 0.625 DP	0.156	0.187
1-1/8	STANDARD	0.500	0.750	1.500	3/8-16	0.438	3/8-24	7/16-20	1.000	3/8-24 x 0.625 DP	0.219	0.250
	OVERSIZE	0.625	0.750	1.500	7/16-14	0.562	7/16-20	1/2-20	1.000	7/16-20 x 0.625 DP	0.250	0.312
1-3/8	STANDARD	0.625	0.750	1.500	7/16-14	0.562	7/16-20	1/2-20	1.250	7/16-20 x 0.625 DP	0.250	0.312
	OVERSIZE	0.750	1.000	2.000	9/16-12	0.688	9/16-18	5/8-18	1.250	9/16-18 x 0.625 DP	0.312	0.375

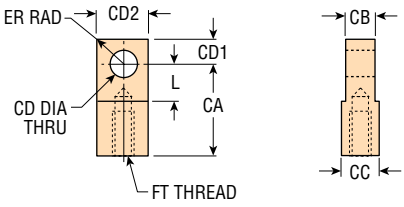
All standard rod ends have four wrench flats (except -I rod end style).

E SERIES MOUNTING ATTACHMENTS
EYE BRACKET



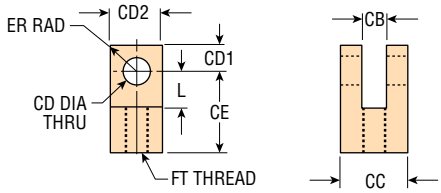
BORE SIZE	PART NO.	LETTER DIMENSION							
		AB	CB	CD	DD	E	F	FL	MR
3/4	2412-01	1.000	0.375	0.375	0.219	1.375	0.812	1.125	0.750
1-1/8	1330	1.375	0.500	0.500	0.281	1.875	0.875	1.250	1.000
1-3/8	2412-02	1.625	0.625	0.625	0.344	2.250	1.062	1.562	1.250

ROD EYE



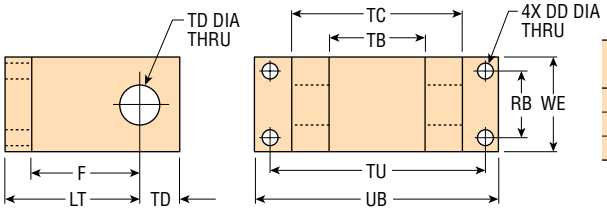
BORE SIZE	PART NO.	LETTER DIMENSION								
		CA	CB	CC	CD	CD1	CD2	ER	FT	L
3/4	2414-01	1.500	0.375	0.500	0.375	0.375	0.750	0.531	1/4-28 x 0.75 DP	0.562
1-1/8	1375-01	1.562	0.500	0.625	0.500	0.438	0.875	0.625	3/8-24 x 0.75 DP	0.625
1-3/8	2414-02	2.000	0.625	0.750	0.625	0.625	1.250	0.906	7/16-20 x 1.00 DP	0.812
	2414-03	2.000	0.625	0.750	0.625	0.625	1.250	0.906	9/16-18 x 1.00 DP	0.812

ROD CLEVIS - PIN INCLUDED



BORE SIZE	PART NO.	LETTER DIMENSION								
		CB	CC	CD	CD1	CD2	CE	ER	FT	L
3/4	12912	0.375	0.875	0.375	0.375	0.750	1.312	0.531	1/4-28	0.562
1-1/8	12909	0.500	1.125	0.500	0.438	0.875	1.375	0.625	3/8-24	0.625
1-3/8	12914	0.625	1.375	0.625	0.625	1.250	1.812	0.906	7/16-20	0.812
	12915	0.625	1.375	0.625	0.625	1.250	1.812	0.906	9/16-18	0.812

TRUNNION BRACKET



BORE SIZE	PART NO.	LETTER DIMENSION								
		DD	F	LT	RB	TB	TC	TD	TU	UB	WE
3/4	2415-01	0.281	1.750	2.250	1.000	1.375	2.375	0.500	3.125	3.625	1.500
1-1/8	2415-02	0.281	2.000	2.500	1.250	1.750	3.250	0.750	4.000	4.500	1.750
1-3/8	2415-03	0.344	2.625	3.125	1.375	2.250	4.000	0.875	4.875	5.500	2.000

All dimensions are reference only unless specifically toleranced.

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