

AV, HV, A



tom thumb®

AV, HV, A

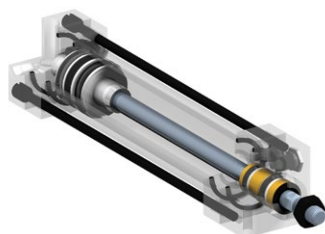
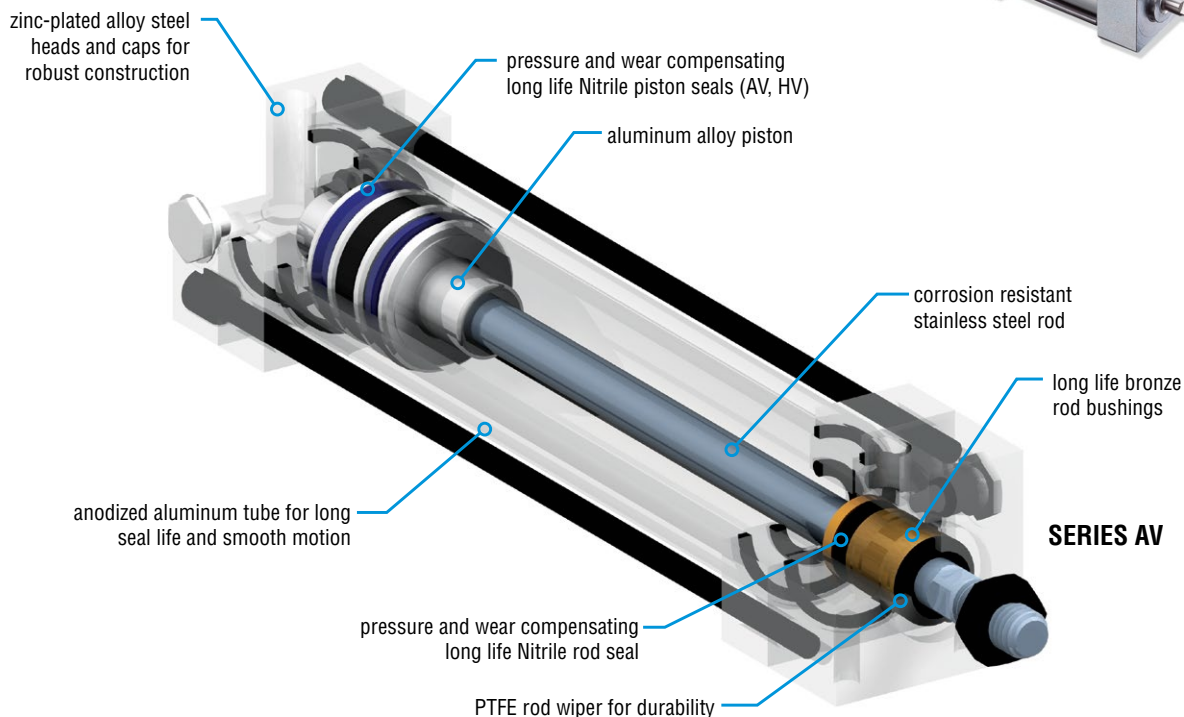
3/4", 1", 1-1/8" BORE TIE ROD HYDRAULIC & PNEUMATIC NFPA CYLINDERS

Major Benefits

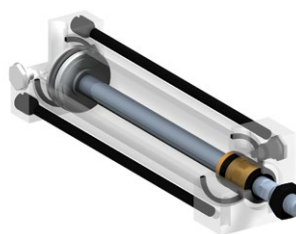
- Long life design for low maintenance
- NFPA repairable for extended life providing long term savings
- Wide range of options for easy application and reduced design time
- Wide range of mounting styles for easy installation



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



SERIES HV
Hydraulic Service



SERIES A
Shortest Length

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

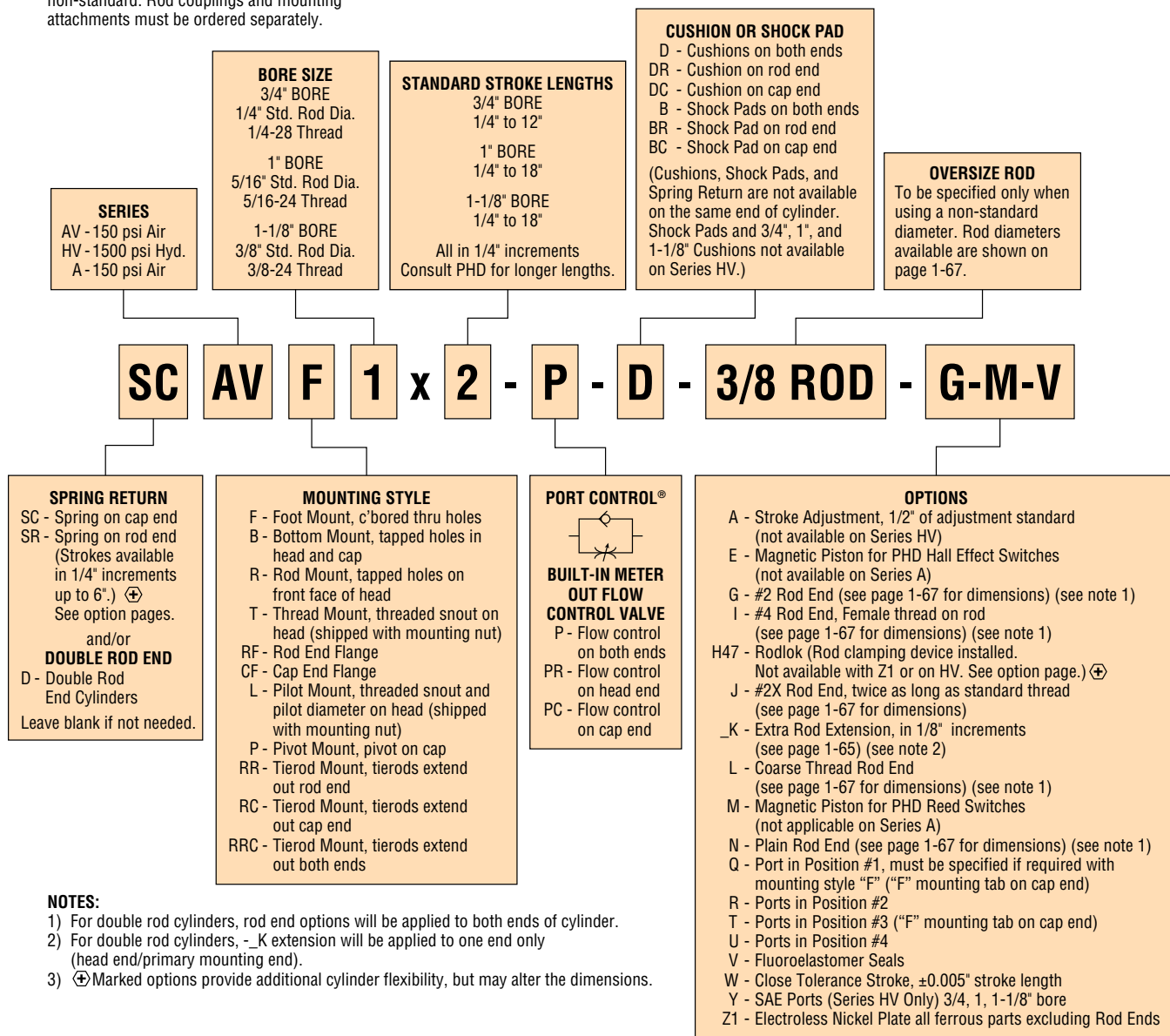
TO ORDER SPECIFY:

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.

AV, HV, A



NOTES:

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



CAD & Sizing Assistance

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

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

SPECIFICATIONS	SERIES AV	SERIES HV	SERIES A
OPERATING PRESSURE STANDARD CYLINDER (NO RODLOK) CYLINDER WITH RODLOK	20 to 150 psi air 30 to 150 psi air	40 to 1500 psi hyd* —	20 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 in²
(Extend or Retract)

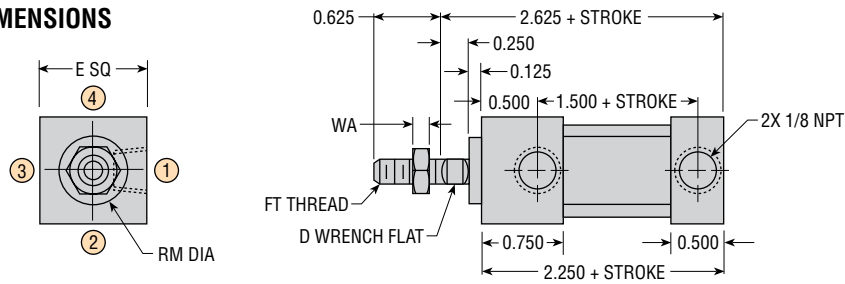


Application & Sizing Assistance

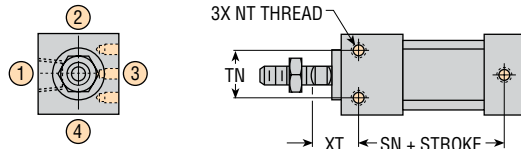
Use PHD's free online Product Sizing Application at www.phdinc.com/apps/sizing

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

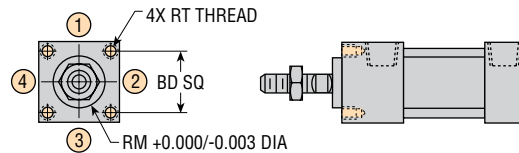
BASIC CYLINDER DIMENSIONS



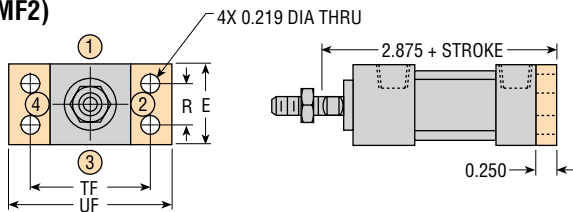
B (MS9)



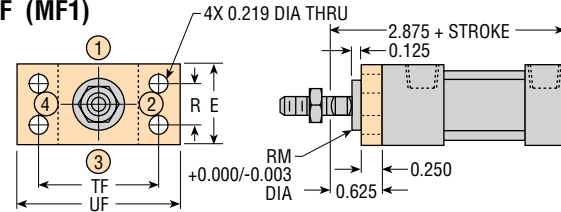
R (MR1)



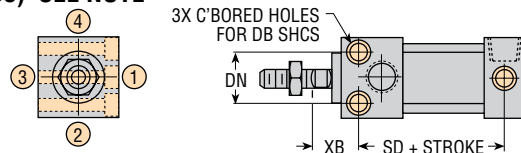
CF (MF2)



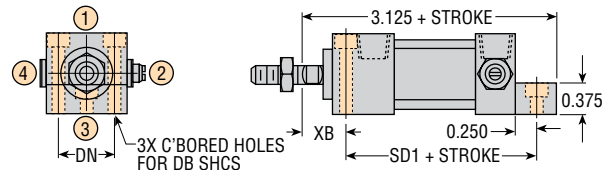
RF (MF1)



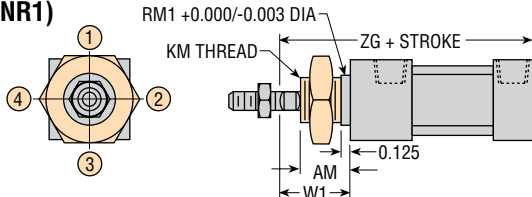
F (MS8) SEE NOTE



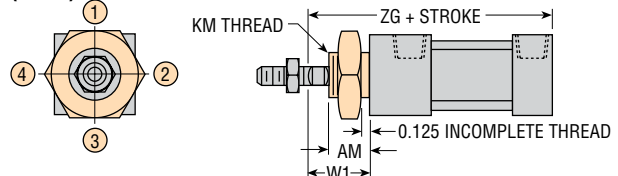
F (MS8) - WITH PORT CONTROL® ON CAP END (-Q or -T without Port Control)



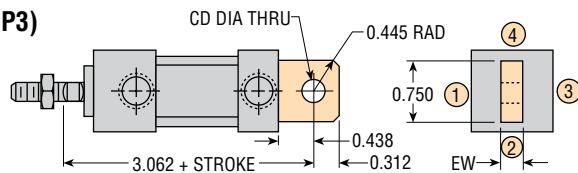
L (MNR1)



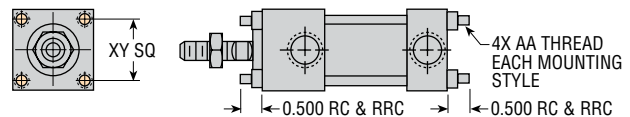
T (MN1)



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
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
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
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

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)

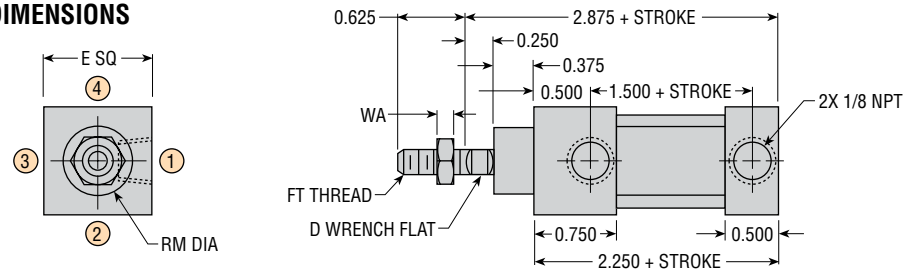
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.

OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

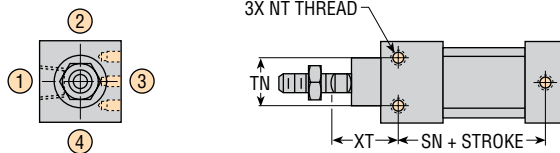
All dimensions are reference only unless specifically toleranced.

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

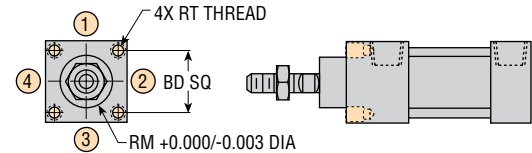
BASIC CYLINDER DIMENSIONS



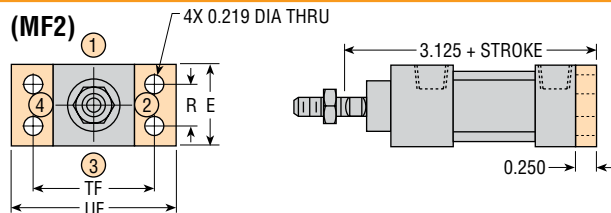
B (MS9)



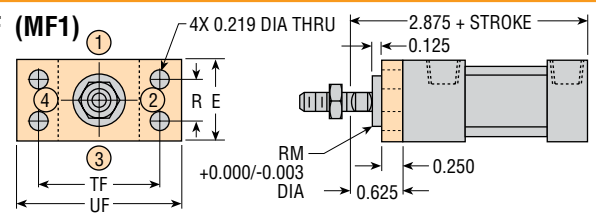
R (MR1)



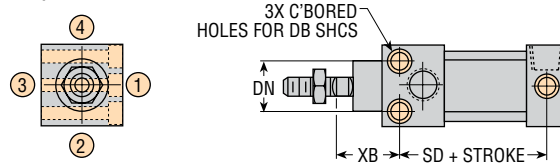
CF (MF2)



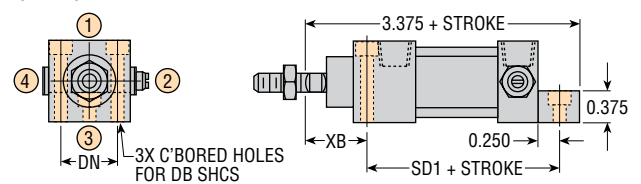
RF (MF1)



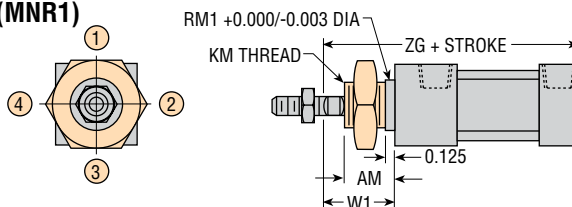
F (MS8) SEE NOTE



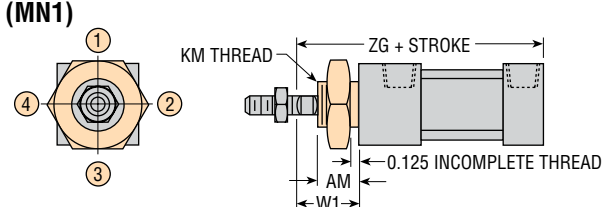
F (MS8) - WITH PORT CONTROL ON CAP END



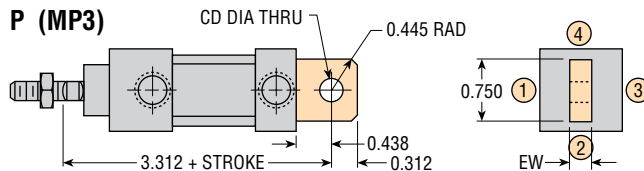
L (MNR1)



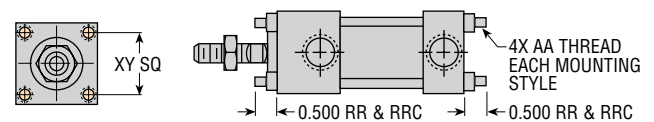
T (MN1)



P (MP3)



RC, RR, RRC (Includes RR & RC)



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

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	0.812	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

CUSHIONS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS FOR EACH CUSHION

SPRING RETURN: ADD AN ADDITIONAL STROKE LENGTH TO (+ STROKE)

DIMENSIONS (2 x STROKE)

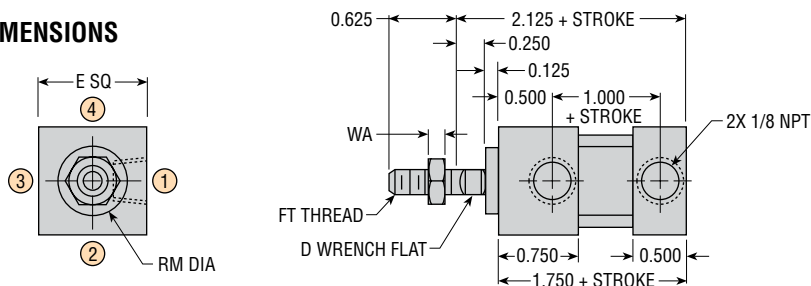
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.

OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

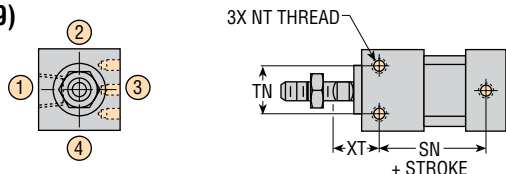
All dimensions are reference only unless specifically toleranced.

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

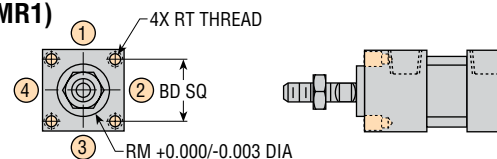
BASIC CYLINDER DIMENSIONS



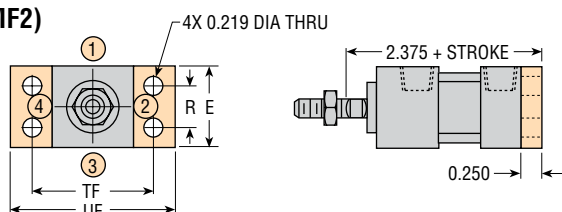
B (MS9)



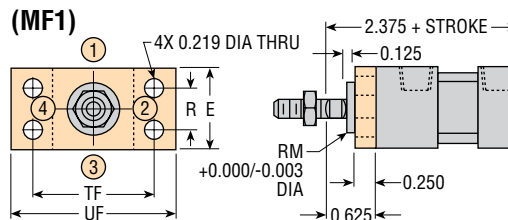
R (MR1)



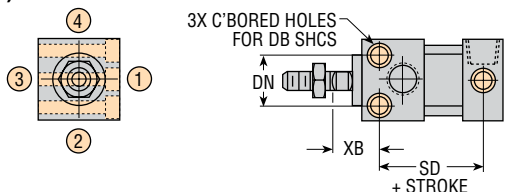
CF (MF2)



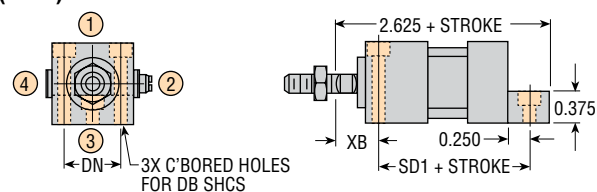
RF (MF1)



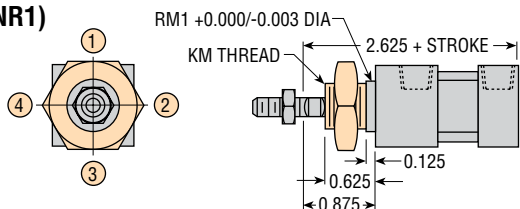
F (MS8) SEE NOTES



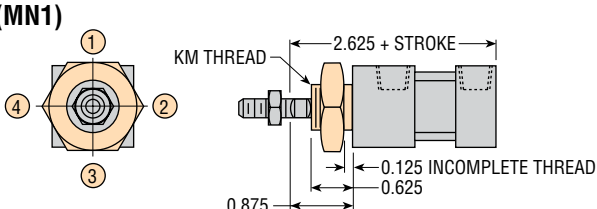
F (MS8) - WITH PORT CONTROL ON CAP END



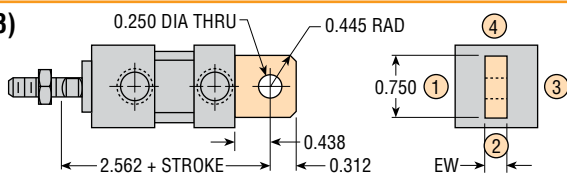
L (MNR1)



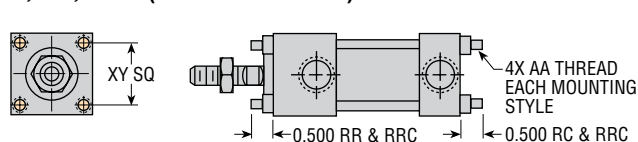
T (MN1)



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
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	#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
1-1/8	#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

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)

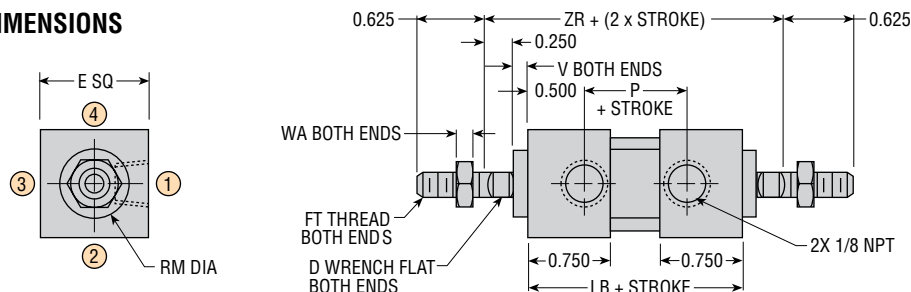
F (MS8) MTG: 3/4" BORE UNITS ORDERED WITH AN OVERSIZE PISTON ROD WILL HAVE MTG. TABS ON THE HEAD END. CONSULT PHD FOR DIMENSIONAL INFORMATION.

OVERSIZE RODS: SEE PAGE 1-67 FOR OVERSIZE ROD SPECIFICATIONS.

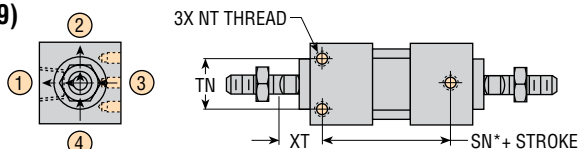
All dimensions are reference only unless specifically toleranced.

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

BASIC CYLINDER DIMENSIONS

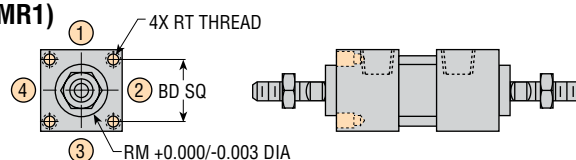


B (MS9)

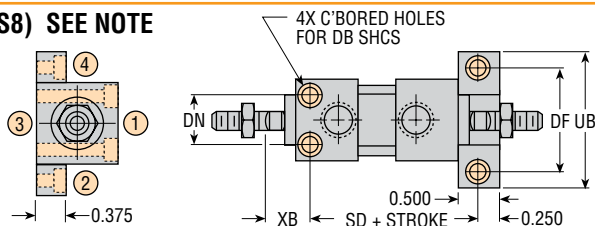


*1" AND 1-1/8" BORE: WITH PORT POSITION #3 ADD 0.062 in
WITH PORT POSITION #2 OR #4 & PORT CONTROLS ADD 0.062 in

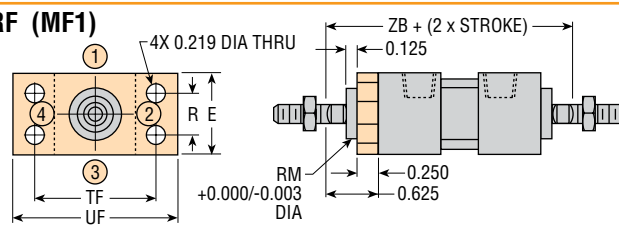
R (MR1)



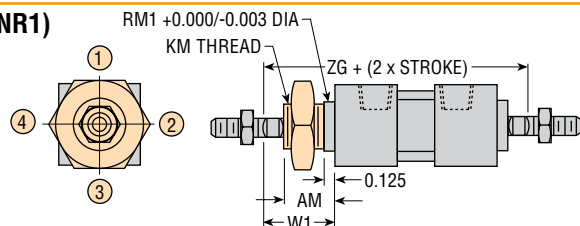
F (MS8) SEE NOTE



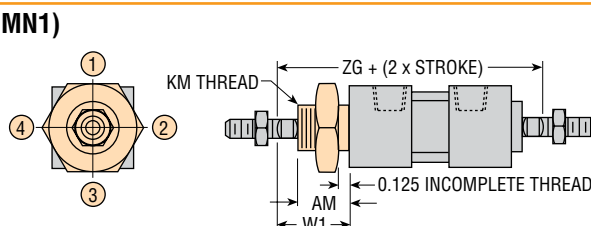
RF (MF1)



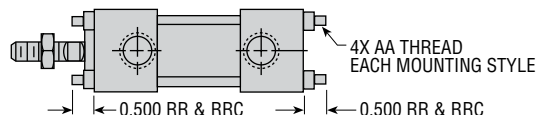
L (MNR1)



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
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
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
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
	WA	XY														
3/4	0.156	0.750														
1	0.188	1.030														
1-1/8	0.219	1.125														

SERIES DA CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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	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	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	2.750

SERIES DHV CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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	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	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	4.250	3.750

SERIES DAV CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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	3.250
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	3.250
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	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.

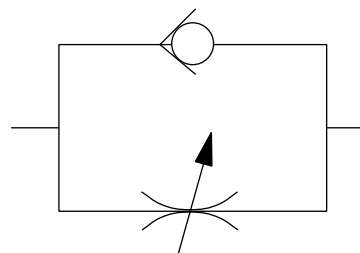
OPTIONS: SERIES A, AV, HV CYLINDERS; 3/4", 1", 1-1/8" BORE

P**PC****PR**

PORT CONTROL®

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

The self-locking needle has micrometer threads and is adjustable under pressure. It determines the orifice size which controls the exhaust volume. The separate ball check is closed while fluid is exhausting from the cylinder, but opens to permit full flow of



incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.

D**DC****DR**

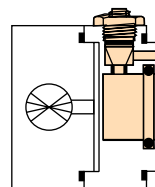
ADJUSTABLE CUSHION

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

See dimension pages for dimensional information.

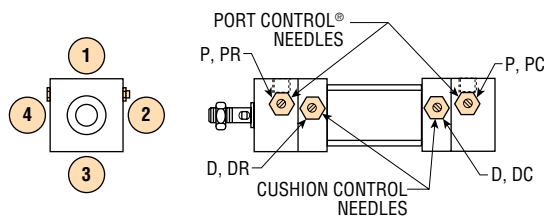
Effective cushion length 1/2"

CUSHION BLOCK



STANDARD PORT CONTROL® AND CUSHION NEEDLE POSITIONS

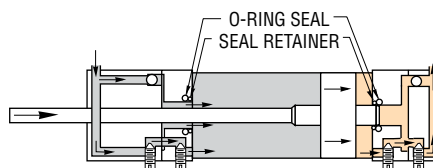
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A, AV, and HV.



PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

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

CUSHION BLOCK STYLE



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

H47

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

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

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

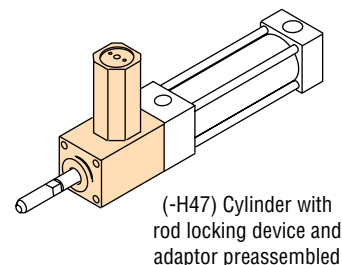
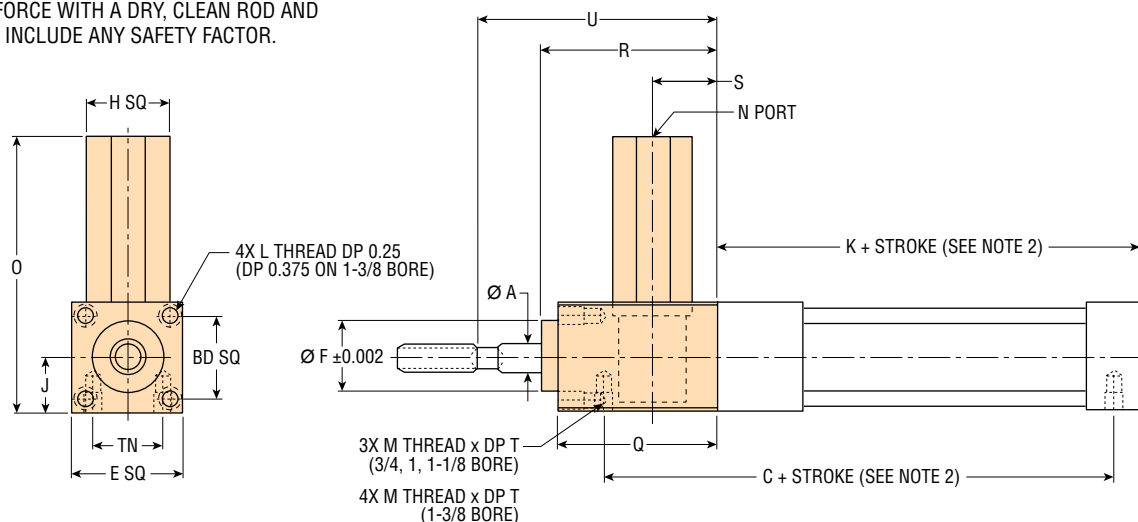
Replacement Rodlok kits can be purchased separately. See chart at right. The locking device and adaptor are not available with the -Z1 corrosion resistant finish.

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

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

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

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



REPLACEMENT RODLOK KITS

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

PART NUMBERS LISTED ABOVE ARE INTENDED FOR REPLACEMENT PURPOSES ONLY.

BORE in	LETTER DIMENSION																	
	A	C	E	F	H	J	K	L	M	N	O	Q	R	S	T	U	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 tolerated.

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

AV, HV, A

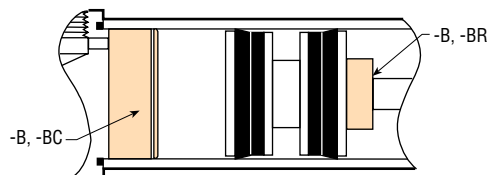
B BC BR

SHOCK PADS

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

Available with all options EXCEPT:

- Same end as Cushion (-D, -DC, or -DR)
- Spring end of Spring Return cylinder (-SC or -SR)
- Same end as Stroke Adjustment (-A)



SR SC

SPRING RETURN

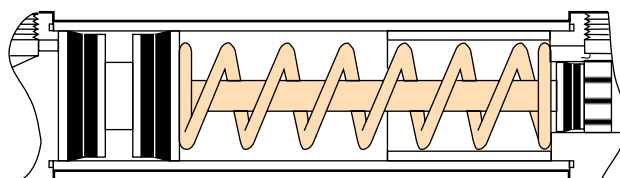
Available in 1/4" increments

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

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

Available with all options EXCEPT:

- Cushion on the spring end (-D, -DC, or -DR)
- Shock pad on the spring end (-B, -BC, or -BR)
- Stroke adjustment on the spring end (-A)



A

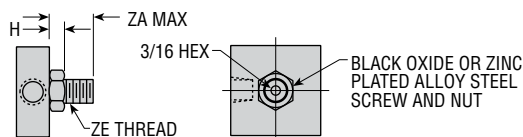
CYLINDER STROKE ADJUSTMENT

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

BORE SIZE	H	ZA	ZE STANDARD	ZE WITH -P OR -PC
3/4	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

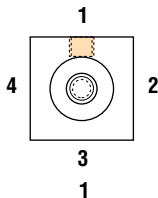


PORT POSITIONS

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.

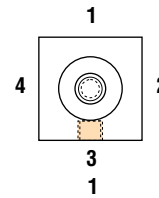
If port position 1 (-Q) or 3 (-T) is desired, add -Q or -T to unit description and -F mounting tab will be added to unit to accommodate units.

STANDARD PORT POSITION 1



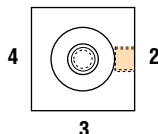
T

PORT POSITION 3



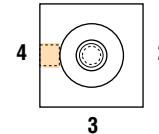
R

PORT POSITION 2



U

PORT POSITION 4



All dimensions are reference only unless specifically toleranced.

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

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E

HALL EFFECT SWITCHES

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

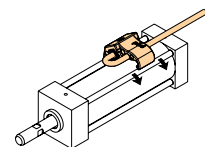
COMPACT HALL EFFECT SWITCHES

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

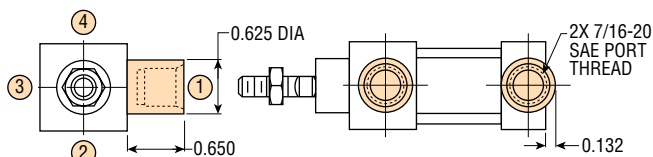
Electroless nickel plating is done on all externally exposed ferrous parts except rods and rod end, or parts made of stainless steel or aluminum. This optional plating treatment gives an alternative method of protecting the cylinder from severe environments.

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

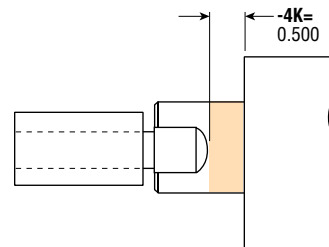
EXTRA ROD EXTENSION

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.

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

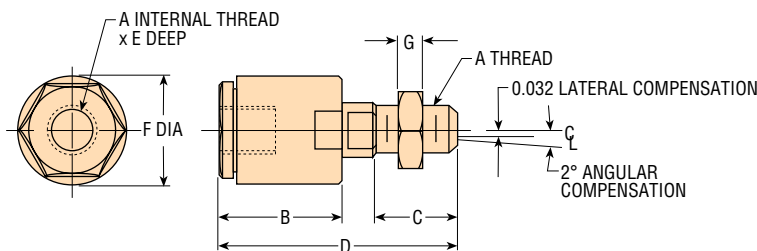
SELF-ALIGNING PISTON ROD COUPLERS

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
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

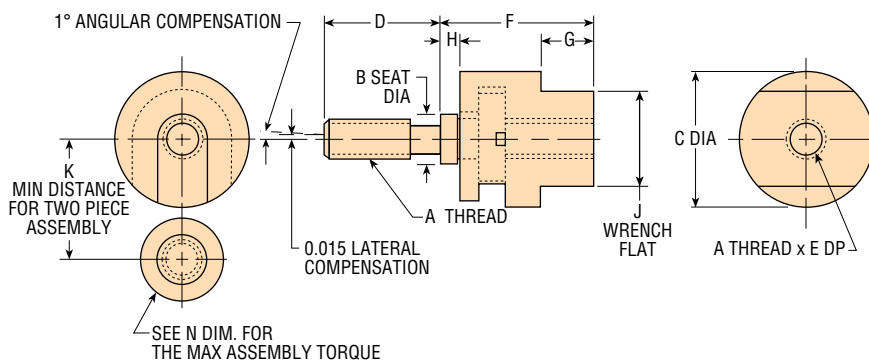
To order, specify the model number.



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.

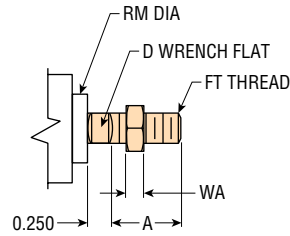


MODEL NO.	LETTER DIMENSION										
	A	B	C	D	E	F	G	H	J	K	N
19300-01	5-40	0.160	0.440	0.375	0.250	0.500	0.170	0.066	5/16	0.390	20 in-lbs
19300-02	10-32	0.250	0.560	0.500	0.281	0.558	0.200	0.058	3/8	0.490	70 in-lbs

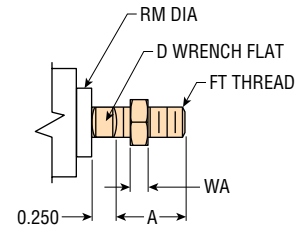
All dimensions are reference only unless specifically toleranced.

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

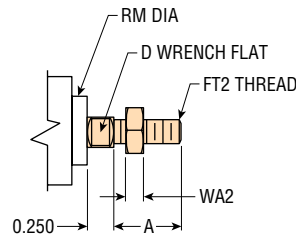
**STANDARD
(#1 ROD END)**



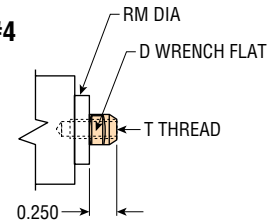
**L
COARSE THREAD ROD END**



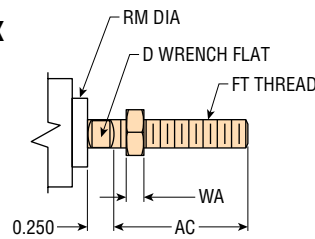
**G
ROD END STYLE #2**



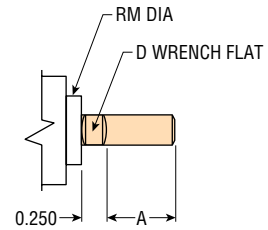
**I
ROD END STYLE #4**



**J
ROD END STYLE #2X**



**N
PLAIN ROD END**



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

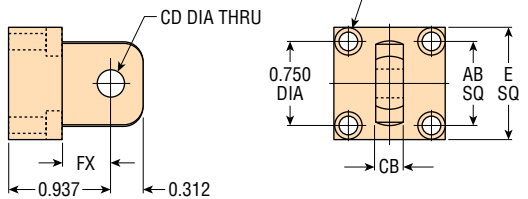
BORE SIZE	ROD TYPE	ROD DIAMETER	LETTER DIMENSION									
			A	AC	CT	D	FT	FT2	RM	T	WA	WA2
3/4	STANDARD	0.250	0.625	1.250	1/4-20	7/32	1/4-28	10-32	0.625	6-32 x 0.437 DP	0.156	0.130
	OVERSIZE	0.312	0.625	1.250	5/16-18	1/4	5/16-24	1/4-28	0.625	10-32 x 0.625 DP	0.187	0.156
1	STANDARD	0.312	0.625	1.250	5/16-18	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

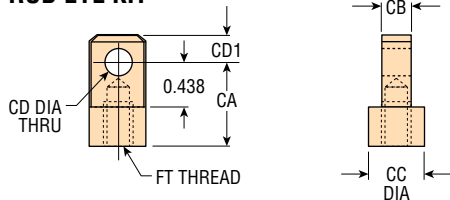
EYE BRACKET KIT



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

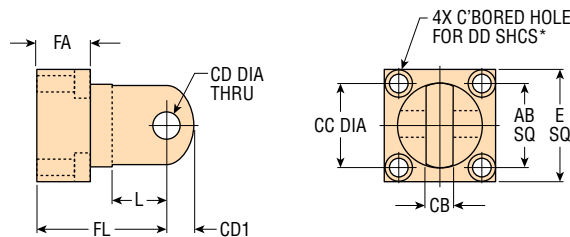
*For 3/4 bore thru hole only.

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	

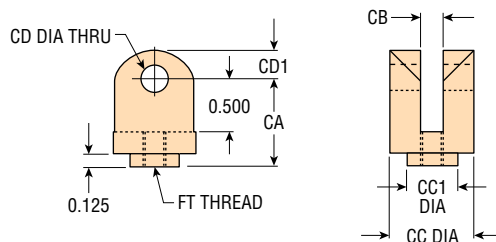
CLEVIS BRACKET KIT - PIN INCLUDED



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.

cleanroom

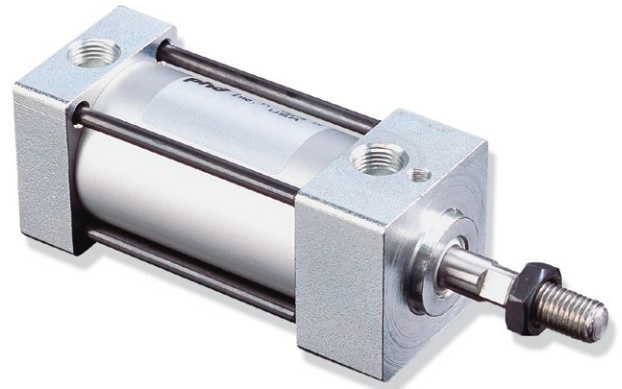


tom thumb®

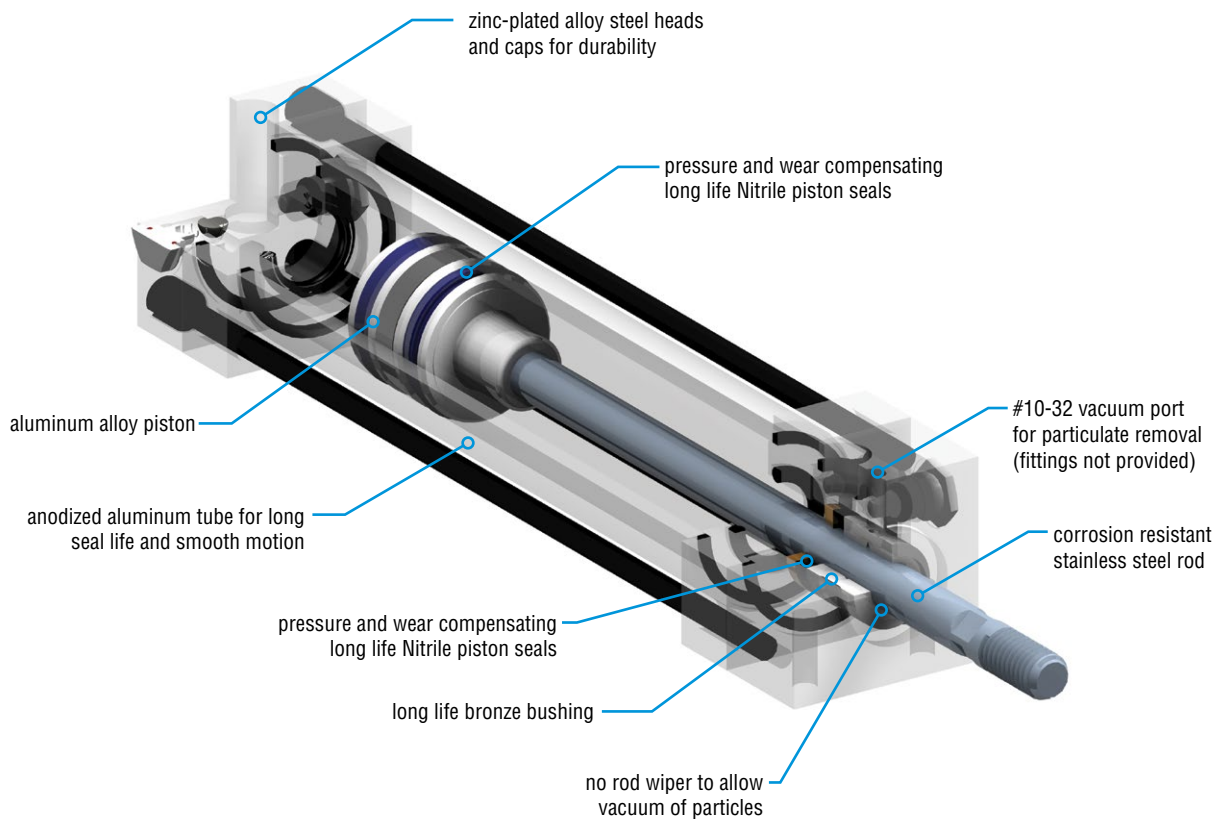
SERIES A, AV 3/4", 1", 1-1/8" BORE CLASS 100 CLEANROOM CYLINDERS (REQUIRES -0)

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

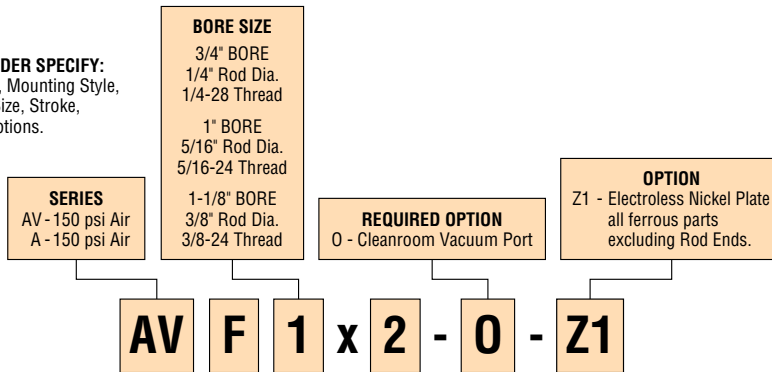


CLEANROOM



ORDERING DATA: CLEANROOM CYLINDERS

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



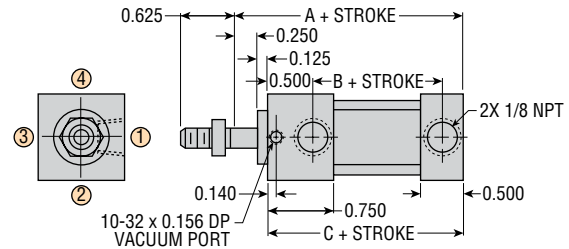
MOUNTING STYLE	STANDARD STROKE LENGTHS
F - Foot Mount, C'bored through holes B - Bottom Mount, Tapped holes in head and cap R - Rod Mount, Tapped holes on front face of head T - Thread Mount, Threaded snout on head (shipped with mounting nut) RF - Rod End Flange CF - Cap End Flange L - Pilot Mount, Threaded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

BORE SIZE	LETTER DIMENSION		
3/4", 1", 1-1/8"	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 in²
(Extend or Retract)

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



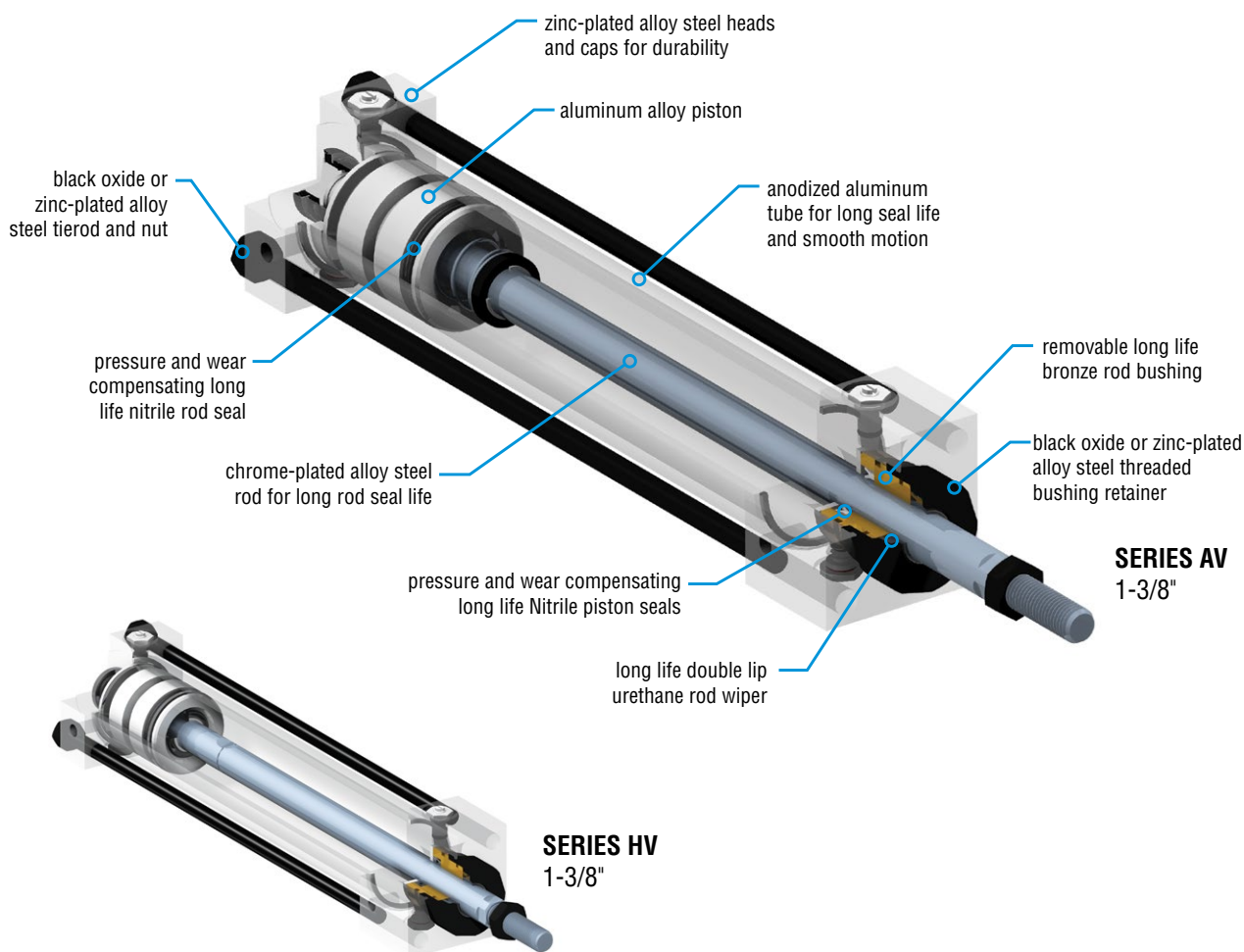
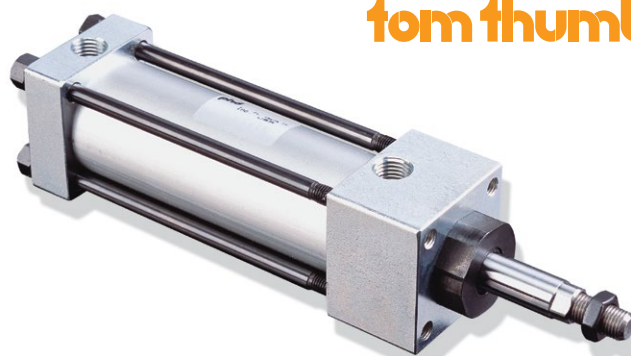
tom thumb®

1-3/8" AV, HV

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

Major Benefits

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

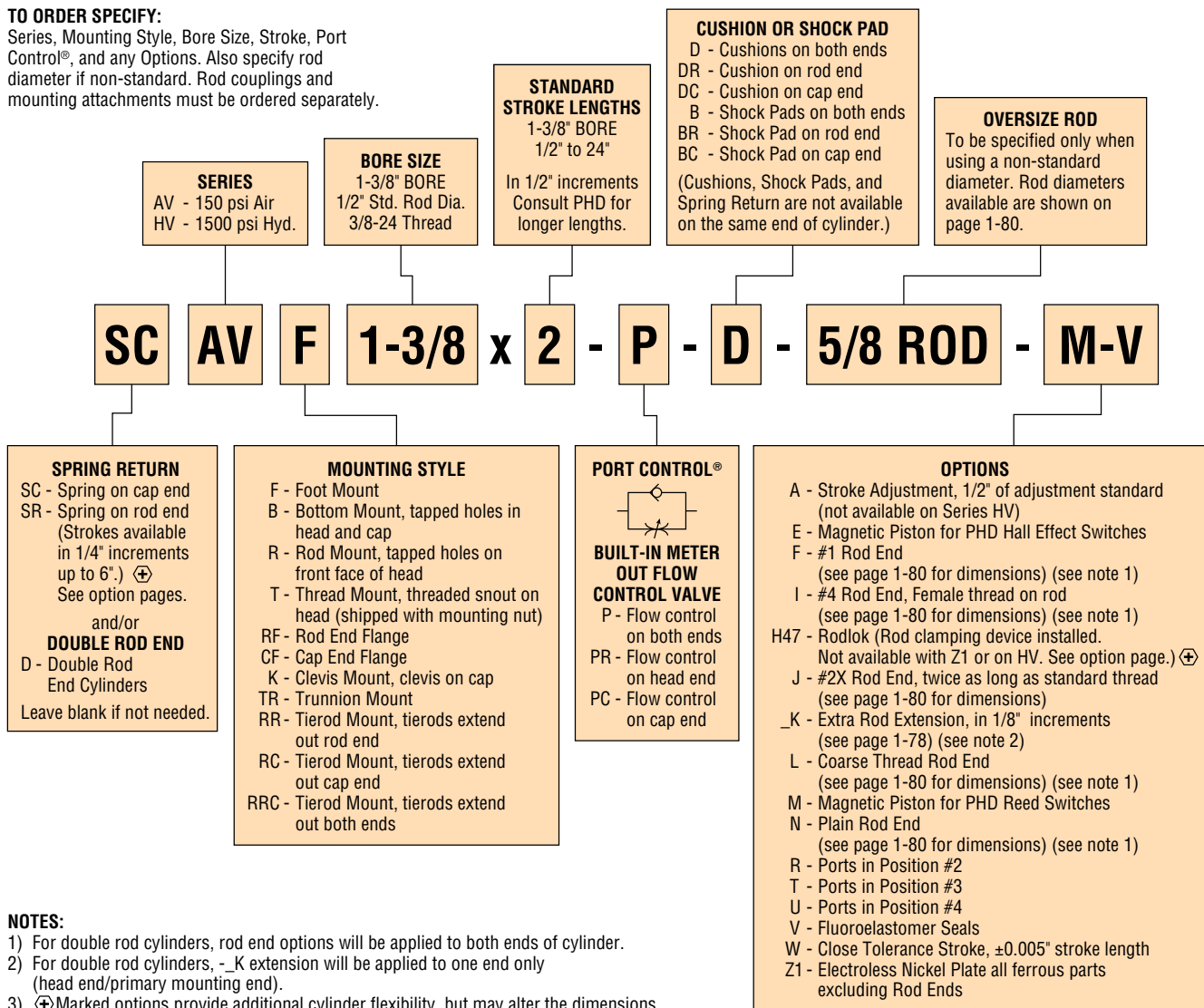


ORDERING DATA: SERIES AV, HV CYLINDERS; 1-3/8" BORE

1-3/8" AV, HV

TO ORDER SPECIFY:

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



NOTES:

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



CAD & Sizing Assistance

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

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

1-3/8" AV, HV

SPECIFICATIONS	SERIES AV	SERIES HV
OPERATING PRESSURE STANDARD CYLINDER (NO RODLOK) CYLINDER WITH RODLOK	20 to 150 psi air 30 to 150 psi air	40 to 1500 psi hyd* —
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 in²

(Extend or Retract)



Application & Sizing Assistance

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

1-3/8" AV, HV

R DIMENSIONS

1.875 SQ

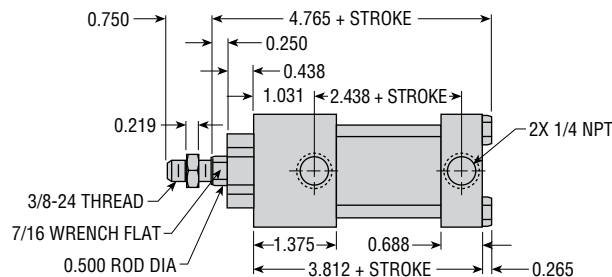
1.250 DIA

1

2

3

4



4X 1/4-28 THREAD x 0.375 DP

1.375 SQ

(F2)

Technical drawing of the F2 hydraulic cylinder showing front and side views with dimensions.

Front View Dimensions:

- Top mounting holes: 4X 0.281 DIA THRU
- Top mounting hole spacing: 1.250 (center-to-center), 1.875 (edge-to-edge)
- Bottom mounting hole spacing: 2.500 (center-to-center), 3.000 (edge-to-edge)
- Mounting holes are labeled 1, 2, 3, and 4.

Side View Dimensions:

- Total length: 4.812 + STROKE
- Stroke length: 0.312
- Mounting flange thickness: 0.265

MF1)

Technical drawing of the MF1 hydraulic cylinder. The front view (left) shows a cylinder with a central port (1), two side ports (2 and 3), and four mounting holes (4). Dimensions include a 4X 0.281 DIA THRU hole, a 1.250 inch diameter for the side ports, a 1.875 inch diameter for the central port, a 2.500 inch distance between side ports, and a 3.000 inch total width. The side view (right) shows the cylinder's profile with dimensions for the stroke (4.827 + STROKE), a 0.125 inch thickness, a 0.327 inch distance from the end to the side port, a 0.312 inch distance from the end to the central port, and a 0.688 inch distance from the end to the side port.

52' - WITH PORT CONTROL & CUSHION ON CAP END

Technical drawing of a 1/2" Bore Hydraulic Cylinder (Type 52) showing front and side views with dimensions.

Front View Dimensions:

- Overall width: 2.625
- Mounting foot width: 1.125
- Port diameter: 4X 0.281 DIA THRU
- Mounting foot height: 0.375

Side View Dimensions:

- Stroke: 5.125 + STROKE
- Bore diameter: 1.062
- Cushioning ring diameter: 0.312
- Mounting foot width: 0.375
- Mounting foot height: 0.500
- Internal dimensions: 0.750, 3.812 + STROKE

N1)

1-1/2-12 THREAD

5.015 + STROKE

0.656

1.000

0.625

1.062

1.312

3.438 + STROKE

The drawing shows a cross-section of a component with a 1-1/2-12 thread. The dimensions are as follows:

- Overall length: 5.015 + STROKE
- Thread length: 0.656
- Distance from thread end to centerline: 1.000
- Distance from thread end to centerline (alternative): 0.625
- Distance from thread end to centerline (alternative): 1.062
- Distance from thread end to centerline (alternative): 1.312
- Distance from thread end to centerline (alternative): 3.438 + STROKE

R (MT4) SEE NOTE BELOW

Technical drawing of the R (MT4) component. The top view shows a square flange with a central hexagonal hole and four mounting holes. Dimensions include a total width of 3.500, a central hole diameter of 2.500, and a flange thickness of 0.500. The side view shows a total length of 2.500 and a central hole diameter of 0.500 DIA BOTH SIDES. A dimension of 0.688 is shown for the distance from the end face to the center of the hole.

①
②
③
④

2.500
3.500
0.500
2.000
0.500 DIA BOTH SIDES
2.500
0.688

Technical drawing of a hydraulic cylinder showing front and end views with dimensions.

Front View Dimensions:

- 0.500 DIA THRU (Through hole diameter)
- 0.687 RAD (Radius of the end face)
- 0.750 (Length of the end face)
- 3.875 + STROKE (Length of the cylinder body)
- 5.125 + STROKE (Total length)
- 0.562 (Distance from end face to center of stroke)
- 0.438 (Distance from end face to center of stroke)

End View Dimensions:

- 1.250 DIA (End face diameter)
- 0.500 (Distance from center to edge)
- 1.125 (Distance from center to edge)
- 1 (Number of ports)
- 2 (Number of ports)
- 3 (Number of ports)
- 4 (Number of ports)

**RR (MX3)
RC (MX2)**

1.375 SQ

1 2 3 4

RRC (MX1)

4X 1/4-28
4X W/RR (MX3) MTG
4X W/RC (MX2) MTG
OPPOSITE END

8X W/RRC (MX1) MTG
4X THIS AND
OPPOSITE END

0.750 RC (MX2) MTG
AND RRC (MX1) MTG

0.265

0.265

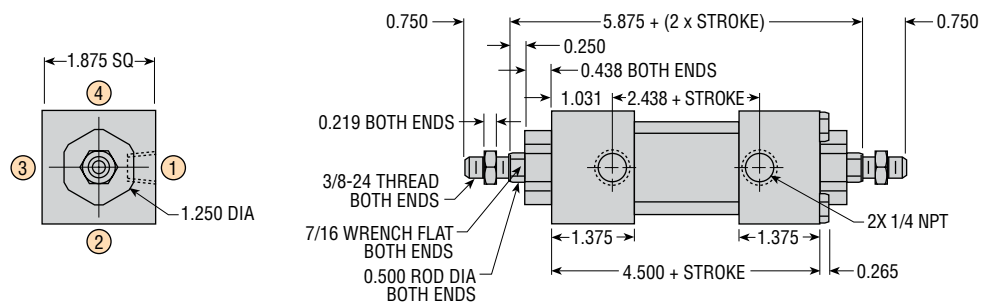
0.750 RR (MX3) MTG AND
RRC (MX1) MTG

TR MOUNTING NOTE: SENSING IN THE EXTEND DIRECTION WILL BE AFFECTED ON UNITS WITH -E OR -M OPTION BECAUSE OF THE TRUNNION MOUNTING BLOCK.

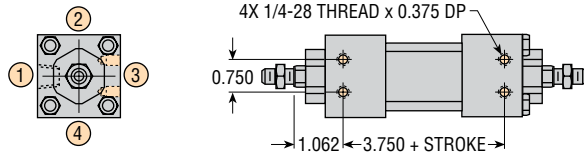


DIMENSIONS: SERIES DAV, DHV DOUBLE ROD END CYLINDERS; 1-3/8" BORE

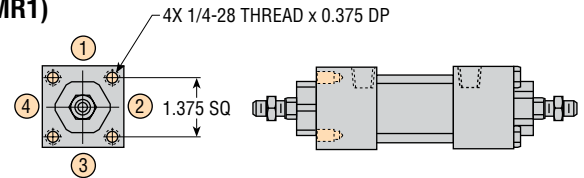
BASIC CYLINDER DIMENSIONS



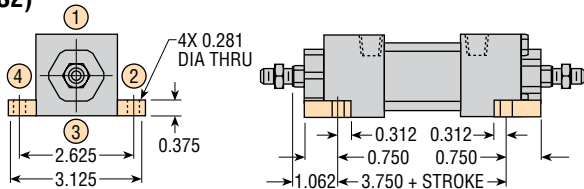
B (MS4)



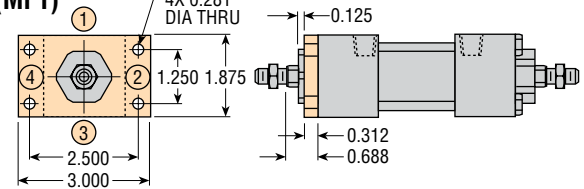
R (MR1)



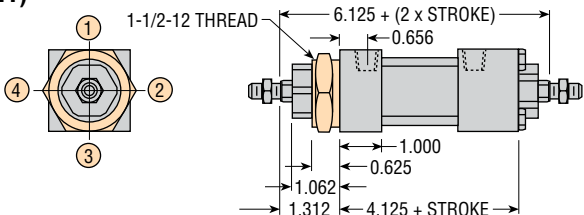
F (MS2)



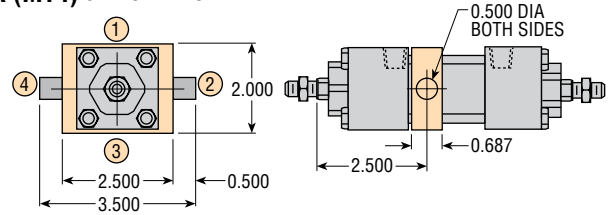
RF (MF1)



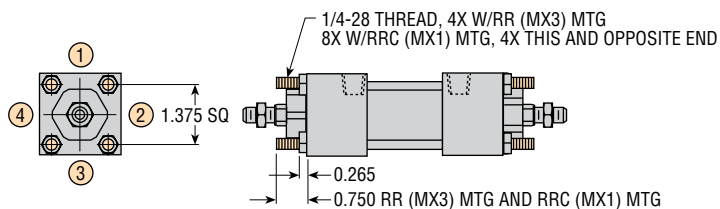
T (MN1)



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.

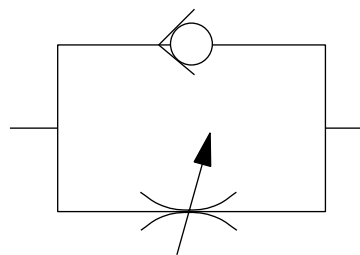
OPTIONS: SERIES AV, HV CYLINDERS; 1-3/8" BORE

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.

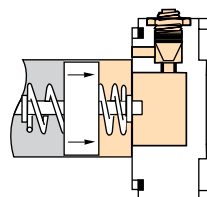


D DC DR ADJUSTABLE CUSHION

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

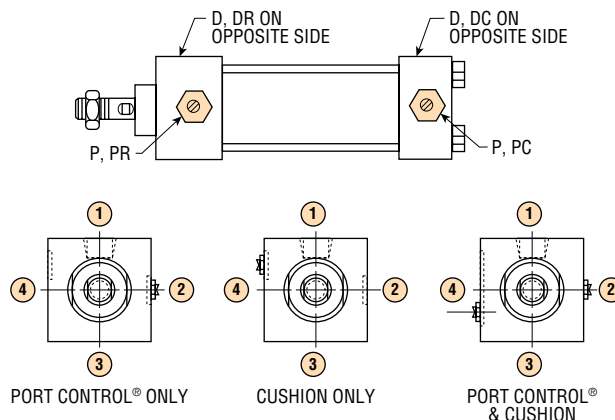


1-3/8" BORE

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.

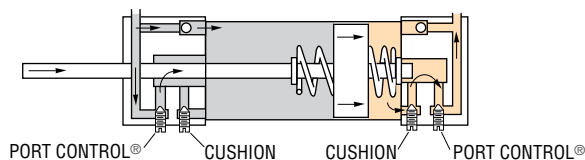
Location may vary depending on mounting and option combinations.



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



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

B

BC

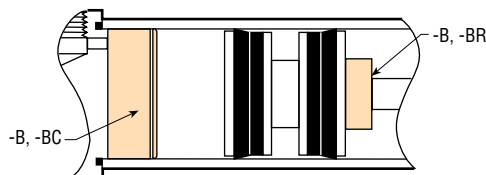
BR

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

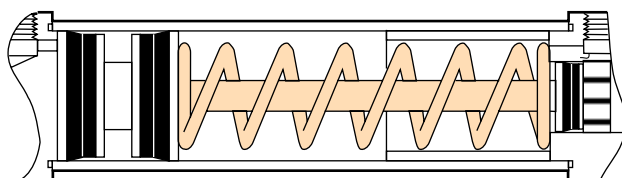
Available in 1/4" increments

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

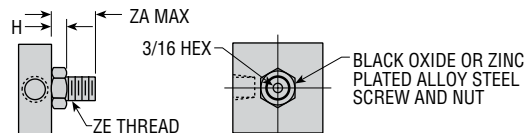
CYLINDER STROKE ADJUSTMENT (SERIES AV)

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

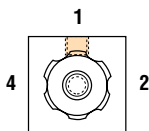
Available with all options EXCEPT:

- 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)



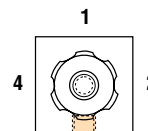
PORT POSITIONS

STANDARD PORT POSITION 1



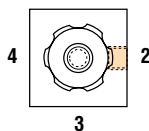
T

PORT POSITION 3



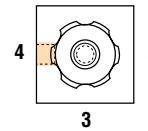
R

PORT POSITION 2



U

PORT POSITION 4



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

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E HALL EFFECT SWITCHES

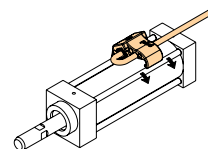
PHD Cylinders may be equipped with a magnetic band (specify -E) on the piston which activates externally mounted PHD Hall Effect Switches. These switches allow the interfacing of the Tom Thumb® air or hydraulic cylinder to various logic systems. This option is for use with the following switches.

COMPACT HALL EFFECT SWITCHES

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

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)

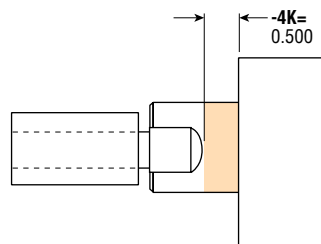
-4K = 1/2 of extra rod extension

-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. ⊕

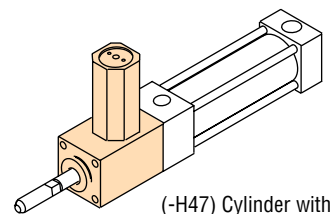
PHD's Rodlok is ideal for locking the piston rod while in a static/stationary position. When the pressure is removed from the port of the Rodlok, the mechanism will grip the rod and prevent it from moving. The loads are held indefinitely without power. Rodlok performance is application and environment 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.

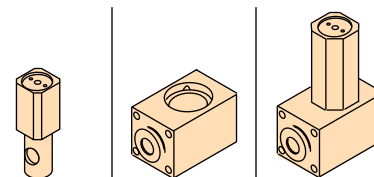


(-H47) Cylinder with rod locking device and adaptor preassembled

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

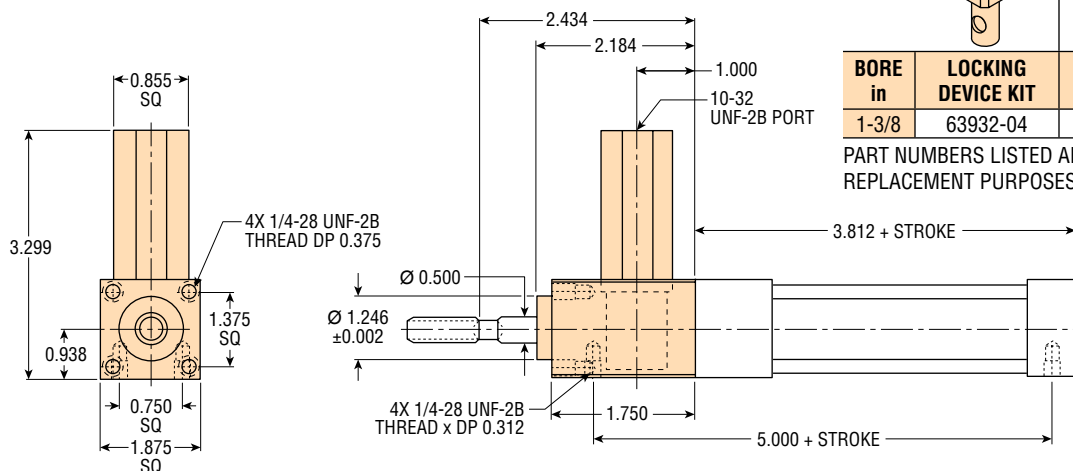
NOTE: *LOCKING FORCE GIVEN IS THE ACTUAL LOCKING FORCE WITH A DRY, CLEAN ROD AND DOES NOT INCLUDE ANY SAFETY FACTOR.

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.



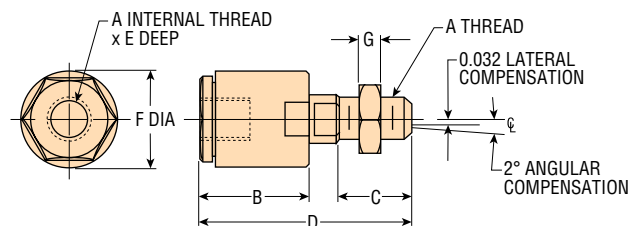
NOTE: BREAKAWAY FORCE ON CYLINDERS WITH RODLOK APPROXIMATELY 30 psi.

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

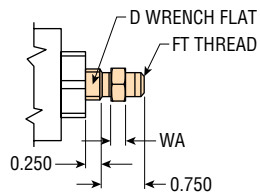
To order, specify the model number.

All dimensions are reference only unless specifically toleranced.

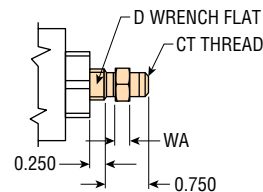
ACCESSORIES: SERIES AV, HV CYLINDERS; 1-3/8" BORE

1-3/8" BORE CYLINDERS

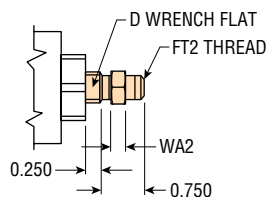
G ROD END STYLE #2 STANDARD ON: (1-3/8" BORE)



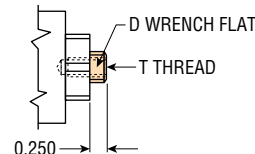
L COARSE THREAD ROD END



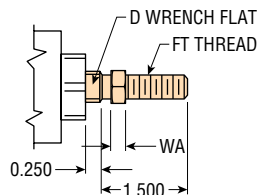
F ROD END STYLE #1



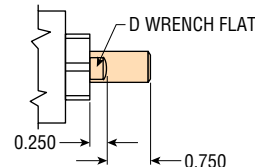
I ROD END STYLE #4



J ROD END STYLE #2X



N PLAIN ROD END

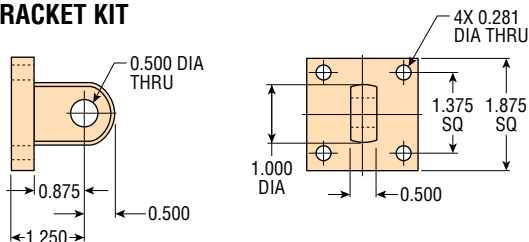


All standard rod ends have four wrench flats (two wrench flats with "I" option).

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

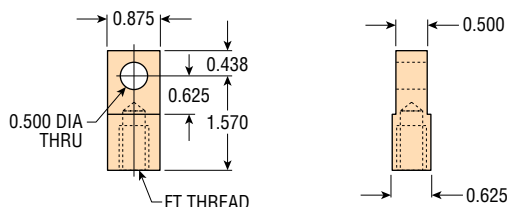
NOTE: On double rod cylinders, both rod ends will be the same on both ends of the cylinder.

EYE BRACKET KIT



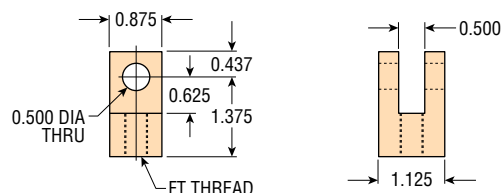
BORE SIZE	PART NO.
1-3/8	1330

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.

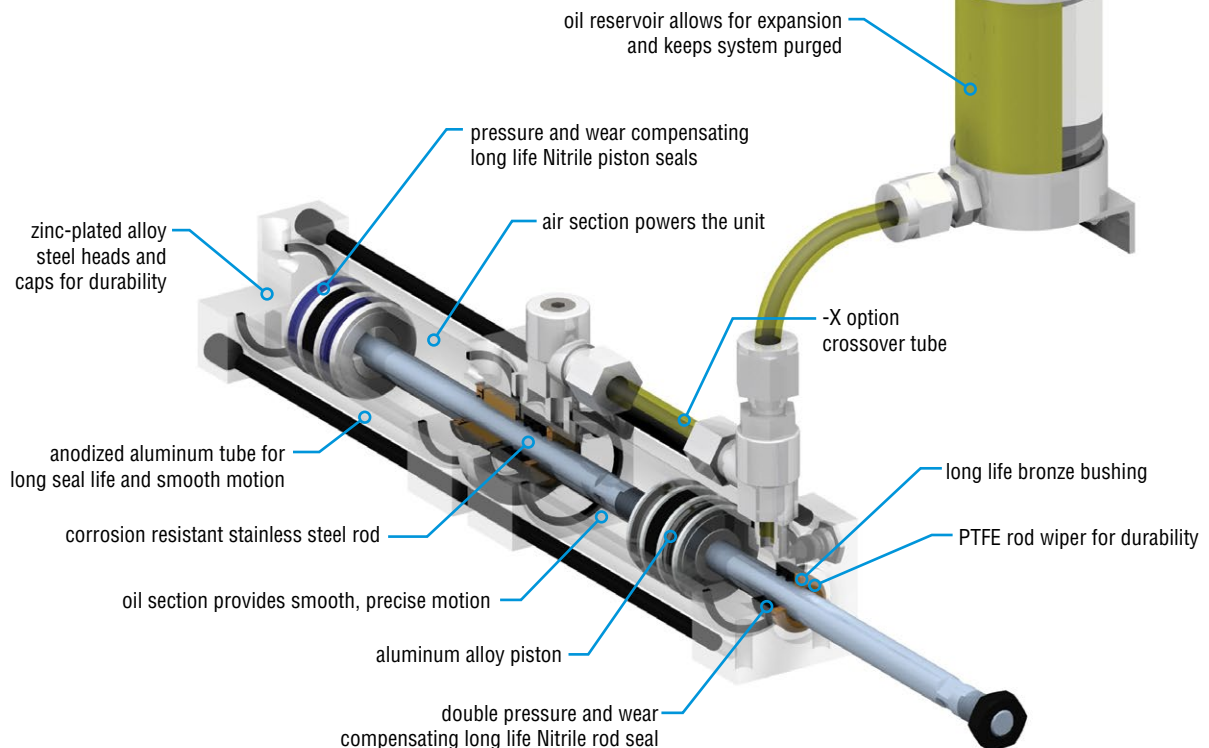
3/4", 1", 1-1/8", 1-3/8" BORE AIR/OIL TANDEM CYLINDERS

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

TD

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**

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.



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



CAD & Sizing Assistance

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

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

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		DISPLACEMENT gal/in OF STROKE
				WITH -C OR -X	W/OUT -C OR -X	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

$$F = P \times A$$

F = Cylinder Force lbs

P = Operating Pressure psi

A = Effective Area in²
(Extend or Retract)



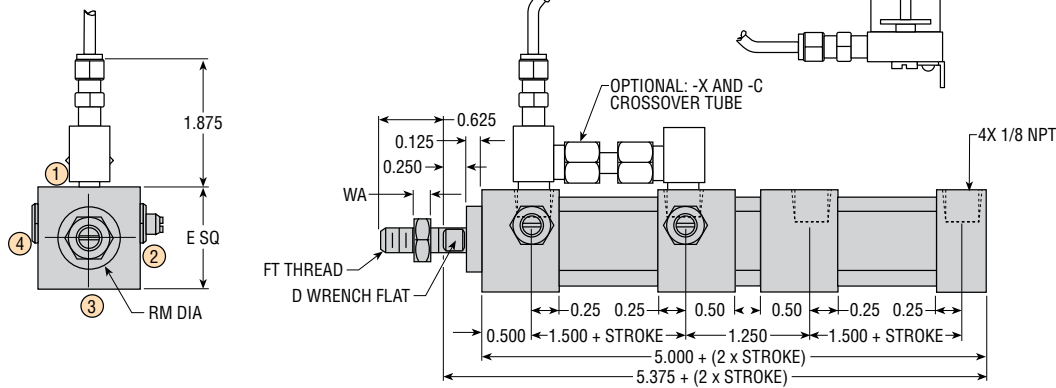
Application & Sizing Assistance

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

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

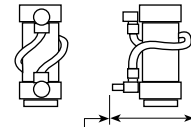
BASIC CYLINDER DIMENSIONS

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



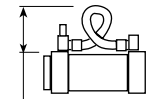
TUBE CROSSOVER VIEW

FOR NON F OR B MOUNT UNITS



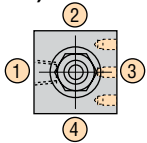
TUBE COIL DIAMETER
APPROXIMATELY 9"
SEE NOTE 1*

F & B MOUNT UNITS

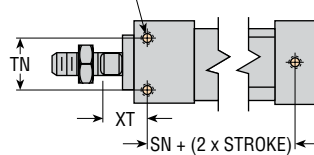


TUBE COIL DIAMETER
APPROXIMATELY 9"
SEE NOTE 1*

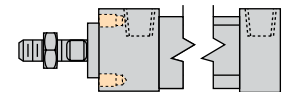
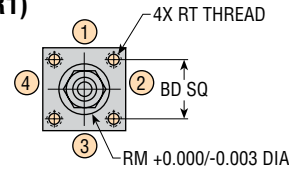
B (MS9)



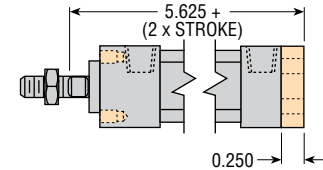
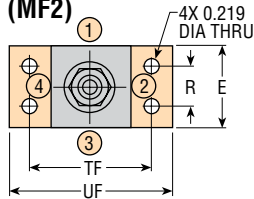
3X NT THREAD



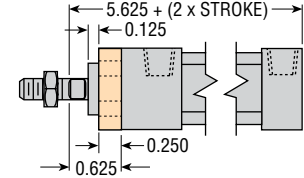
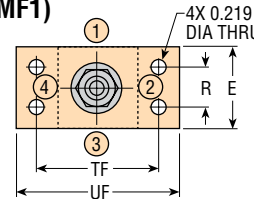
R (MR1)



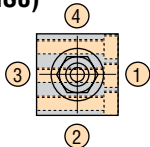
CF (MF2)



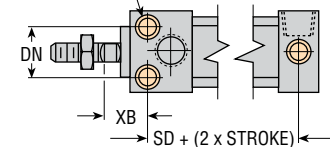
RF (MF1)



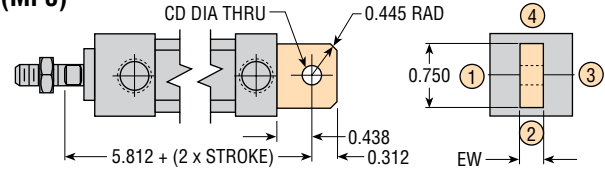
F (MS8)



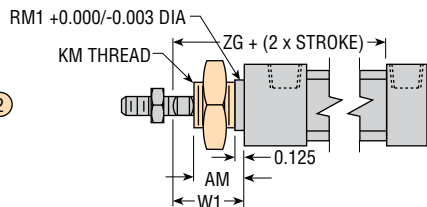
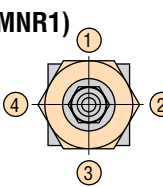
3X C-BORED HOLES
FOR DB SHCS



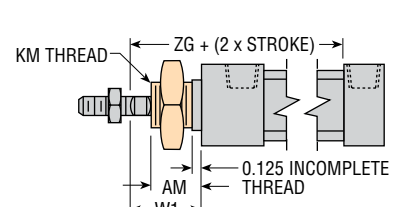
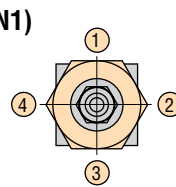
P (MP3)



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
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	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
1-1/8	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

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

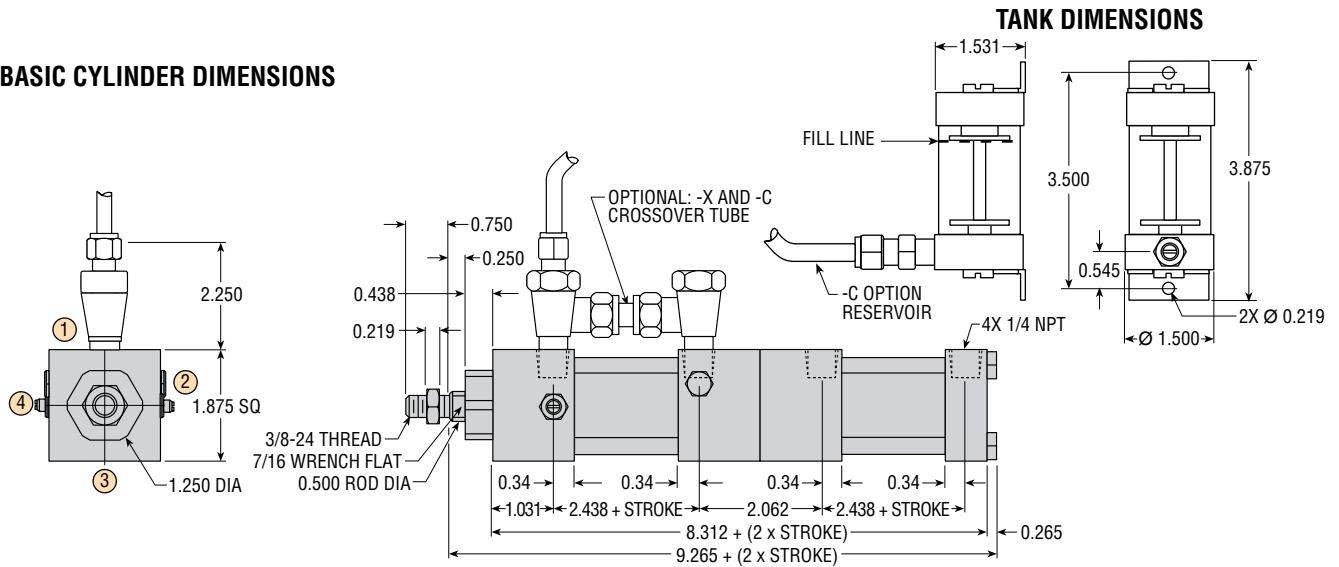
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

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

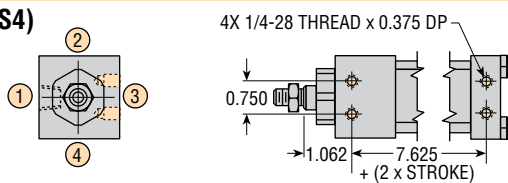
BASIC CYLINDER DIMENSIONS



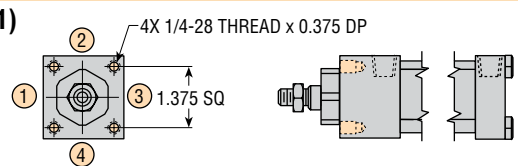
-C Option Air/Oil Tandem Mounting and Operation Notes:

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.

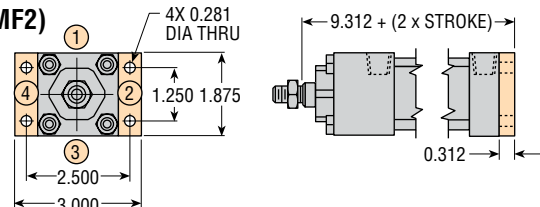
B (MS4)



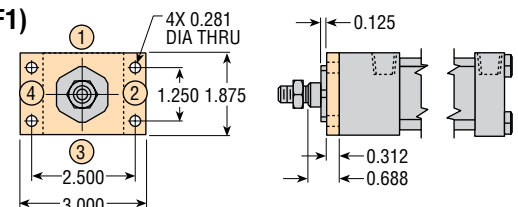
R (MR1)



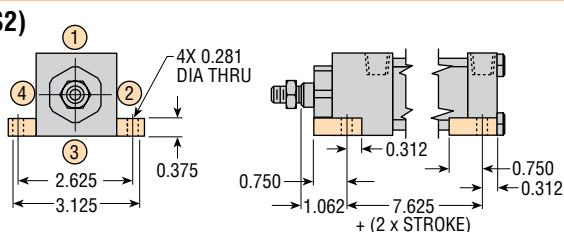
CF (MF2)



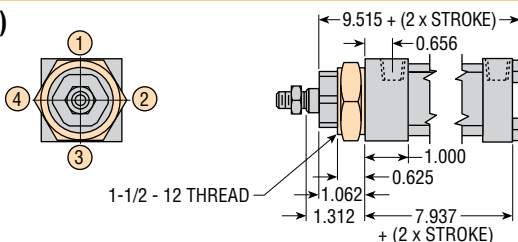
RF (MF1)



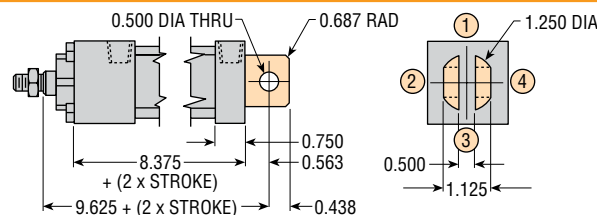
F (MS2)



T (MN1)



K (MP1)



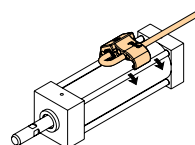
All standard rod ends have four wrench flats (two wrench flats with "I" option).

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

All dimensions are reference only unless specifically toleranced.

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

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES



E HALL EFFECT SWITCHES

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

COMPACT HALL EFFECT SWITCHES

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

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.

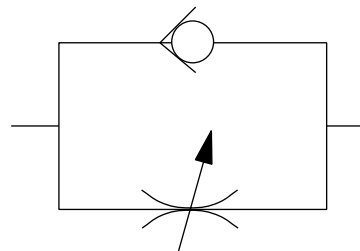
X CROSSOVER TUBE Air/Oil Tandem models only (Series TD)

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®

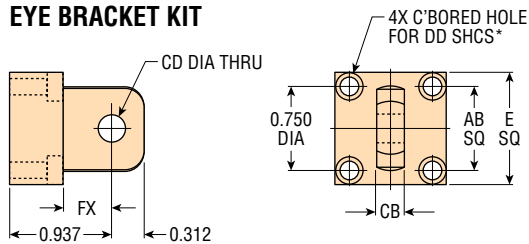
The exclusive PHD Port Control®, based on the "meter-out" principle, features an adjustable needle and a separate ball check. Both are built into the cylinder end cap and are used to control the speed of the cylinder over its entire stroke.

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.



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

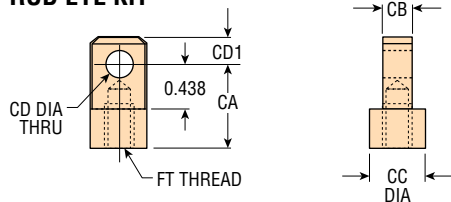
EYE BRACKET KIT



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

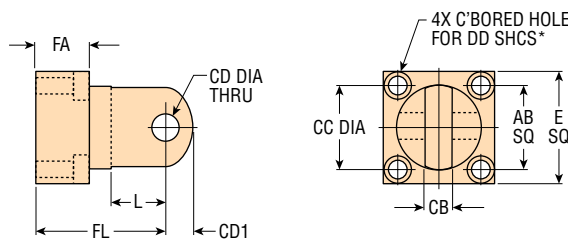
*For 3/4 bore thru hole only.

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

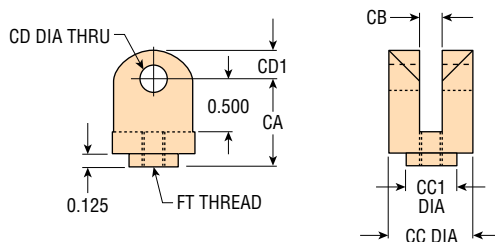
CLEVIS BRACKET KIT - PIN INCLUDED



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

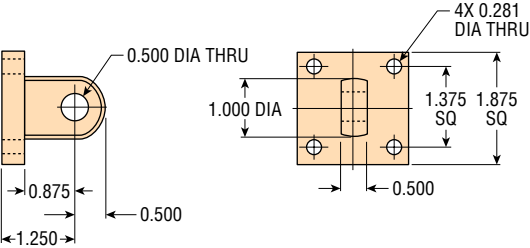


BORE SIZE	PART NO.	LETTER DIMENSION						
		CA	CB	CC	CC1	CD	CD1	FT
3/4	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	12908	0.875	0.379	0.875	0.562	0.375	0.375	3/8-24 TO SLOT

All dimensions are reference only unless specifically toleranced.

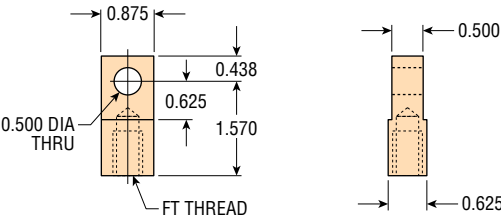
ACCESSORIES: SERIES TD AIR/OIL TANDEM; 1-3/8" BORE

EYE BRACKET KIT



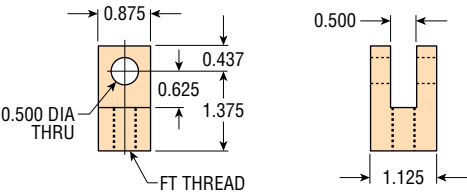
BORE SIZE	PART NO.
1-3/8	1330

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

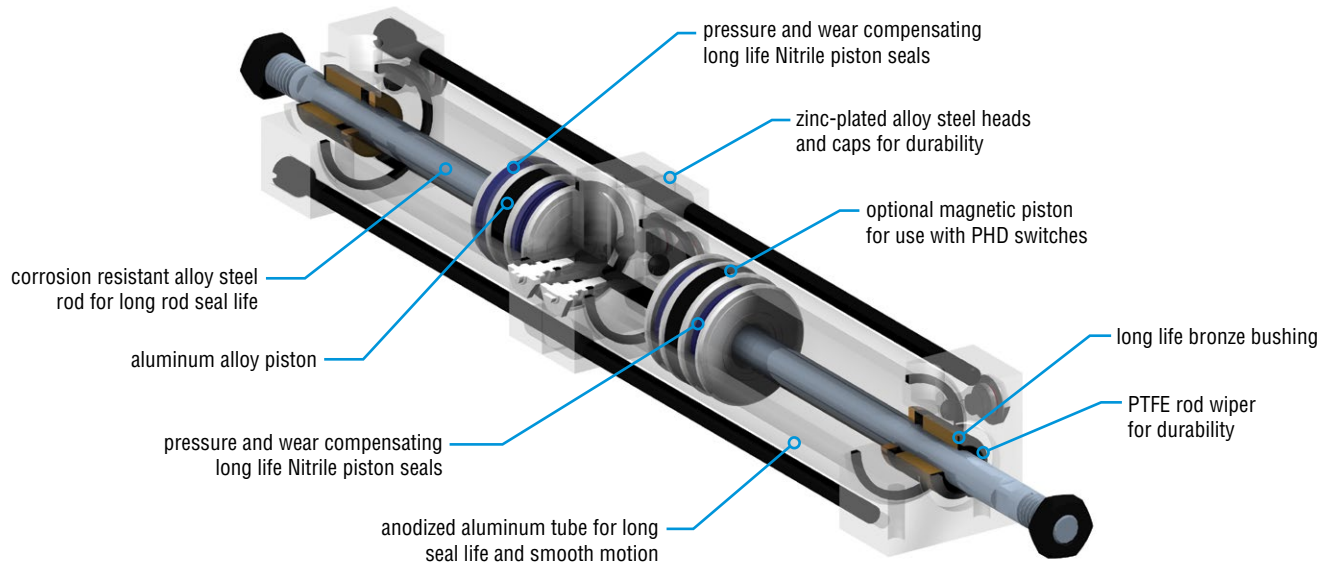
Major Benefits

- 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

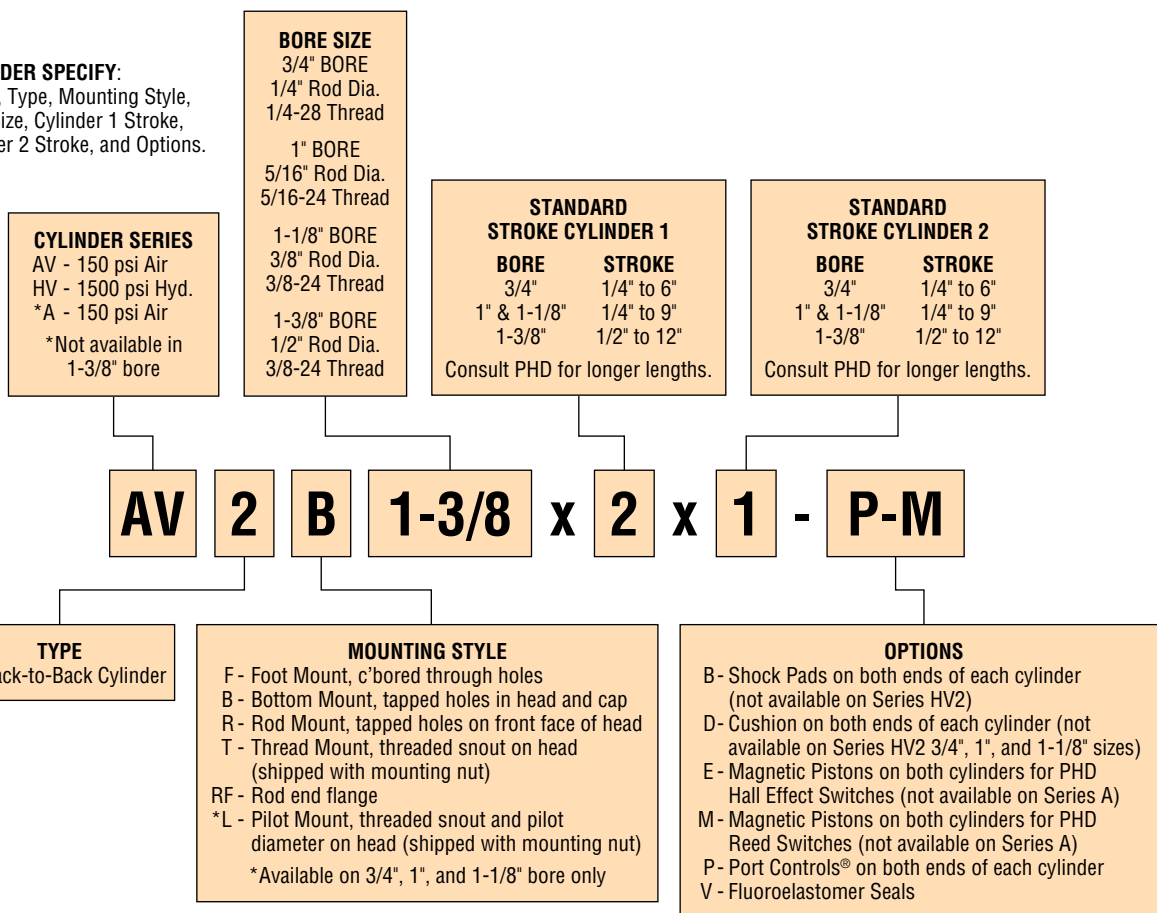
*Cutaway depicts
a 1-1/8" bore AV2 unit.*



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

AV2, HV2, A2

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



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



CAD & Sizing Assistance

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

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

AV2, HV2, A2

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

$$F = P \times A$$

F = Cylinder Force lbs

P = Operating Pressure psi

A = Effective Area in²

(Extend or Retract)

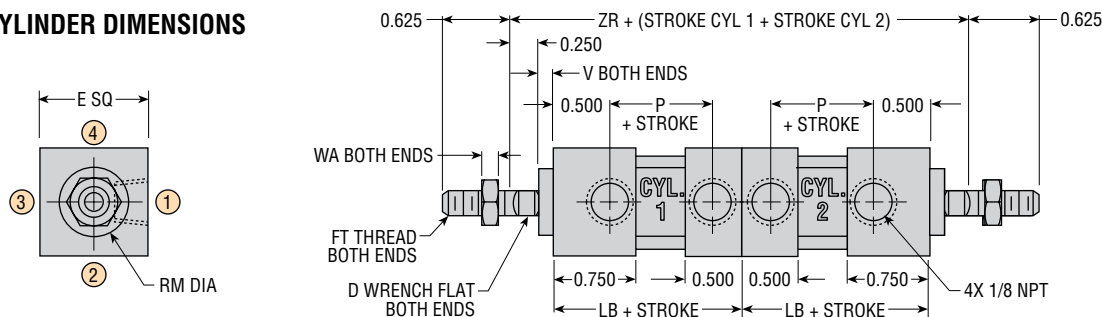


Application & Sizing Assistance

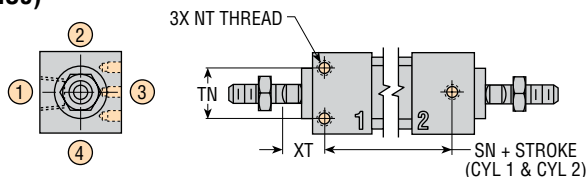
Use PHD's free online Product Sizing Application at www.phdinc.com/apps/sizing

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

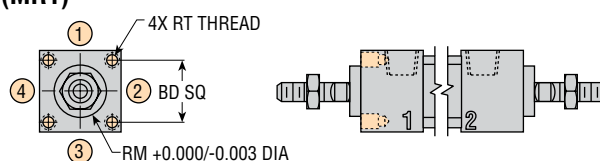
BASIC CYLINDER DIMENSIONS



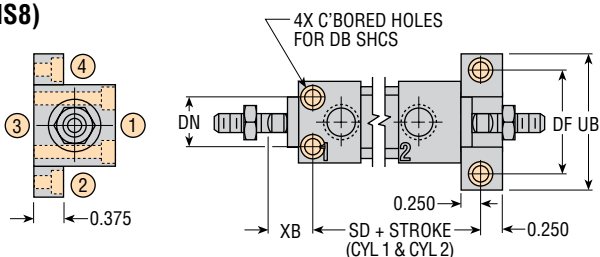
B (MS9)



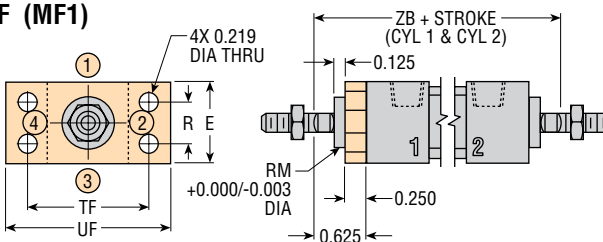
R (MR1)



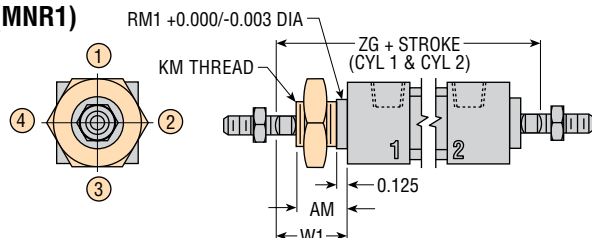
F (MS8)



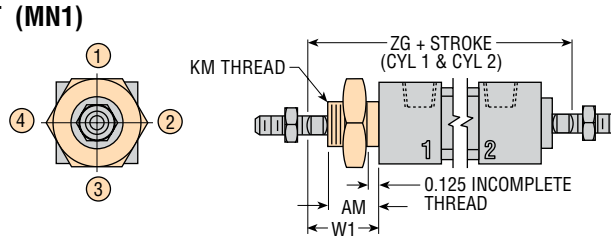
RF (MF1)



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
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	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
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

SERIES A2 CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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	4.250
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	4.250
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	4.250

SERIES HV2 CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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
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
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

SERIES AV2 CYLINDERS

BORE SIZE	LETTER DIMENSION												
	AM	KM	LB	P	RM1	SD	SN	V	W1	XB	XT	ZB	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
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
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

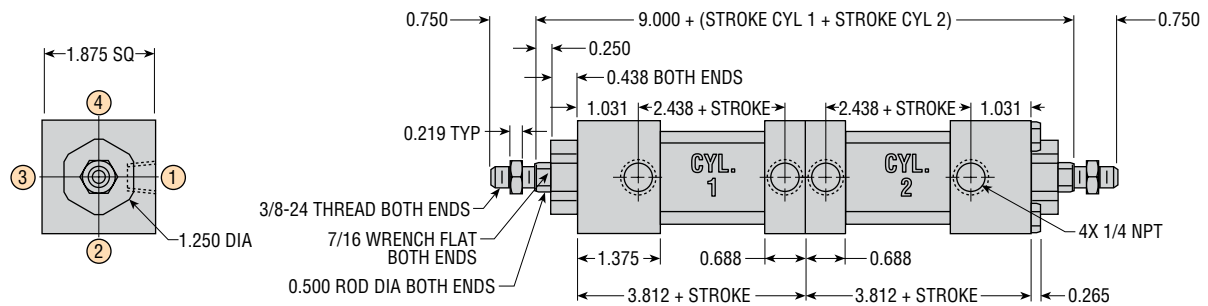
PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

CUSHIONS: ADD 1.000 in TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (2" TOTAL TO OVERALL)

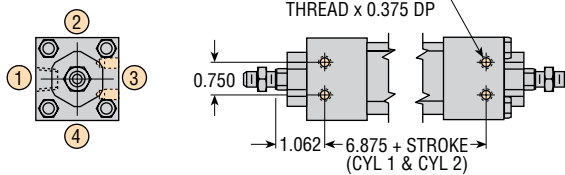
SHOCK PADS: ADD 0.500 in TO ALL (+ STROKE) DIMENSIONS OF CYLINDER 1 AND CYLINDER 2 (1" TOTAL TO OVERALL)

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

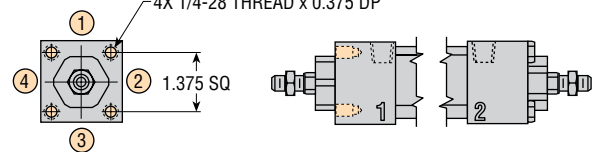
BASIC CYLINDER DIMENSIONS



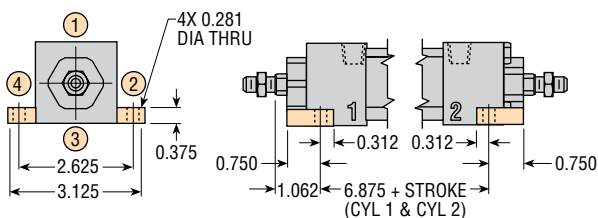
B (MS4)



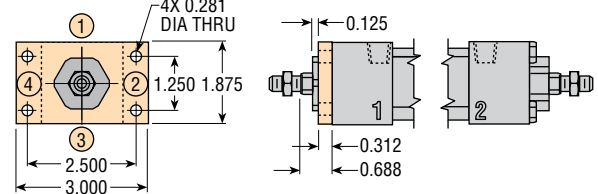
R (MR1)



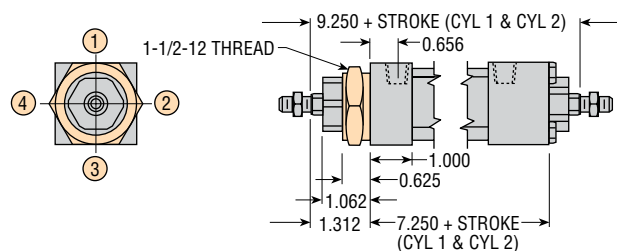
F (MS2)



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

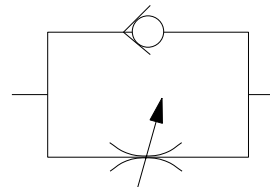
P

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.

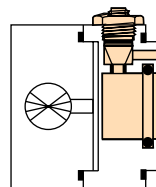
See dimension pages for dimensional information.

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

1-3/8" Series A2V, H2V = Poppet Style

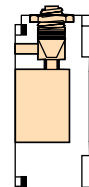
Effective cushion length 1/2"

CUSHION BLOCK



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

POPPET STYLE

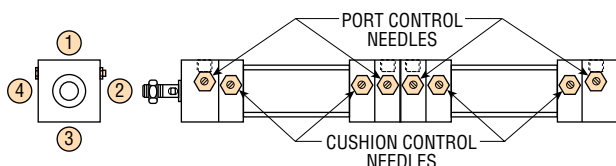


1-3/8" BORE

STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS

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

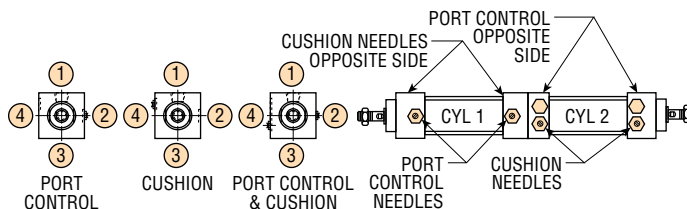
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A2, AV2, and HV2. Consult PHD for special Port Control® or cushion needle positions.



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.

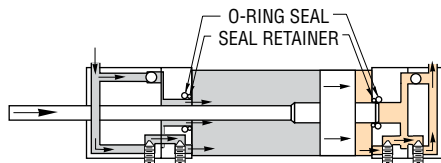


PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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

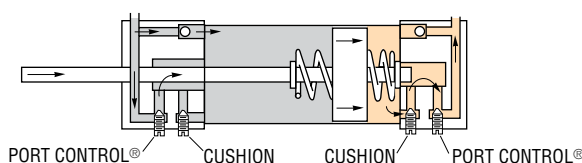


PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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

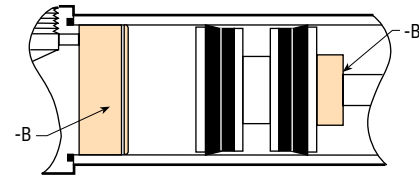
B

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

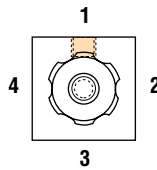


AV2, HV2, A2

PORT POSITIONS

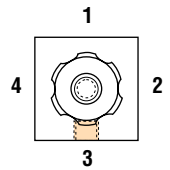
Port position 1 is standard on all cylinders.

PORT POSITION 1 (STANDARD)



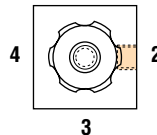
T

PORT POSITION 3



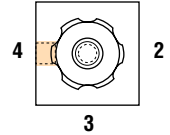
R

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.

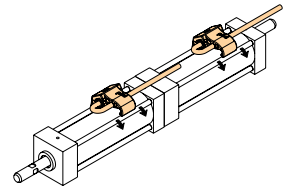
COMPACT HALL EFFECT SWITCHES

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

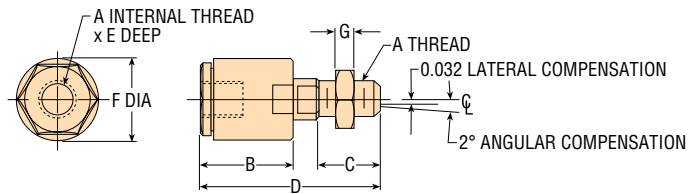
Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

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.

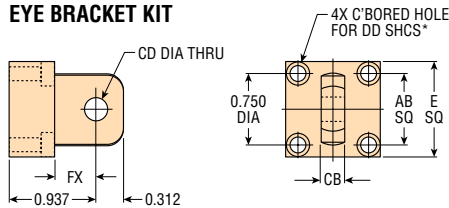
Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke.



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.

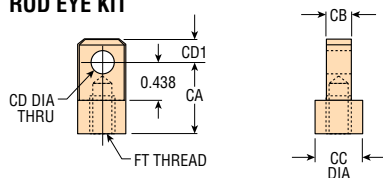
EYE BRACKET KIT



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 &	A2	1077-02	1.000	0.373	0.250	#10	1.375	0.437
1-1/8	AV2, HV2	1077-03	1.000	0.373	0.375	#10	1.375	0.437

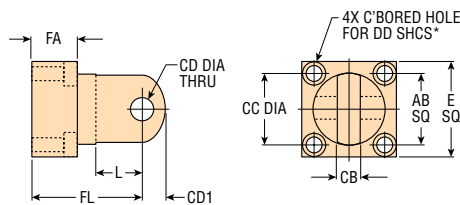
*For 3/4 bore thru hole only.

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

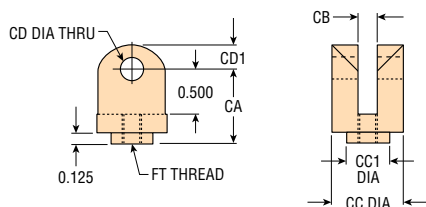
CLEVIS BRACKET KIT - PIN INCLUDED



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 &	A2	12902	1.000	0.379	0.875	0.250	0.375	#10	1.375	0.500	1.250	0.531
1-1/8	AV2	12903	1.000	0.379	0.875	0.375	0.375	#10	1.375	0.500	1.250	0.531

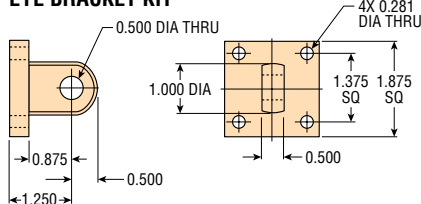
*For 3/4 bore thru hole only.

ROD CLEVIS KIT - PIN INCLUDED



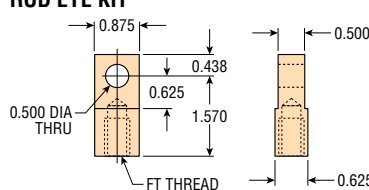
BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CC1	CD	CD1	FT
3/4	A2, AV2	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	A2	12905	0.875	0.379	0.875	0.562	0.250	0.375	5/16-24 TO SLOT
	AV2	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	A2	12907	0.875	0.379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



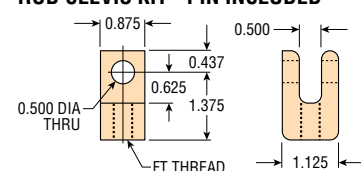
BORE SIZE	CYLINDER SERIES	PART NO.
1-3/8	AV2, HV2	1330

ROD EYE KIT



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

A3V, H3V, A3



tom thumb®

A3, A3V, H3V

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

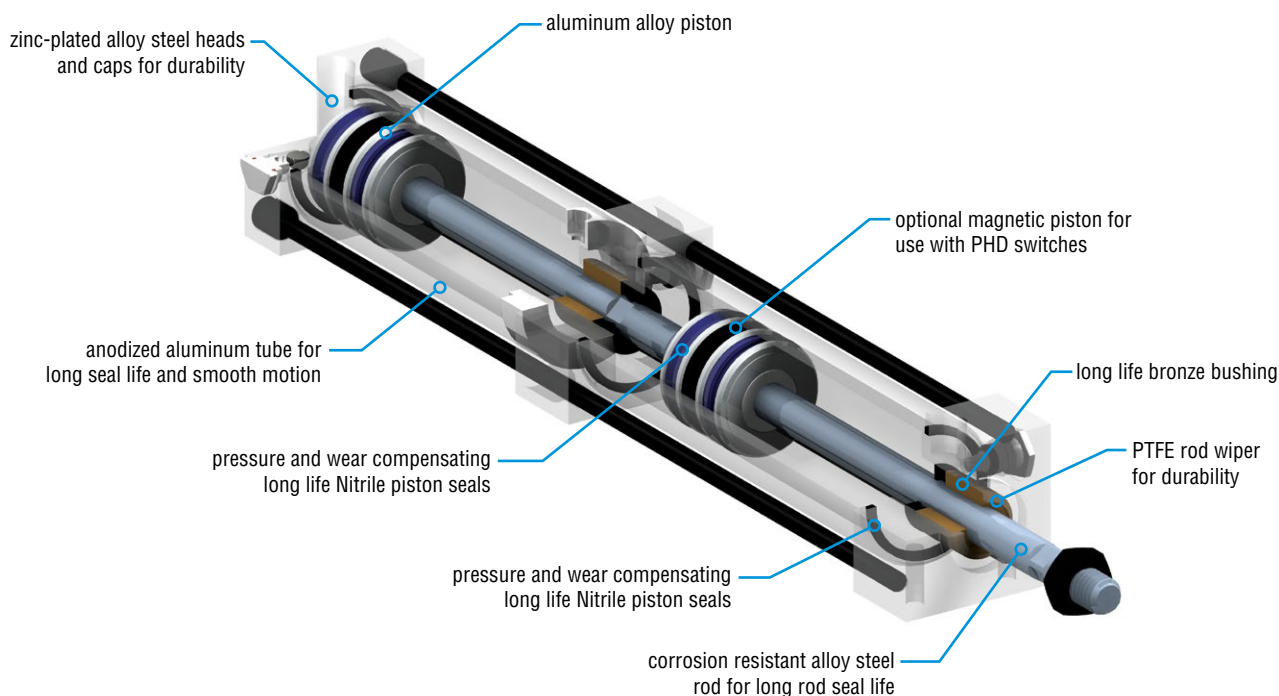
Major Benefits

- 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.*



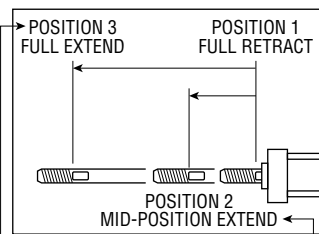
ORDERING DATA: SERIES A3, A3V, H3V; 3/4", 1", 1-1/8", 1-3/8" BORE

A3, A3V, H3V

TO ORDER SPECIFY:

Series, Type, Mounting Style, Bore Size, Cylinder 1 Stroke, Cylinder 2 Stroke, and Options.

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



CAD & Sizing Assistance

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

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

A3, A3V, H3V

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

$$F = P \times A$$

F = Cylinder Force lbs

P = Operating Pressure psi

A = Effective Area in²
(Extend or Retract)



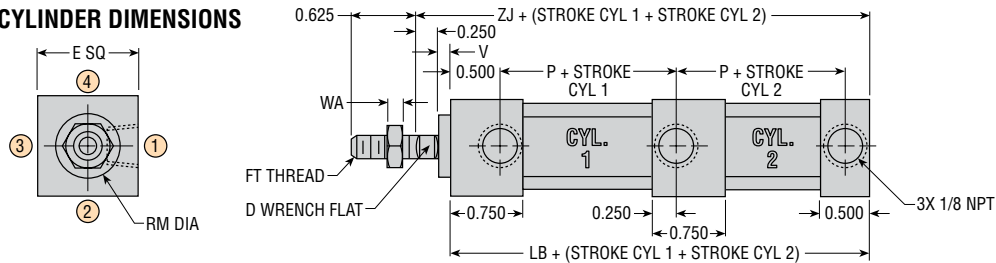
Application & Sizing Assistance

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

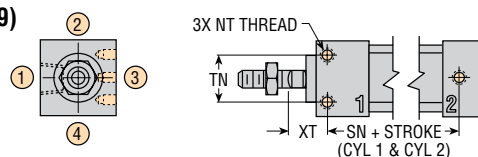
DIMENSIONS: SERIES A3, A3V, H3V CYLINDERS; 3/4", 1", 1-1/8" BORE

A3, A3V, H3V

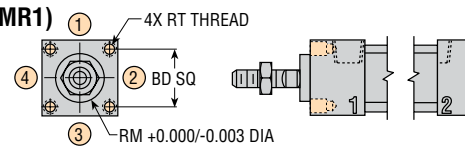
BASIC CYLINDER DIMENSIONS



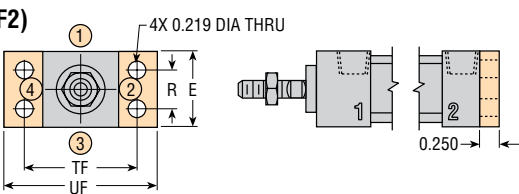
B (MS9)



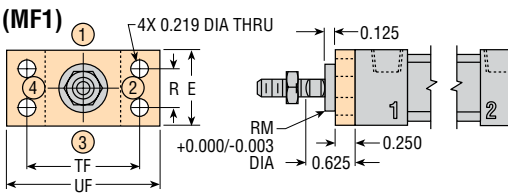
R (MR1)



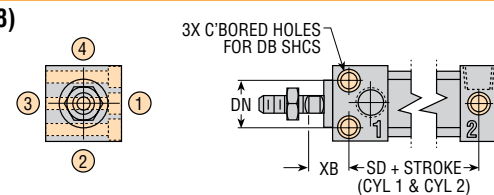
CF (MF2)



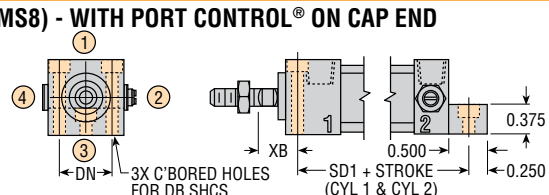
RF (MF1)



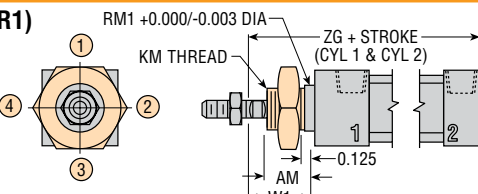
F (MS8)



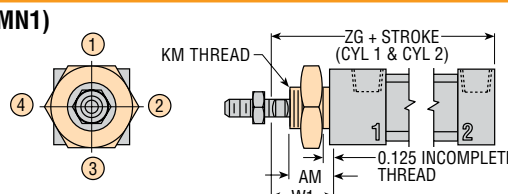
F (MS8) - WITH PORT CONTROL® ON CAP END



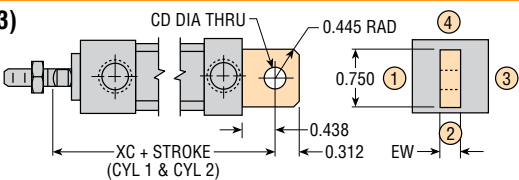
L (MNR1)



T (MN1)



P (MP3)



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

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

CUSHIONS: ADD 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	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION
	BD	D	DB	DF	DN	E	EW
3/4	0.750	3/16	#8	1.375	0.625	1.000	0.250
1	1.000	1/4	#10	1.750	0.875	1.375	0.375
1-1/8	1.125	5/16	#10	1.875	1.000	1.500	0.375

DIMENSIONS COMMON TO ALL SERIES

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

SERIES A3 CYLINDERS

BORE SIZE	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION
	AM	CD	KM	LB	P	P1	RM1
3/4	0.625	0.250	5/8-18	3.312	1.000	1.562	0.687
1	0.625	0.250	3/4-16	3.312	1.000	1.562	0.812
1-1/8	0.625	0.250	3/4-16	3.312	1.000	1.562	0.812

SERIES A3V CYLINDERS

BORE SIZE	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION
	AM	CD	KM	LB	P	P1	RM1
3/4	0.625	0.250	5/8-18	4.312	1.500	2.062	0.687
1	0.625	0.375	3/4-16	4.312	1.500	2.062	0.812
1-1/8	0.875	0.375	1-14	4.312	1.500	2.062	1.062

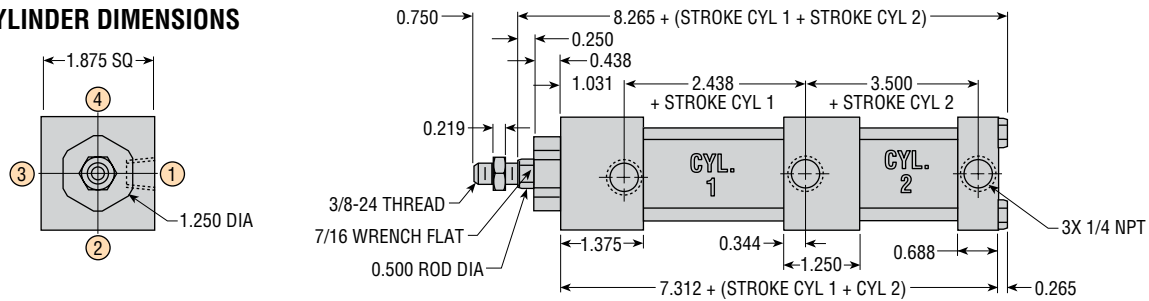
SERIES H3V CYLINDERS

BORE SIZE	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION	LETTER DIMENSION
	AM	CD	KM	LB	P	P1	RM1
3/4	0.625	0.250	5/8-18	4.312	1.500	2.062	0.687
1	0.625	0.375	3/4-16	4.312	1.500	2.062	0.812
1-1/8	0.875	0.375	1-14	4.312	1.500	2.062	1.062

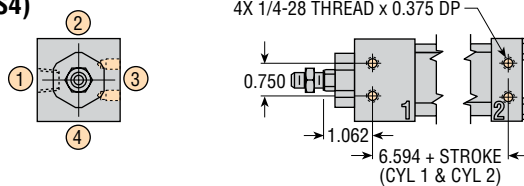
DIMENSIONS: SERIES A3V, H3V CYLINDERS; 1-3/8" BORE

A3, A3V, H3V

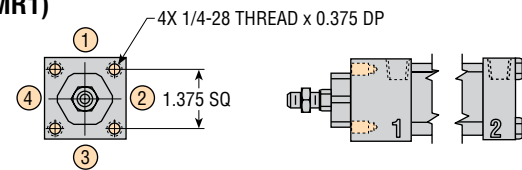
BASIC CYLINDER DIMENSIONS



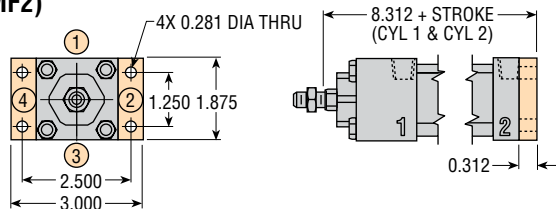
B (MS4)



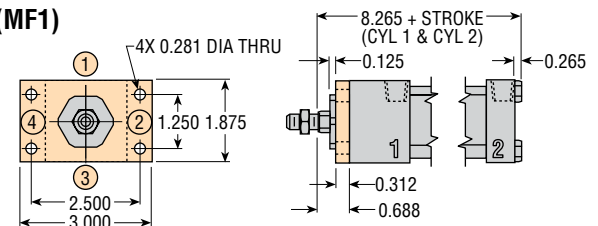
R (MR1)



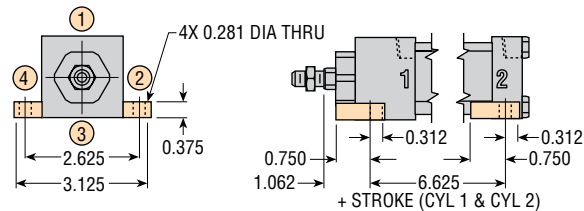
CF (MF2)



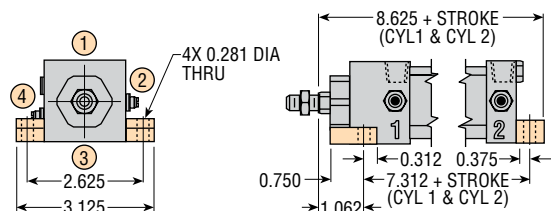
RF (MF1)



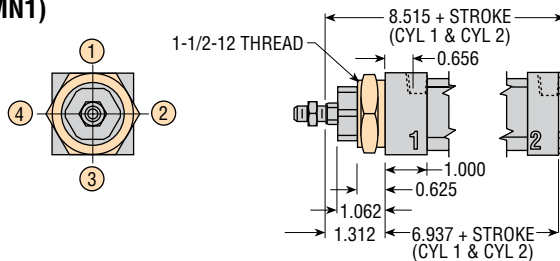
F (MS2)



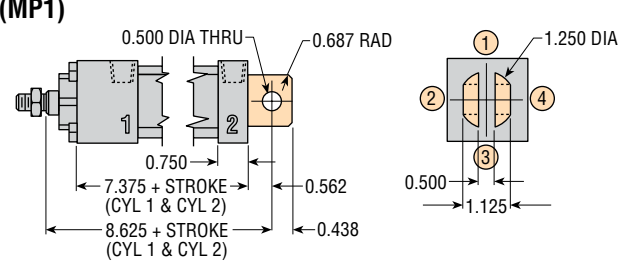
F (MS2)-WITH PORT CONTROL® & CUSHION ON CAP END



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.

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

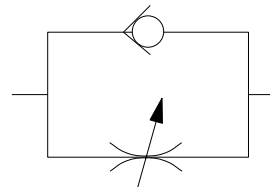
P

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.

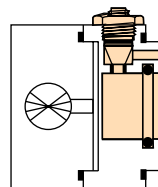
See dimension pages for dimensional information.

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

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

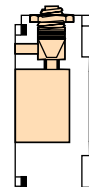
Effective cushion length 1/2"

CUSHION BLOCK



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

POPPET STYLE

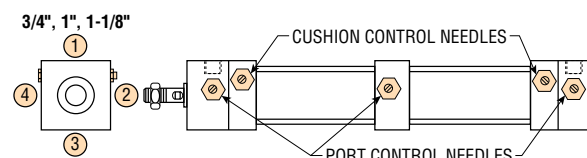


1-3/8" BORE

STANDARD PORT CONTROL® & CUSHION NEEDLE POSITIONS

(3/4", 1", 1-1/8" Bore Series A3, AV3, and HV3 Cylinders)

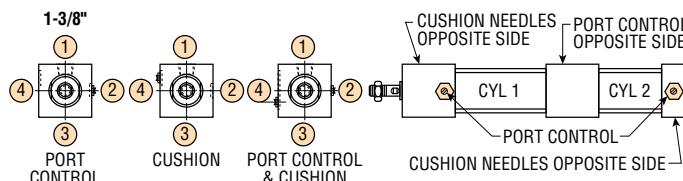
Port Control® and cushion needles are located in position 2 on standard cylinders. They may be located at position 4 when specified on all Series A3, A3V, and H3V. Consult PHD for special Port Control® or cushion needle positions.



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.

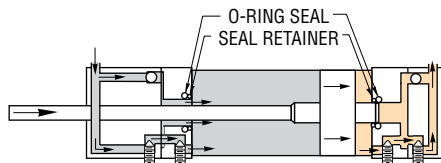


PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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 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

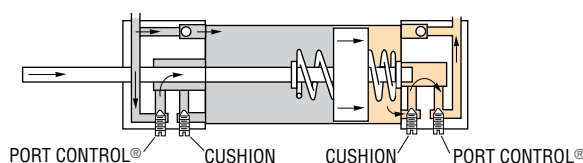


PORT CONTROL® AND ADJUSTABLE CUSHION COMBINATION

(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

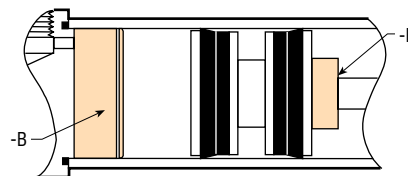
B

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)



A3, A3V, H3V

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:

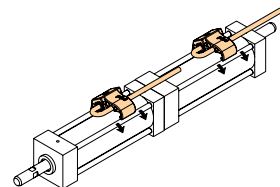
COMPACT HALL EFFECT SWITCHES

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

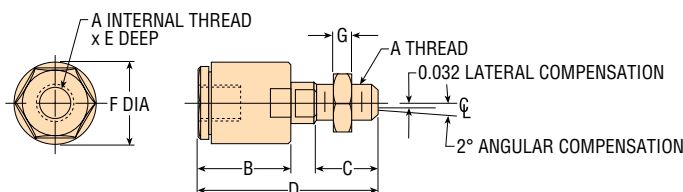
Fluoroelastomer seals are available to achieve seal compatibility with certain fluids. Seal compatibility should be checked with the fluid manufacturer for proper application. Consult PHD for high temperature use.

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

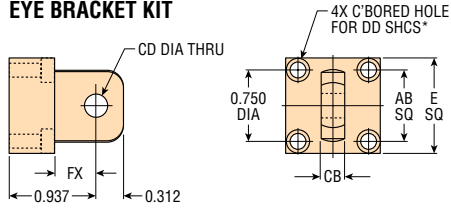
To order, specify the model number.

All dimensions are reference only unless specifically toleranced.

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

A3, A3V, H3V

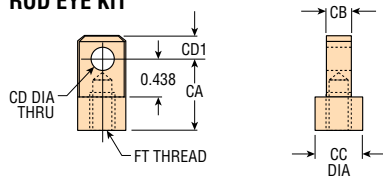
EYE BRACKET KIT



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

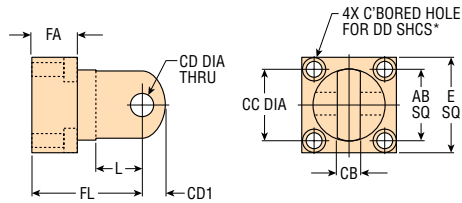
*For 3/4 bore thru hole only.

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	

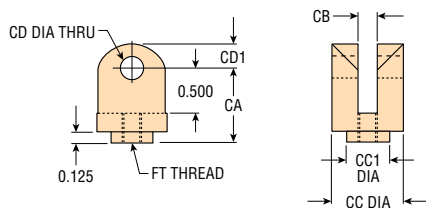
CLEVIS BRACKET KIT - PIN INCLUDED



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

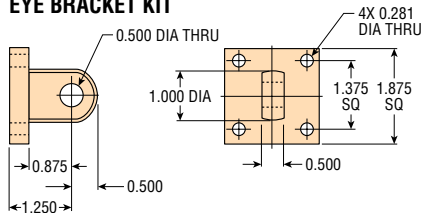
*For 3/4 bore thru hole only.

ROD CLEVIS KIT - PIN INCLUDED



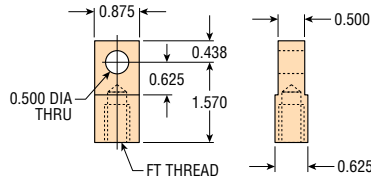
BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION						
			CA	CB	CC	CC1	CD	CD1	FT
3/4	A3, A3V, H3V	12904	0.812	0.254	0.750	0.437	0.250	0.250	1/4-28 TO SLOT
1	A3	12905	0.875	0.379	0.875	0.562	0.250	0.375	5/16-24 TO SLOT
	A3V, H3V	12906	0.875	0.379	0.875	0.562	0.375	0.375	5/16-24 TO SLOT
1-1/8	A3	12907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



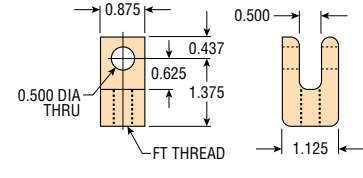
BORE SIZE	CYLINDER SERIES	PART NO.
1-3/8	A3V, H3V	1330

ROD EYE KIT



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

EA, EL, EH, ES



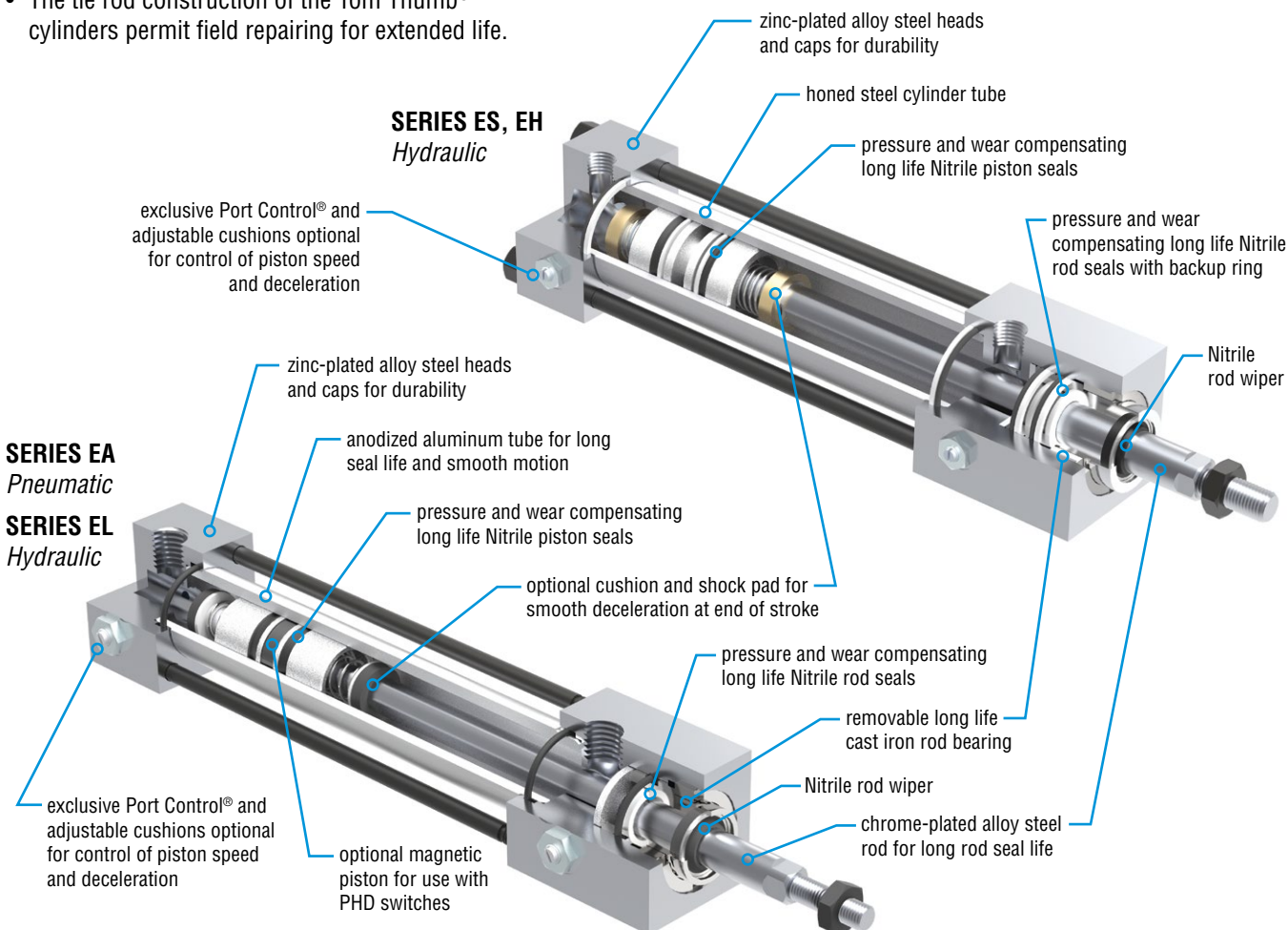
tom thumb®

HEAVY DUTY CYLINDERS

EA, EL, EH, ES

Major Benefits

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

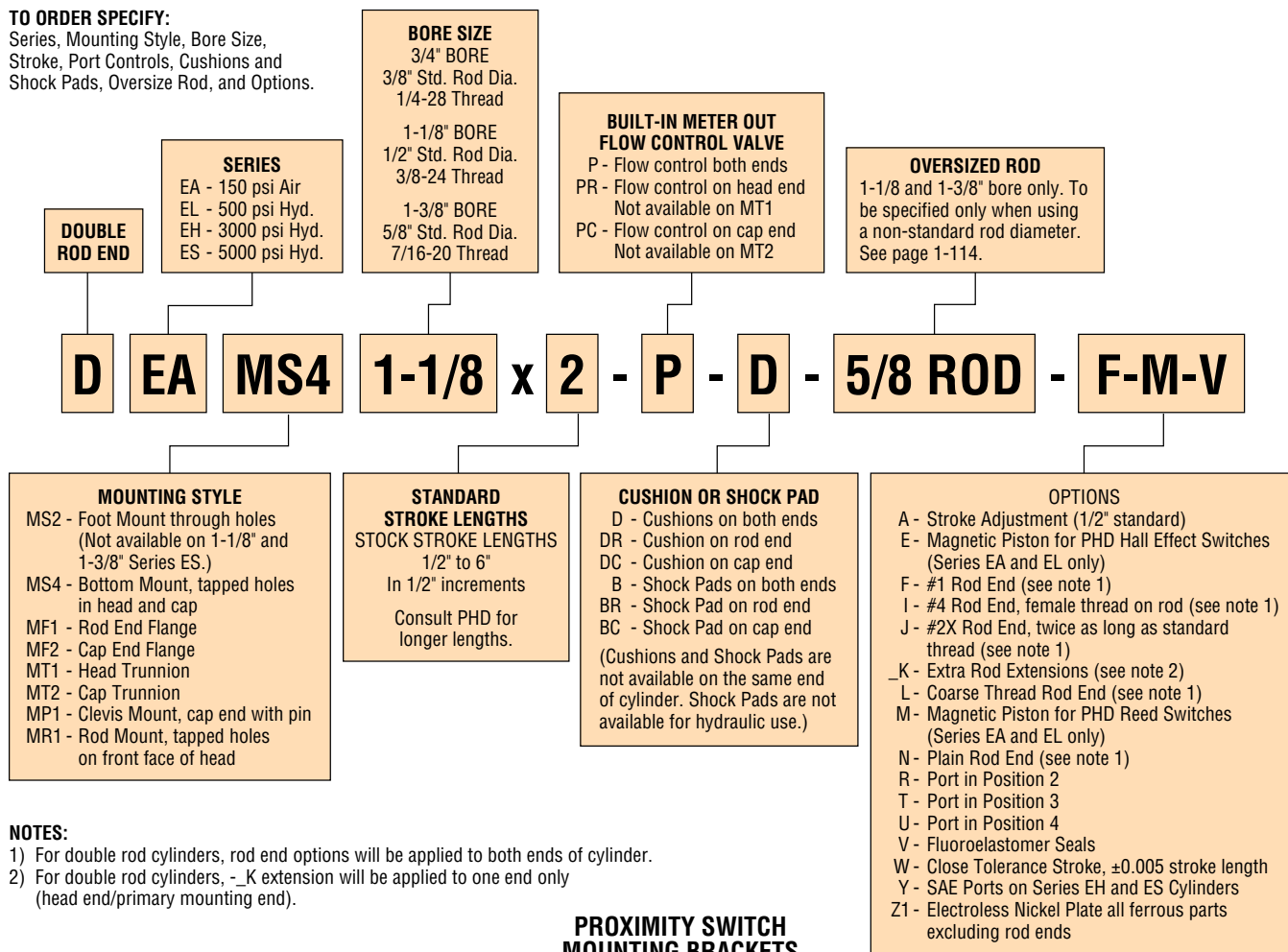


ORDERING DATA: SERIES EA, EL, EH, ES HEAVY DUTY CYLINDERS

TO ORDER SPECIFY:

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

EA, EL, EH, ES



NOTES:

- For double rod cylinders, rod end options will be applied to both ends of cylinder.
- 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.



CAD & Sizing Assistance

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

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

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

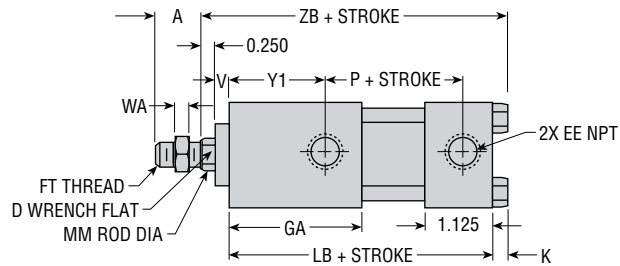
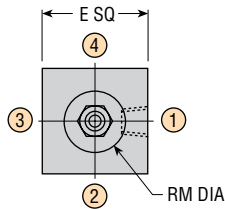
SERIES	AIR MAX. psi	HYDRAULIC	
		MAX. psi	WITH -E OR -M OPTION
EA	150	—	—
EL	—	500	500
EH	—	3000	—
ES	—	5000	—

STROKE TOLERANCE

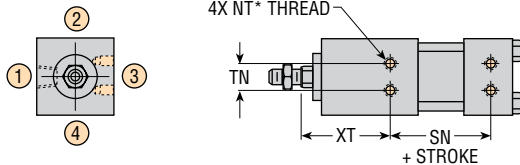
Tolerance on the nominal stroke length is ± 0.032 for all cylinders.

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

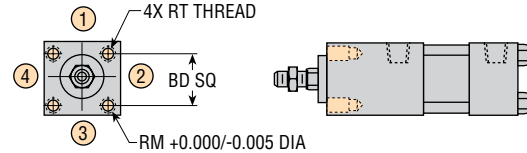
BASIC CYLINDER DIMENSIONS



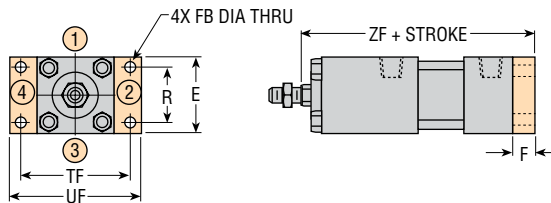
MS4



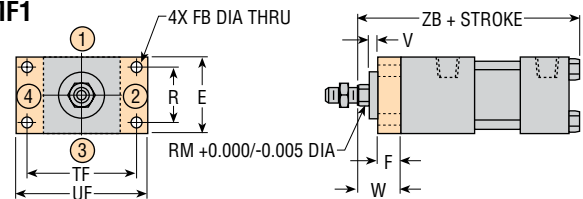
MR1



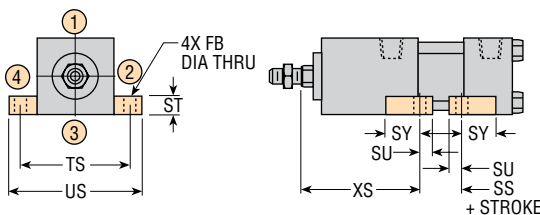
MF2



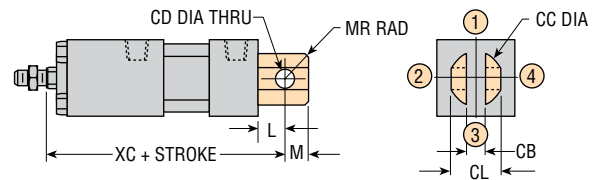
MF1



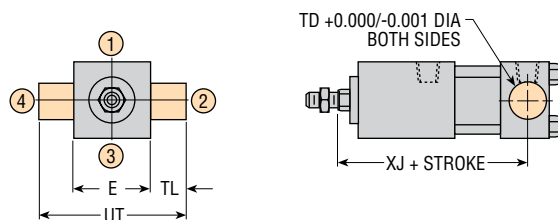
MS2



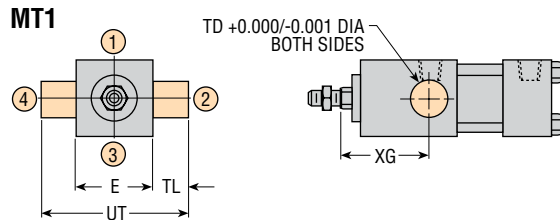
MP1 (CLEVIS PIN INCLUDED)



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*
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
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
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

BORE SIZE	LETTER DIMENSION																			
	RT	SN	SS	ST	SU	SY	TD	TF	TL	TS	TN	UF	US	UT	V	W	WA	XC	XG	XJ
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
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
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

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

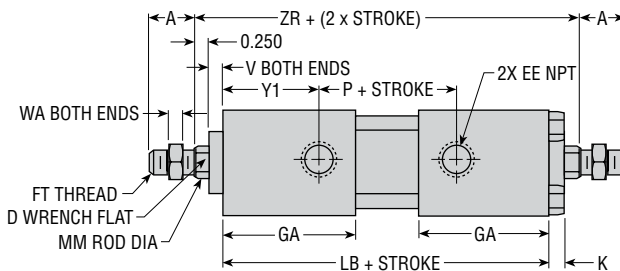
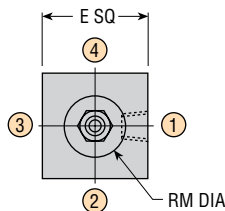
MS2 MTG. STYLE: NOT AVAILABLE ON 1-1/8" & 1-3/8" SERIES ES CYLINDERS

*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

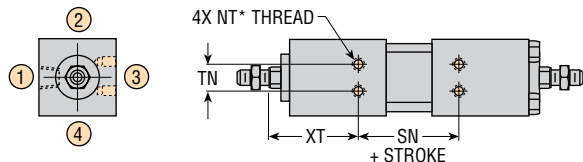
All dimensions are reference only unless specifically toleranced.

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

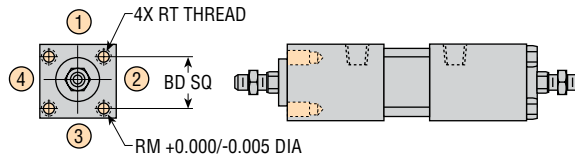
BASIC CYLINDER DIMENSIONS



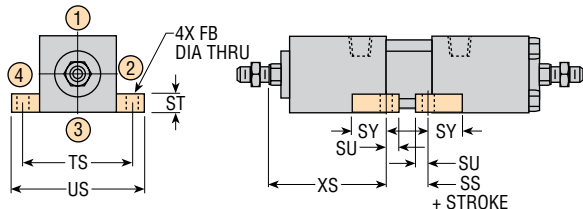
MS4



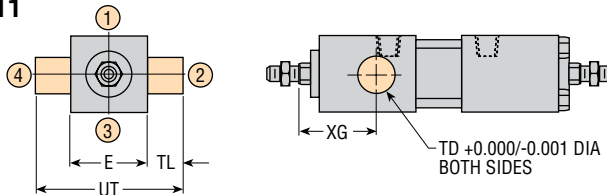
MR1



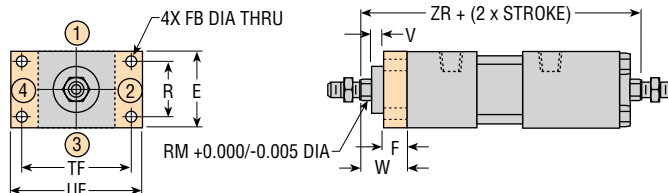
MS2



MT1



MF1



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

BORE	LETTER DIMENSION																
SIZE	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
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
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
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

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.

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

P

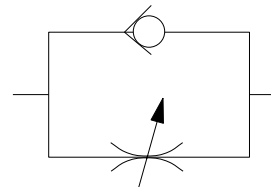
PORT CONTROL®

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

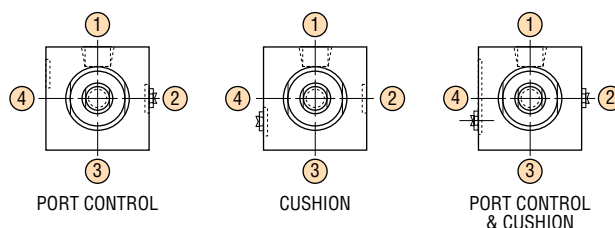
is exhausting from the cylinder, but opens to permit full flow of incoming fluids. The PHD Port Control® provides the optimum in speed control for small bore cylinders. It saves space and eliminates the cost of installation and fittings for external flow control valves.



EA, EL, EH, ES

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.



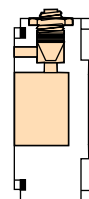
D

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.

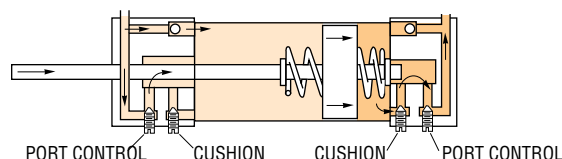
See dimension pages for dimensional information.
Series E = Poppet Style

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.



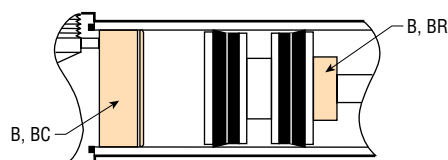
B

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

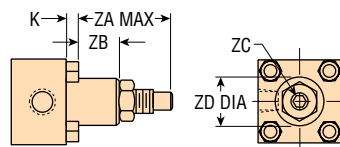
A

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

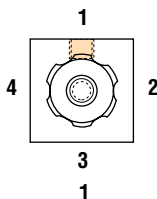


BORE SIZE	LETTER DIMENSION				
	K	ZA	ZB	ZC	ZD
3/4	0.000	2.219	1.125	1/8 HEX	0.750
1-1/8	0.250	2.125	0.875	1/4 HEX	1.000
1-3/8	0.312	2.125	0.812	1/4 HEX	1.250

PORT POSITIONS

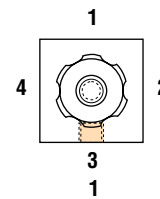
Port position 1 is standard on all cylinders.

PORT POSITION 1 (STANDARD)



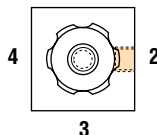
T

PORT POSITION 3



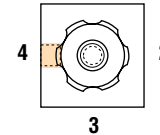
R

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:

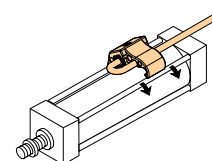
COMPACT HALL EFFECT SWITCHES

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)

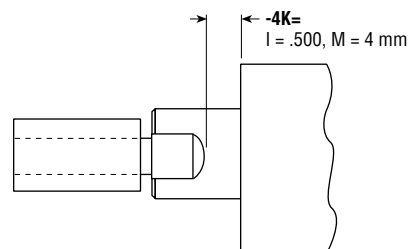
-4K = 1/2 of extra rod extension

-8K = 1, etc.

Length code example (for metric units)

-4K = 4 mm of extra rod extension

-12K = 12 mm, etc.



EA, EL, EH, ES

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.

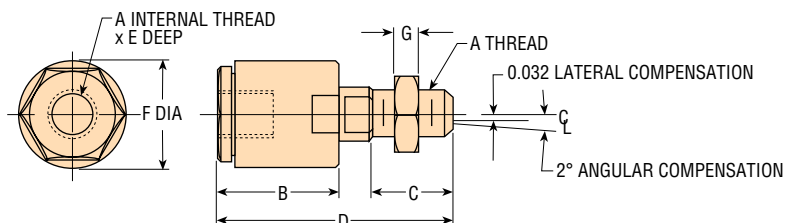
Cylinder efficiency is increased by eliminating friction caused by misalignment. Couplers compensate for 2° angular error and 1/32" lateral misalignment on push and pull stroke. (Miniature Couplers compensate for 1° of angular error.)

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.

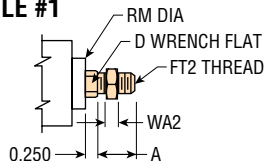
MODEL NO.	LETTER DIMENSION						
	A	B	C	D	E	F	G
250	1/4-28	1.000	0.625	1.875	0.500	0.875	0.156
312	5/16-24	1.000	0.625	1.875	0.500	0.875	0.187
375	3/8-24	1.000	0.625	1.875	0.500	0.875	0.219
437	7/16-20	1.125	0.750	2.187	0.500	1.000	0.250
500	1/2-20	1.125	0.750	2.187	0.500	1.000	0.312
625	5/8-18	1.750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



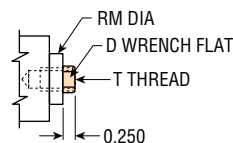
All dimensions are reference only unless specifically toleranced.

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

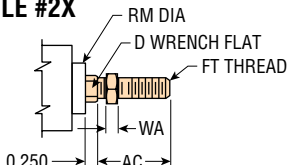
F ROD END STYLE #1



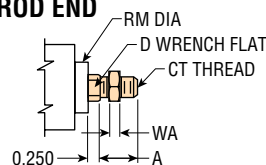
I ROD END STYLE #4



J ROD END STYLE #2X



L COARSE THREAD ROD END



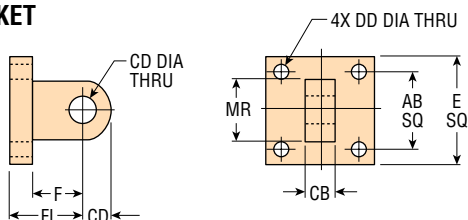
CLEVIS BRACKET - PIN INCLUDED

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).

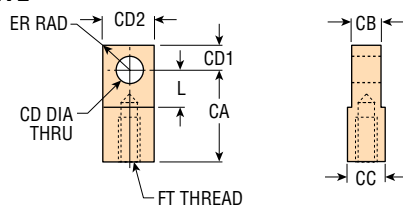
E SERIES MOUNTING ATTACHMENTS

EYE BRACKET



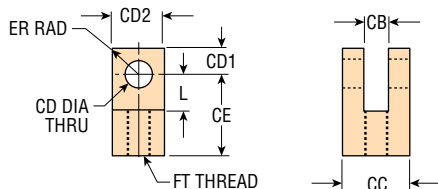
BORE SIZE	PART NO.	LETTER DIMENSION							
		AB	CB	CD	DD	E	F	FL	MR
3/4	2412-01	1.000	0.375	0.375	0.219	1.375	0.812	1.125	0.750
1-1/8	1330	1.375	0.500	0.500	0.281	1.875	0.875	1.250	1.000
1-3/8	2412-02	1.625	0.625	0.625	0.344	2.250	1.062	1.562	1.250

ROD EYE



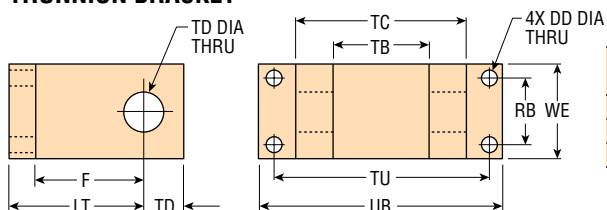
BORE SIZE	PART NO.	LETTER DIMENSION								
		CA	CB	CC	CD	CD1	CD2	ER	FT	L
3/4	2414-01	1.500	0.375	0.500	0.375	0.375	0.750	0.531	1/4-28 x 0.75 DP	0.562
1-1/8	1375-01	1.562	0.500	0.625	0.500	0.438	0.875	0.625	3/8-24 x 0.75 DP	0.625
1-3/8	2414-02	2.000	0.625	0.750	0.625	0.625	1.250	0.906	7/16-20 x 1.00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

NPG, NHG



tom thumb®

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



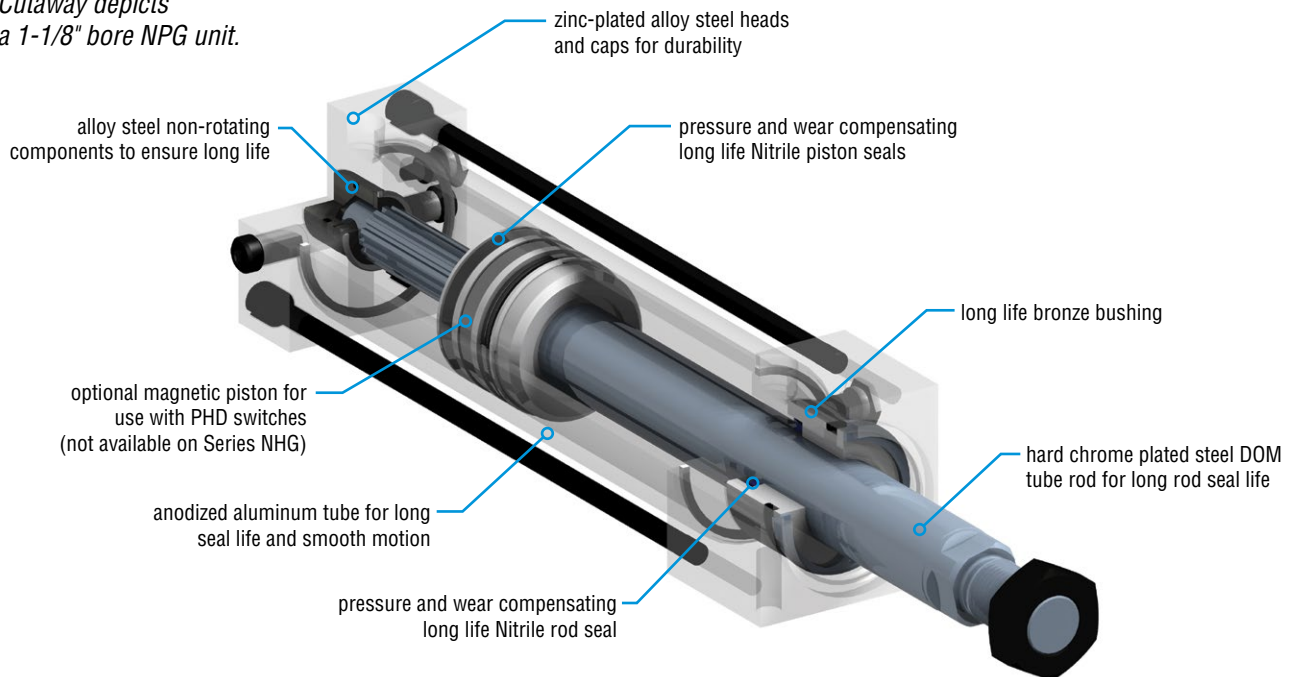
NPG, NHG

Major Benefits

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

Series NP

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



ORDERING DATA: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

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

SPRING RETURN

SC - Spring on cap end
SR - Spring on rod end

(Spring Return available on Series NPG Cylinders up to 3" of stroke in 1/4" increments.)

MOUNTING STYLE

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

STANDARD STROKE LENGTHS
STOCK STROKE LENGTHS
1/2" to 18"
in 1/2" increments

Longer strokes available, consult PHD.

SHOCK PAD

B - Shock Pads on both ends
BR - Shock Pad on rod end
BC - Shock Pad on cap end

Shock Pads and Spring Return are not available on the same end of cylinder. Shock Pads are not available for Hydraulic use.

SC

NPG

MF1

1-1/8

x

2

-

P

-

B

-

N-V-Z1

CYLINDER SERIES

NPG - 1500 psi Air
NHG - 1500 psi Hydraulic

BORE SIZE

1-1/8" BORE
5/8" Rod Dia.
7/16-20 Threads

1-3/8" BORE
3/4" Rod Dia.
9/16-18 Threads

PORT CONTROL® BUILT-IN METER OUT FLOW CONTROL VALVE

P - Flow control both ends
PR - Flow control on head end
PC - Flow control on cap end

OPTIONS

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

NOTE:

SAE Ports available. Consult PHD for sizes.

PROXIMITY SWITCH MOUNTING BRACKETS

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

See Switches and Sensors section for complete ordering information.



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



CAD & Sizing Assistance

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

ENGINEERING DATA: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

NPG, NHG

SPECIFICATIONS	SERIES NPG	SERIES NHG
OPERATING PRESSURE	20 to 150 psi air	40 to 1500 psi hyd*
OPERATING TEMPERATURE	-20° to +180°F [-29° to +82°C]	-20° to +180°F [-29° to +82°C]
STROKE TOLERANCE	±0.032	±0.032
REPEATABILITY	±0.001 of original position	±0.001 of original position
LUBRICATION	Permanently lubricated	—
MAINTENANCE	Field repairable	Field repairable

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

CYLINDER FORCE AND WEIGHT TABLE

BORE	ROD DIAMETER in	ROD DIRECTION	EFFECTIVE AREA FORCE lb/psi	AIR CONSUMPTION at 80 psi CUBIC ft/in OF STROKE	DISPLACEMENT gal/in OF STROKE*	BASE WEIGHT	ADDER PER 1" OF STROKE
1-1/8	5/8	EXTEND	0.994	0.0037	0.0043	1.55	0.14
		RETRACT	0.687	0.0026	0.0300		
1-3/8	3/4	EXTEND	1.485	0.0055	0.0064	2.16	0.19
		RETRACT	1.043	0.0039	0.0045		

MAXIMUM ALLOWABLE EXTEND STROKE

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

CYLINDER FORCE CALCULATIONS

Imperial

$$F = P \times A$$

F = Cylinder Force lbs

P = Operating Pressure psi

A = Effective Area in²
(Extend or Retract)



Application & Sizing Assistance

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

SIDELOADING

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

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

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

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

TORSION AND BACKLASH

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

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

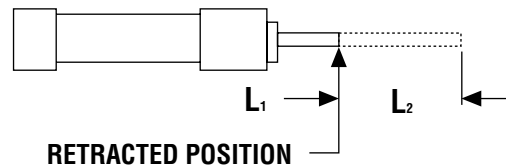
BORE	SERIES	K ₁	K ₂	C
1-1/8	NP	8.7	34.8	0.18
1-3/8	NP	15.6	74.8	0.10

WHERE:

θ = Angular deflection in minutes of arc

T = Torque applied (in-lb)

L₁ = Distance that rod is extended



L₂ = Stroke length

K₁ = Constant reflecting the polar moment of inertia and the modulus of rigidity for the spline rod

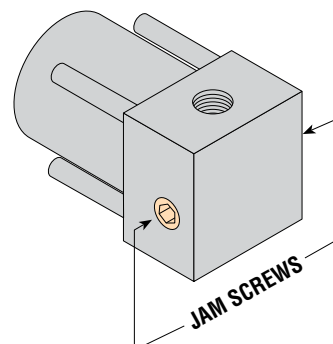
K₂ = Constant reflecting the polar moment of inertia and the modulus of rigidity for the piston rod

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

MAXIMUM ALLOWABLE TORQUE

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

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

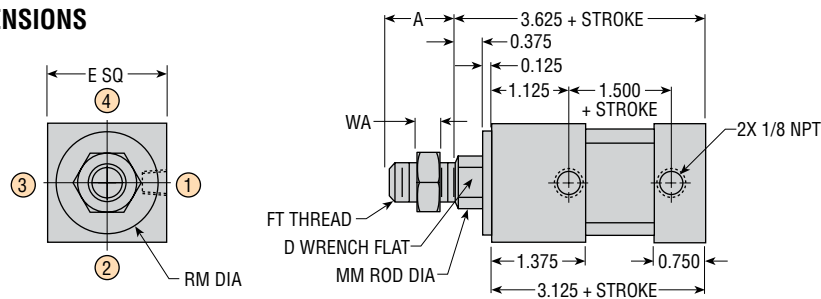


All dimensions are reference only unless specifically toleranced.

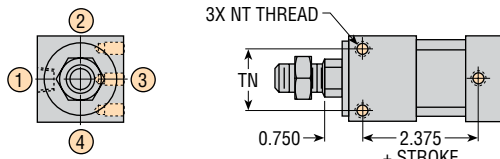
DIMENSIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

NPG, NHG

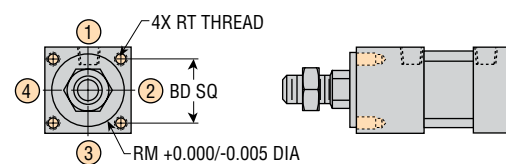
BASIC CYLINDER DIMENSIONS



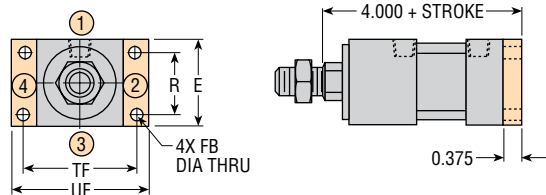
MS9



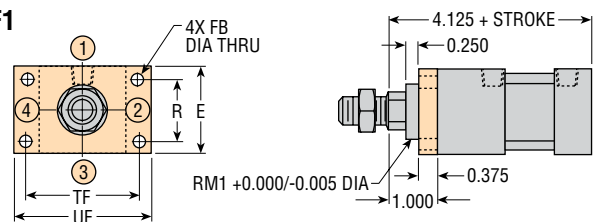
MR1



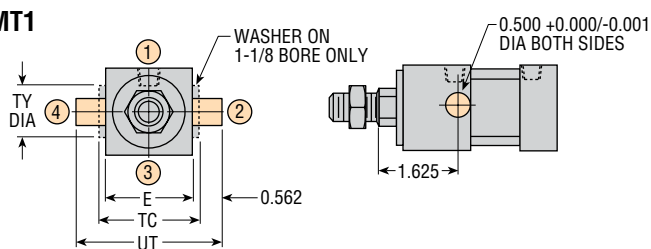
MF2



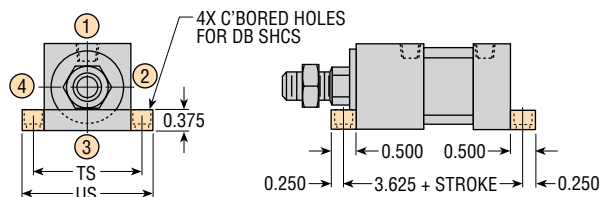
MF1



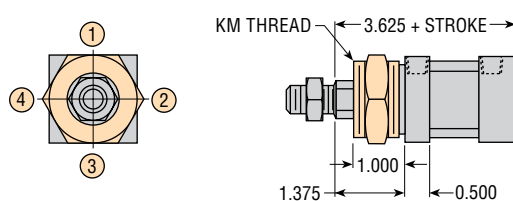
MT1



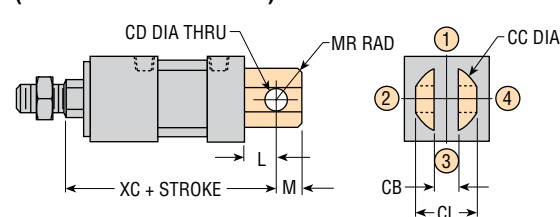
MS10



MN1



MP1 (CLEVIS PIN INCLUDED)



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	DB	E	FB	FT	KM	L	M	MM	MR
1-1/8	0.750	1.125	0.375	0.875	0.375	0.875	0.500	#10	1.500	0.219	7/16-20	1-1/4-12	0.750	0.375	0.625	0.440
1-3/8	1.000	1.375	0.500	1.250	0.500	1.125	0.625	1/4	1.750	0.281	9/16-18	1-1/2-12	0.625	0.500	0.750	0.720

BORE SIZE	LETTER DIMENSION										
	RM1	RT	TC	TF	TN	TS	TY	UF	US	UT	WA
1-1/8	1.000	10-32 x 0.25 DP	1.750	2.000	1.000	1.875	1.000	2.500	2.250	2.625	0.250
1-3/8	1.125	1/4-28 x 0.38 DP	N/A	2.250	1.250	2.188	N/A	2.750	2.625	2.875	0.312

PORT POSITIONS: INDICATED BY CIRCLED NUMBERS

SHOCK PADS: ADD 0.25 in TO ALL (+ STROKE) DIMENSIONS FOR EACH SHOCK PAD

SPRING RETURN: ADD ADDITIONAL STROKE LENGTH TO ALL (+ STROKE) DIMENSIONS (2 x STROKE)

All dimensions are reference only unless specifically toleranced.

OPTIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

SR

SC

SPRING RETURN

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

Available with all options EXCEPT:

- Cushion on the spring end
- Shock pad on the spring end
- Stroke adjustment on the spring end

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

W

CLOSE TOLERANCE STROKE

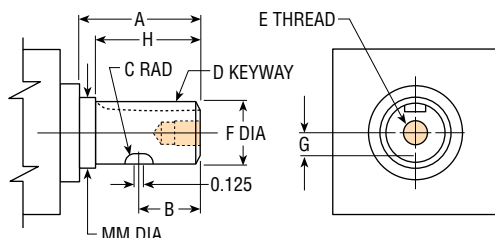
This option may be specified when a precise stroke length is required and stroke adjustment is not acceptable. By specifying this option, a stroke length with a tolerance of ± 0.005 will be supplied. Standard stroke tolerance is ± 0.032 .

Maximum stroke for cylinders with close tolerance is 18".

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

H

PLAIN KEYED ROD ENDS



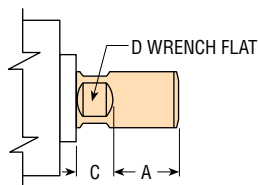
BORE SIZE	LETTER DIMENSION								
	A	B	C	D	E	F	G	H	MM
1-1/8	1.500	0.375	0.156	1/8 x 1/16 x 1.00	10-32 x 0.31 DP	0.500	0.094	1.375	0.625
1-3/8	1.625	0.812	0.219	3/16 x 3/32 x 1.10	5/16-24 x 0.44 DP	0.750	0.156	N/A	N/A

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

N

PLAIN ROD END

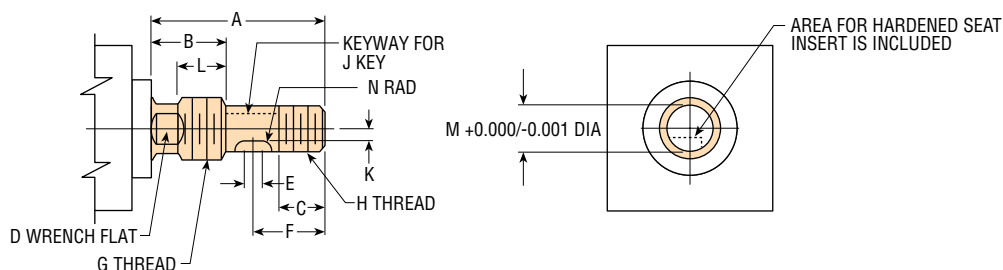
All standard rod ends have four wrench flats.



BORE SIZE	ROD DIA	LETTER DIMENSION		
		A	B	D
1-1/8	0.625	0.970	0.530	1/2
1-3/8	0.750	1.095	0.530	5/8

S

KEYED AND THREADED ROD ENDS



KEYWAY ORIENTATION: FULLY ADJUSTABLE
KEY AND JAM NUTS: INCLUDED

BORE SIZE	LETTER DIMENSION												
	A	B	C	D	E	F	G	H	J	K	L	M	N
1-1/8	2.187	1.000	0.562	1/2	0.215	0.852	5/8-18	1/2-20	1/8 x 1/8 x 5/8	0.125	0.625	0.500	0.093
1-3/8	2.375	1.000	0.625	5/8	0.242	0.977	3/4-16	5/8-18	3/16 x 3/16 x 3/4	0.156	0.625	0.625	0.125

All dimensions are reference only unless specifically toleranced.

OPTIONS: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

MAGNETIC PISTON FOR USE WITH PHD PROXIMITY SWITCHES

E

HALL EFFECT SWITCHES

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

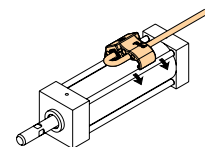
COMPACT HALL EFFECT SWITCHES

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

See Switches and Sensors section for complete switch information.

M

REED SWITCHES



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

COMPACT REED SWITCHES

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

See Switches and Sensors section for complete switch information.

P

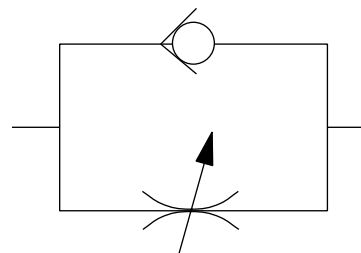
PC

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.

B

BC

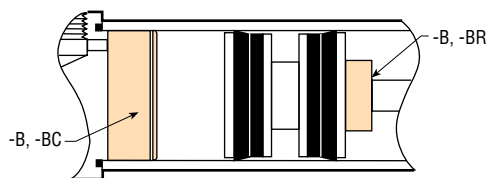
BR

SHOCK PADS

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

Available with all options EXCEPT:

- Same end as Cushion
- Spring end of Spring Return cylinder
- Same end as Stroke Adjustment



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

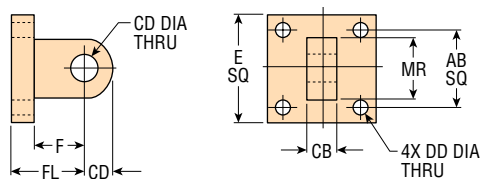
ELECTROLESS NICKEL PLATING

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.

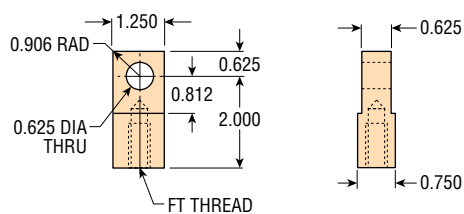
ACCESSORIES: SERIES NPG, NHG CYLINDERS; 1-1/8", 1-3/8" BORE

EYE BRACKET KIT



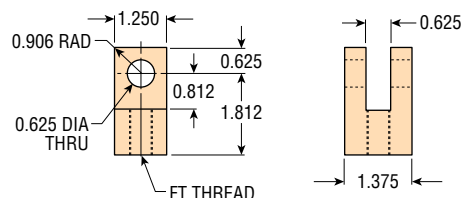
BORE SIZE	CYLINDER SERIES	PART NO.	LETTER DIMENSION							
			AB	CB	CD	DD	E	F	FL	MR
1-1/8	NPG, NHG	2412-01	1.000	0.375	0.375	0.219	1.375	0.812	1.125	0.750
1-3/8	NPG, NHG	1330	1.375	0.500	0.500	0.281	1.875	0.875	1.250	1.000

ROD EYE KIT



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

ROD CLEVIS KIT - PIN INCLUDED



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

All dimensions are reference only unless specifically toleranced.