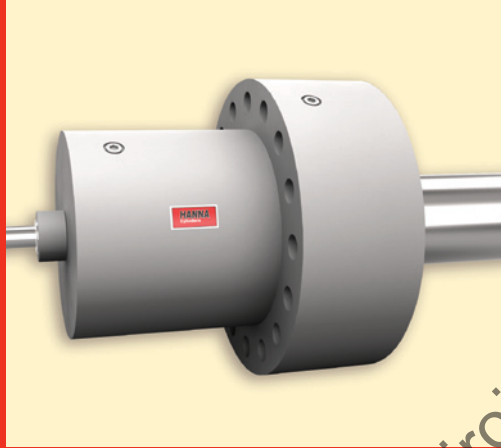


HANNA cylinders



Product Catalog
Catalog #HC-2009-1

**DESIGNING AND MANUFACTURING
CUSTOM CYLINDERS FOR OVER
100 YEARS.**

Designed and built for the demanding applications of the 21st century.

Today, many industrial applications demand more from hydraulic and pneumatic cylinders than ever before.

Greater pressures. Higher speeds. Closer tolerances. Zero leakage performance. Servo/proportional system response. Meeting these high performance demands requires true premium-quality cylinders... such as the product line offered by Hanna Cylinders.

For over a century, Hanna has earned a reputation as industry innovators. We continually strive to stay on the leading edge of motion control technology by utilizing the latest in state-of-the-art designs and materials in our products. What's more, only Hanna Cylinders offers a single source for tie-rod, mill-type and rotating cylinders, as well as custom welded units.

Capabilities. Hanna has over 100 years of experience in engineering and manufacturing custom cylinders. There is no cylinder too big or too small — from 1.5 to 40 inch bore to 400 inch stroke and high-pressure applications up to 10,000 psi. In house painting, specialty coatings, large machining centers, boring mills, honing equipment, 3D modeling, stress calculations, special materials, special seals, ASME U stamp, 10 CFR 50, harsh environment applications and complex cylinders. Every cylinder is 100% tested. In our 170,000-square-foot facility with 25-ton crane capacity, state-of-the-art ERP and quality systems, ***we can handle all of your cylinder requirements.***



Series 2H for Heavy-Duty Service

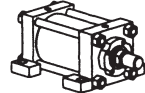
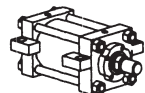
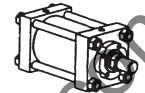
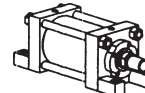
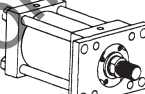
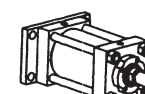
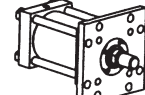
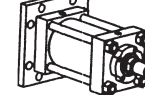
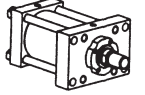
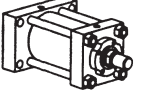
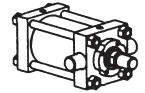
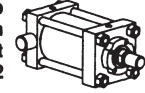
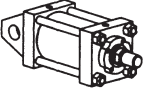
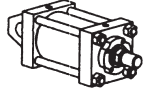
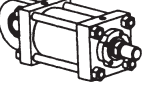
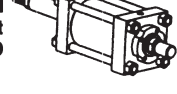
- 1.50" – 14.00" Bores
- Pressure Ratings Up to 3,000 PSI
- N.F.P.A. Interchangeability — 22 Mounting Styles

Series 3L for Medium-Duty Service

- 1.50" – 6.00" Bores
- Pressure Ratings Up to 1,800 PSI
- N.F.P.A. Interchangeability — 24 Mounting Styles

SERIES 2H HEAVY-DUTY HYDRAULIC CYLINDERS

1.50" thru 8.00" Bores

		Description	Page No.			
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HANNA
cylinders

Series 2H Hydraulic Cylinders for Heavy-Duty Service

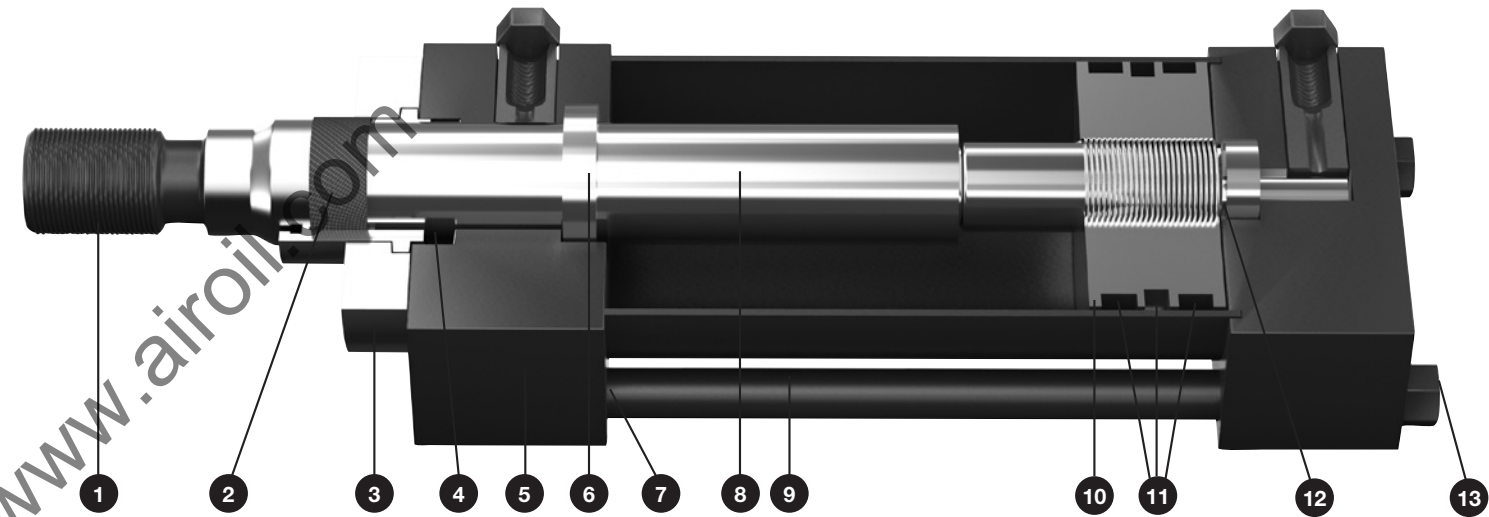
Hanna's Series 2H heavy-duty hydraulic cylinders have been designed for today's higher pressures and faster moving machinery applications.

Ruggedly built, 2H cylinders incorporate many field-proven design features that assure trouble-free performance for millions of cycles. Included are Hanna's unique non-metallic Duralon® rod bearing, and our glass-filled Teflon® O-ring energized piston seal with two bronze-filled bearing strips, completely eliminating metal-to-metal contact at bearing surfaces. This assures long life and extremely low friction. In addition, it makes standard Series 2H cylinders the most suitable units available for applications that demand ruggedness, precision, zero leakage and day-in, day-out performance.

Series 2H cylinders give you virtually unlimited flexibility in machinery design, with a full range of bore sizes (1.50" through 14.00"*) offered. Developed for pressure ratings up to 3000 p.s.i., 2H cylinders are available in 22 N.F.P.A. mounting styles. S.A.E. porting is available at no extra cost.

* Refer to Series 3H Catalog 911 for bore sizes over 14.00". Consult factory for other special requirements.

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Teflon and Dacron are Trademarks of DuPont Company



Series 2H Features and Benefits

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity. Studded rod ends are available.

2. Duralon Rod Bearing

Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings are capable of sustaining much higher compressive loads than either bronze or cast iron, have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

3. Gland Construction

Two-piece (gland plus retainer plate), bolted-on or full-face retainer design. Packings may be captive in the gland or located in the head.

4. Rod Seal

Series 2H cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance. Viton U-cup is available for use with non-petroleum based fluids or for higher temperature service.

5. Heads

Steel heads are precision-machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

6. Cushion Check Seals

Self-aligning, full-floating design, the cushion check seals are closely fitted to cushion sleeve and spear. The seals serve as both cushion seal and check valve, providing effective cushioning and fast breakaway.

7. Tube Seal

Buna-N O-ring seal. Viton available for use with non-petroleum based fluids, or for higher temperature service.

8. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failures. The rods provide 100,000 minimum yield strength in diameters up to 3.50"; 59,000 average yield strength in 4.00" diameter and above. All sizes are hard chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish.

9. Tubing

Steel tubing is precision-honed to a 16-20 micro-inch finish for close tolerance between piston bearing and tube wall.

10. Piston

One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

11. Piston Sealing System

Hanna's glass-filled Teflon, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with U-cup type seals. Bronze-filled bearing strips provide non-metallic bearing points on the piston, assuring long life and extremely low friction.

12. Piston-to-Rod Connection

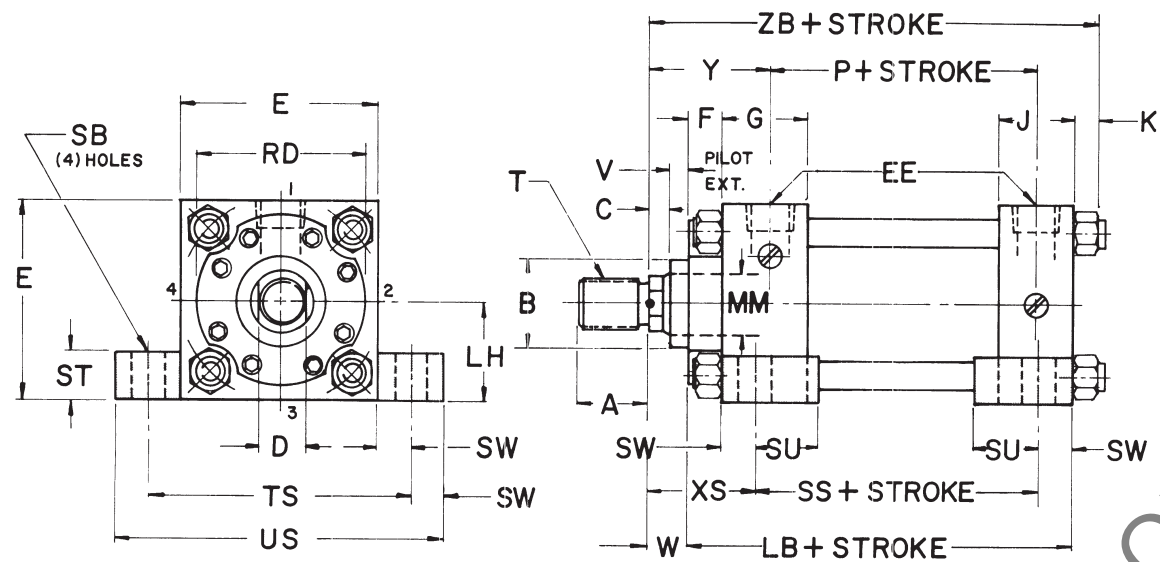
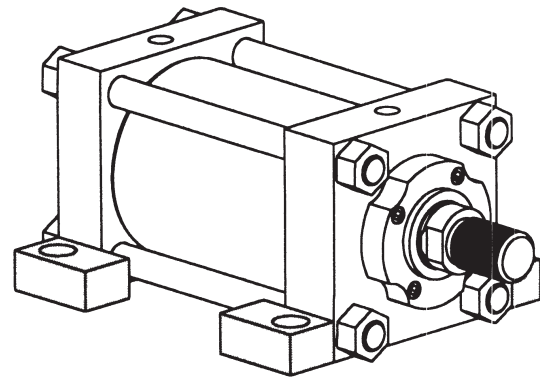
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

13. Tie Rods

Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.

SERIES 2H 1.50"-8.00" Bores MS2 Side Lug Mount

(For 10.00" - 14.00" Bores, see Page 38)



NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	LH -.006 -.008	EE		F	G	J	K	LB	P	SB	SS	ST	SU	SW	TS ±.010	US
			SAE STRAIGHT THREAD	NPTF**													
1.50	2.50	1.250	#8 (750-16)	1/2	38	1.75	1.50	.31	5.00	2.88	438	3.88	50	.94	38	3.25	4.00
2.00	3.00	1.500	#8 (750-16)	1/2	62	1.75	1.50	.44	5.25	2.88	.562	3.62	.75	1.25	.50	4.00	5.00
2.50	3.50	1.750	#8 (750-16)	1/2	62	1.75	1.50	.44	5.38	3.00	.812	3.38	.94	1.56	.69	4.88	6.25
3.25	4.50	2.250	#12 (1 062-12)	3/4	75	2.00	1.75	.56	6.25	3.50	.812	4.12	.94	1.56	.69	5.88	7.25
4.00	5.00	2.500	#12 (1 062-12)	3/4	88	2.00	1.75	.56	6.62	3.75	1.062	4.00	1.19	2.00	.88	6.75	8.50
5.00	6.50	3.250	#12 (1 062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25	1.062	4.50	1.19	2.00	.88	8.25	10.00
6.00	7.50	3.750	#16 (1 312-12)	1	1.00*	2.25	2.25	.88	8.38*	4.88	1.312	5.12	1.44	2.50	1.12	9.75	12.00
7.00	8.50	4.250	#20 (1 625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38	1.562	5.75	1.69	2.88	1.38	11.25	14.00
8.00	9.50	4.750	#24 (1 875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12	1.562	6.75	1.69	2.88	1.38	12.25	15.00

* With (K) Rod F = 88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MS2

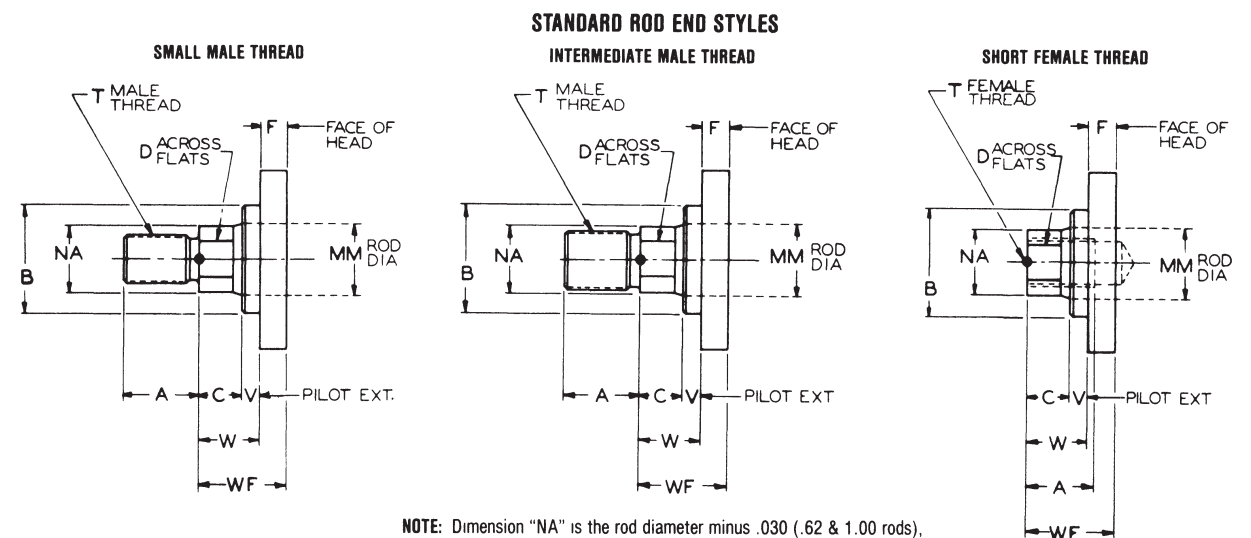
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XS	Y	ZB	PSI RATING†
	ROD DIA. CODE	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	62	75	1.125	38	50	62	-	44-20	50-20	44-20	25	62	1.38	2.00	5.94	3000
	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	50	1.00	1.75	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	25	75	1.88	2.38	6.44	3000
	G	1.38	1.62	2.000	62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	38	1.00	2.12	2.62	6.69	3000
	H	1.75	2.00	2.375	75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	50	1.25	2.56	2.88	7.06	3000
2.50	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	25	75	2.06	2.38	6.56	3000
	G	1.38	1.62	2.000	62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	38	1.00	2.31	2.62	6.81	3000
	H	1.75	2.00	2.375	75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	50	1.25	2.56	2.88	7.06	3000
3.25	G	1.38	1.62	2.000	62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	25	88	2.31	2.75	7.69	3000
	H	1.75	2.00	2.375	75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	38	1.12	2.56	3.00	7.94	3000
	J	2.00	2.25	2.625	88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	38	1.25	2.69	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	25	1.00	2.75	3.00	8.19	3000
	J	2.00	2.25	2.625	88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	25	1.12	2.88	3.12	8.31	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	38	1.38	3.12	3.38	8.56	3000
5.00	J	2.00	2.25	2.625	88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	25	1.12	2.88	3.12	9.00	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	38	1.38	3.12	3.38	9.25	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	38	1.38	3.12	3.38	9.25	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	38	1.38	3.12	3.38	9.25	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	38	1.38	3.38	3.50	10.50	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	25	1.25	3.38	3.50	10.50	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	3.38	3.50	10.50	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	3.38	3.50	10.50	3000
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	25	1.25	3.62	3.81	11.75	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	3.62	3.81	11.75	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	3.62	3.81	11.75	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	25	1.25	3.62	3.81	11.75	3000
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	25	1.25	3.62	3.81	11.75	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	3.62	3.94	12.81	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	3.62	3.94	12.81	3000
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	25	1.25	3.62	3.94	12.81	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	25	1.25	3.62	3.94	12.81	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	25	1.25	3.62	3.94	12.81	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

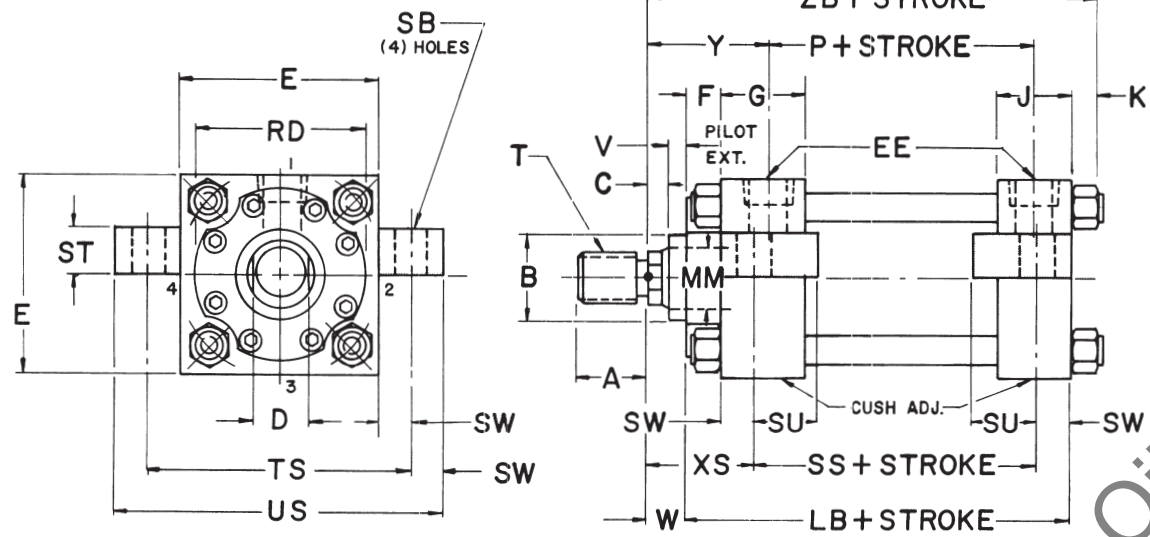
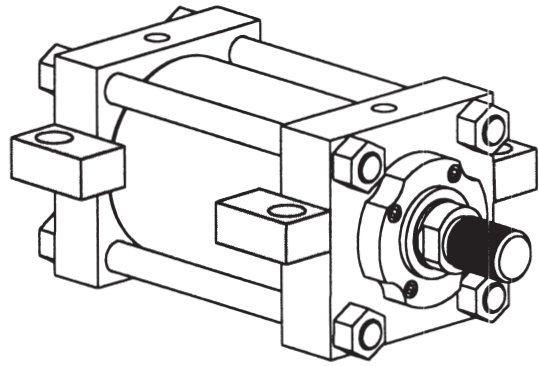
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MS3 Centerline Lug Mount



NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	G	J	K	LB	P	SB	SS	ST	SU	SW	TS ±.010	US
		SAE STRAIGHT THREAD	NPTF**													
1.50	2.50	#8 (750-16)	1/2	38	1.75	1.50	.31	5.00	2.88	438	3.88	.50	94	.38	3.25	4.00
2.00	3.00	#8 (750-16)	1/2	62	1.75	1.50	.44	5.25	2.88	562	3.62	.75	1.25	50	4.00	5.00
2.50	3.50	#8 (750-16)	1/2	62	1.75	1.50	.44	5.38	3.00	812	3.38	.94	1.56	.69	4.88	6.25
3.25	4.50	#12 (1062-12)	3/4	75	2.00	1.75	.56	6.25	3.50	812	4.12	.94	1.56	.69	5.88	7.25
4.00	5.00	#12 (1062-12)	3/4	.88	2.00	1.75	.56	6.62	3.75	1062	4.00	1.19	2.00	.88	6.75	8.50
5.00	6.50	#12 (1062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25	1062	4.50	1.19	2.00	.88	8.25	10.00
6.00	7.50	#16 (1312-12)	1	1.00*	2.25	2.25	.88	8.38*	4.88	1312	5.12	1.44	2.50	1.12	9.75	12.00
7.00	8.50	#20 (1625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38	1562	5.75	1.69	2.88	1.38	11.25	14.00
8.00	9.50	#24 (1875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12	1562	6.75	1.69	2.88	1.38	12.25	15.00

* With (K) Rod F = 88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MS3

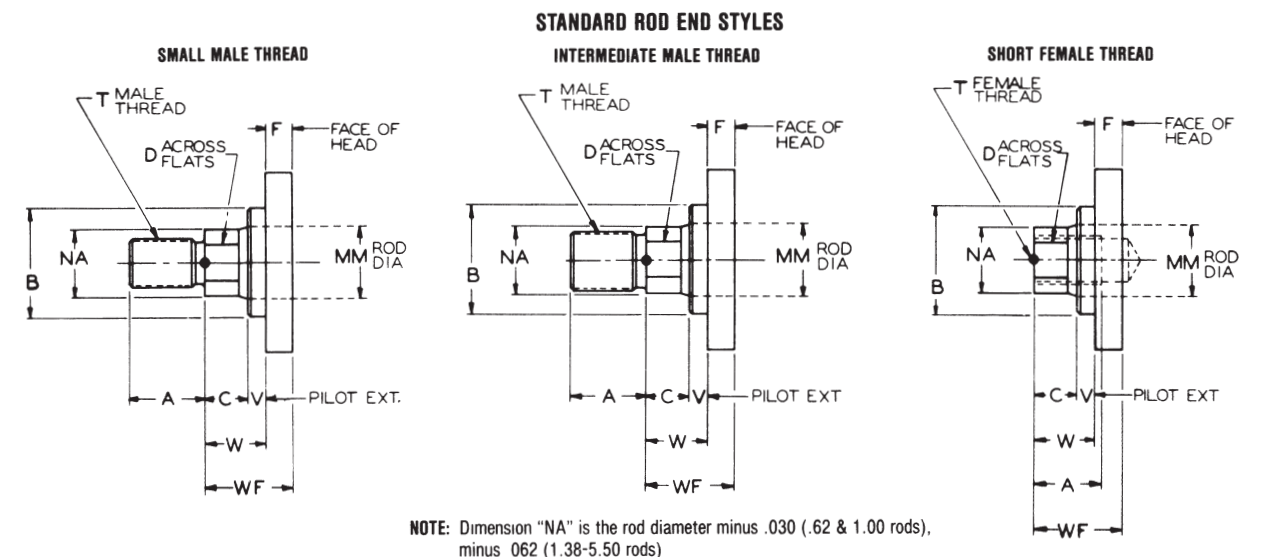
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XS	Y	ZB	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	62	75	1.125	38	50	.62	-	44-20	50-20	44-20	25	.62	1.38	2.00	5.94	3000
	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	50	1.00	1.75	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	25	.75	1.88	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	100-14	125-12	100-14	38	1.00	2.12	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	50	88	1.00	-	75-16	88-14	75-16	25	.75	2.06	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	100-14	125-12	100-14	38	1.00	2.31	2.62	6.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	125-12	150-12	125-12	.50	1.25	2.56	2.88	7.06	3000
3.25	F	1.38	1.62	2.000	.62	1.12	1.38	3.50	100-14	125-12	100-14	25	.88	2.31	2.75	7.69	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	125-12	150-12	125-12	.38	1.12	2.56	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	150-12	175-12	150-12	.38	1.25	2.69	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	125-12	150-12	125-12	.25	1.00	2.75	3.00	8.19	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	150-12	175-12	150-12	25	1.12	2.88	3.12	8.31	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	188-12	225-12	188-12	38	1.38	3.12	3.38	8.56	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	150-12	175-12	150-12	25	1.12	2.88	3.12	9.00	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	188-12	225-12	188-12	38	1.38	3.12	3.38	9.25	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	225-12	275-12	225-12	38	1.38	3.12	3.38	9.25	3000
	M	3.50	4.00	4.250	1.00	3.00	3.50	5.62	250-12	300-12	250-12	38	1.38	3.12	3.38	9.25	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	188-12	225-12	188-12	38	1.38	3.38	3.50	10.50	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	225-12	275-12	225-12	25	1.25	3.38	3.50	10.50	3000
	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	250-12	300-12	250-12	.25	1.25	3.38	3.50	10.50	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	300-12	375-12	300-12	.25	1.25	3.38	3.50	10.50	3000
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	225-12	275-12	225-12	25	1.25	3.62	3.81	11.75	3000
	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	250-12	300-12	250-12	25	1.25	3.62	3.81	11.75	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	300-12	375-12	300-12	25	1.25	3.62	3.81	11.75	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	325-12	425-12	325-12	25	1.25	3.62	3.81	11.75	3000
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	350-12	475-12	350-12	25	1.25	3.62	3.81	11.75	3000
	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	250-12	300-12	250-12	25	1.25	3.62	3.94	12.81	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	300-12	375-12	300-12	25	1.25	3.62	3.94	12.81	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	400-12	525-12	400-12	25	1.25	3.62	3.94	12.81	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

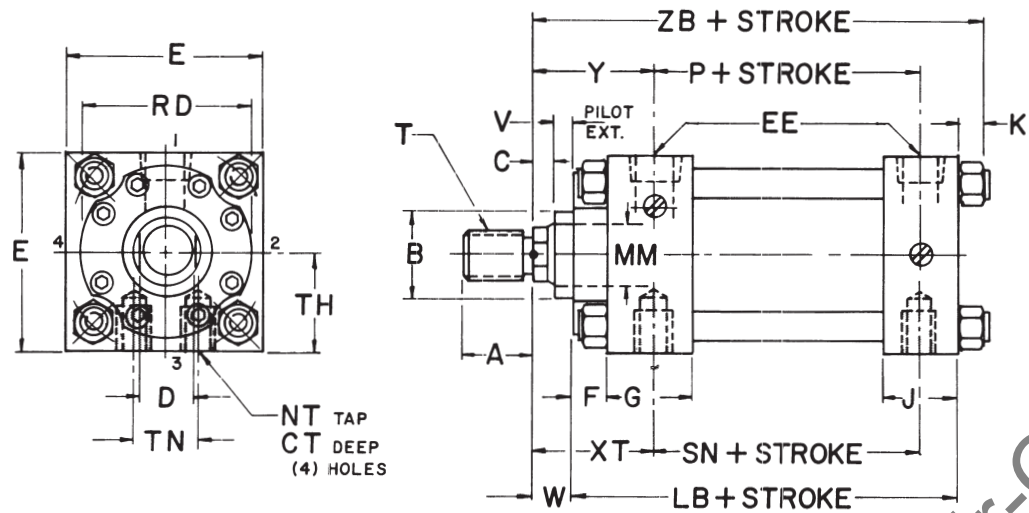
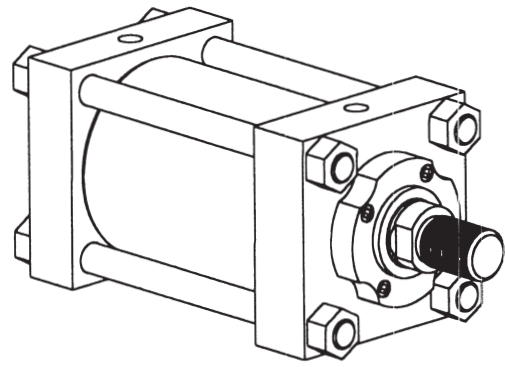
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MS4 Side Tapped Mount



NOTE: For high loads, thrust key is recommended

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	TH -.006 -.008	EE		F	G	J	K	LB	NT	P	SN	TN ±.010
			SAE STRAIGHT THREAD	NPTF**									
1.50	2.50	1.250	#8 (1.750-16)	1/2	38	1.75	1.50	31	5.00	38-16	2.88	2.88	.75
2.00	3.00	1.500	#8 (1.750-16)	1/2	62	1.75	1.50	44	5.25	50-13	2.88	2.88	.94
2.50	3.50	1.750	#8 (1.750-16)	1/2	62	1.75	1.50	.44	5.38	62-11	3.00	3.00	1.31
3.25	4.50	2.250	#12 (1.062-12)	3/4	75	2.00	1.75	56	6.25	75-10	3.50	3.50	1.50
4.00	5.00	2.500	#12 (1.062-12)	3/4	88	2.00	1.75	56	6.62	100-8	3.75	3.75	2.06
5.00	6.50	3.250	#12 (1.062-12)	3/4	88	2.00	1.75	75	7.12	100-8	4.25	4.25	2.94
6.00	7.50	3.750	#16 (1.312-12)	1	100*	2.25	2.25	88	8.38*	125-7	4.88	5.12	3.31
7.00	8.50	4.250	#20 (1.625-12)	1 1/4	100	2.75	2.75	1.00	9.50	150-6	5.38	5.88	3.75
8.00	9.50	4.750	#24 (1.875-12)	1 1/2	100	3.00	3.00	1.06	10.50	150-5	6.12	6.62	4.25

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MS4

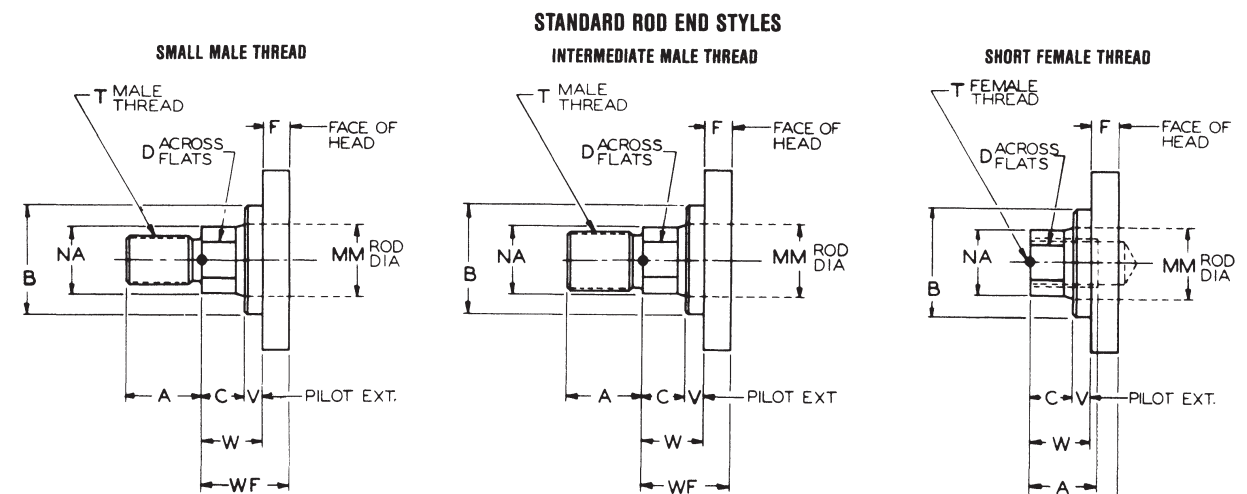
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	CT	XT	Y	ZB	PSI RATING†
	ROD DIA. CODE	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	62	75	1.125	38	50	62	-	44-20	50-20	44-20	.25	62	.56	2.00	2.00	5.94	3000
	F	1.00	1.12	1.500	50	.88	1.00	-	75-16	.88-14	75-16	.50	1.00	.44	2.38	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	50	.88	1.00	-	75-16	.88-14	75-16	.25	75	.62	2.38	2.38	6.44	3000
	G	1.38	1.62	2.000	62	1.12	1.38	-	100-14	1.25-12	100-14	.38	1.00	.44	2.62	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	50	.88	1.00	-	75-16	.88-14	75-16	.25	.75	.69	2.38	2.38	6.56	3000
	G	1.38	1.62	2.000	62	1.12	1.38	-	100-14	1.25-12	100-14	.38	1.00	.44	2.62	2.62	6.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	.44	2.88	2.88	7.06	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	.81	3.00	2.75	7.69	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	.81	3.75	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	.75	3.12	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	.88	3.00	3.00	8.19	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	.75	3.12	3.12	8.31	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	.75	3.38	3.38	8.56	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	1.31	3.12	3.12	9.00	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	1.31	3.38	3.38	9.25	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	.81	3.38	3.38	9.25	3000
6.00	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	2.50-12	2.75-12	2.50-12	.25	1.25	1.38	3.81	3.81	11.75	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	1.38	3.81	3.81	11.75	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	.88	3.81	3.81	11.75	3000
7.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	.88	3.81	3.81	11.75	3000
	M	3.50	3.50	3.750	1.00	3.00	3.50	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	2.00	3.94	3.94	12.81	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.00	3.94	3.94	12.81	3000
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	1.38	3.94	3.94	12.81	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	1.38	3.94	3.94	12.81	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	1.38	3.94	3.94	12.81	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

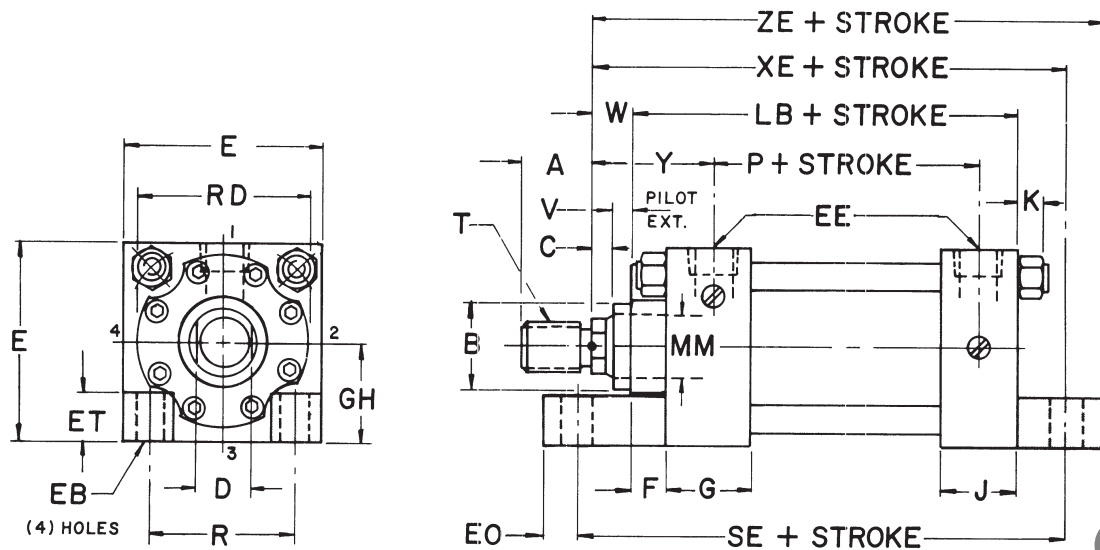
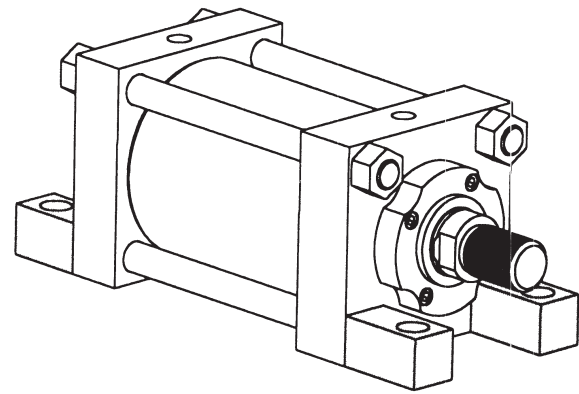
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MS7 End Lug Mount



NOTE Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	GH -.006 -.008	EB	EE		EO	ET	F	G	J	K	LB	P	R ±.010	SE
				SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	1.250	.44	#8 (750-16)	1/2	.38	.88	.38	1.75	1.50	.31	5.00	2.88	1.63	6.75
2.00	3.00	1.500	.56	#8 (750-16)	1/2	.50	.94	.62	1.75	1.50	.44	5.25	2.88	2.05	7.12
2.50	3.50	1.750	.56	#8 (750-16)	1/2	.50	.94	.62	1.75	1.50	.44	5.38	3.00	2.55	7.25
3.25	4.50	2.250	.69	#12 (1 062-12)	3/4	.62	1.25	.75	2.00	1.75	.56	6.25	3.50	3.25	8.50
4.00	5.00	2.500	.69	#12 (1 062-12)	3/4	.62	1.19	.88	2.00	1.75	.56	6.62	3.75	3.82	8.88
5.00	6.50	3.250	.94	#12 (1 062-12)	3/4	.88	1.50	.88	2.00	1.75	.75	7.12	4.25	4.95	10.12
6.00	7.50	3.750	1.06	#16 (1 312-12)	1	1.00	1.75	1.00*	2.25	2.25	.88	8.38*	4.88	5.73	11.75
7.00	8.50	4.250	1.19	#20 (1 625-12)	1 1/4	1.12	1.88	1.00	2.75	2.75	1.00	9.50	5.38	6.58	13.12
8.00	9.50	4.750	1.31	#24 (1 875-12)	1 1/2	1.25	2.00	1.00	3.00	3.00	1.06	10.50	6.12	7.50	14.50

CAUTION Check for interference between rod attachment and mounting lug

Specify longer than standard "C" dimension if necessary

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

MS7

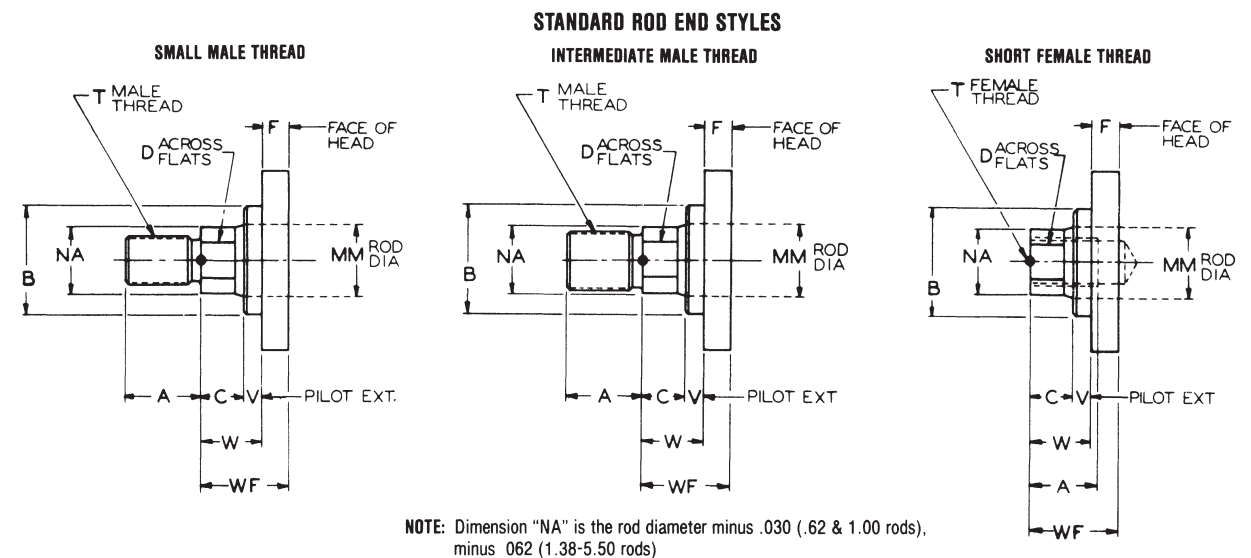
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XE	Y	ZE	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	44-20	50-20	.44-20	.25	.62	6.50	2.00	6.88	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	75-16	.88-14	.75-16	.50	1.00	6.88	2.38	7.25	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	75-16	.88-14	.75-16	.25	.75	6.94	2.38	7.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.19	2.62	7.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	75-16	.88-14	.75-16	.25	.75	7.06	2.38	7.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.31	2.62	7.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.56	2.88	8.06	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	8.25	2.75	8.88	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.50	3.00	9.12	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	8.62	3.12	9.25	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	8.75	3.00	9.38	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	8.88	3.12	9.50	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	9.12	3.38	9.75	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	9.75	3.12	10.62	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	10.00	3.38	10.88	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	10.00	3.38	10.88	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	10.00	3.38	10.88	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	11.31	3.50	12.31	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	11.31	3.50	12.31	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	11.31	3.50	12.31	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	11.31	3.50	12.31	3000
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	12.56	3.81	13.69	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	12.56	3.81	13.69	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	12.56	3.81	13.69	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	12.56	3.81	13.69	3000
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	12.56	3.81	13.69	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	13.75	3.94	15.00	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	13.75	3.94	15.00	3000
8.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	13.75	3.94	15.00	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	13.75	3.94	15.00	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	13.75	3.94	15.00	3000
8.00	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	13.75	3.94	15.00	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

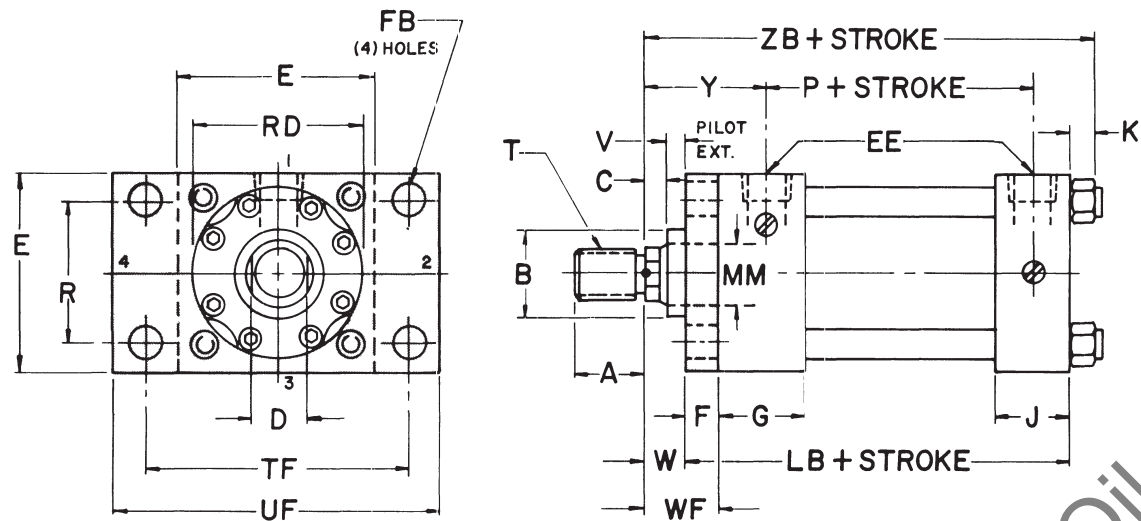
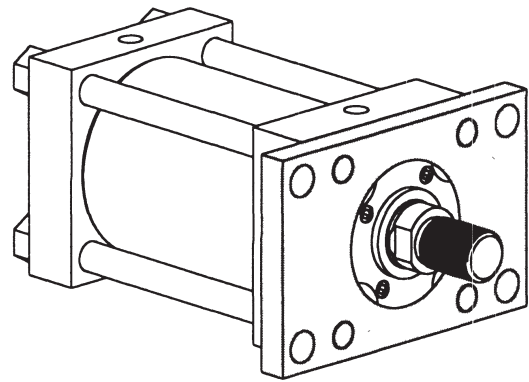
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MF1 Head Rectangular Flange Mount



MF1

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA.	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	44-20	.25	.62	1.00	2.00	5.94	1300
	F	1.00	1.12	1.500	.50	.88	1.00	-	75-16	.88-14	75-16	.50	1.00	1.38	2.38	6.31	950
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.44	1950
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.69	1300
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.56	1650
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.81	1250
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	7.06	925
	J	2.00	2.25	2.625	.88	1.69	2.00	-	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	8.06	1050
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.25	1.00	1.88	3.00	8.19	1350
	J	2.00	2.25	2.625	.88	1.69	2.00	-	1.50-12	1.75-12	1.50-12	.25	1.12	2.00	3.12	8.31	1200
5.00	K	2.50	3.00	3.125	1.00	2.06	2.50	-	1.88-12	2.25-12	1.88-12	.38	1.38	2.25	3.38	8.56	950
	M	3.50	4.250	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.25	1.25	2.25	3.38	9.25	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	-	1.88-12	2.25-12	1.88-12	.38	1.38	2.25	3.38	9.25	850
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	2.25	3.50	9.25	250
7.00	M	3.50	4.250	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	2.25	3.81	11.75	300
	N	4.00	4.750	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.25	3.81	11.75	300
8.00	P	4.50	5.250	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	2.25	3.81	11.75	150
	R	5.00	5.750	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	2.25	3.81	11.75	150
8.00	M	3.50	4.250	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	2.25	3.94	12.81	275
	N	4.00	4.750	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.25	3.94	12.81	275
8.00	P	4.50	5.250	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	2.25	3.94	12.81	125
	S	5.50	6.250	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	2.25	3.94	12.81	125

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

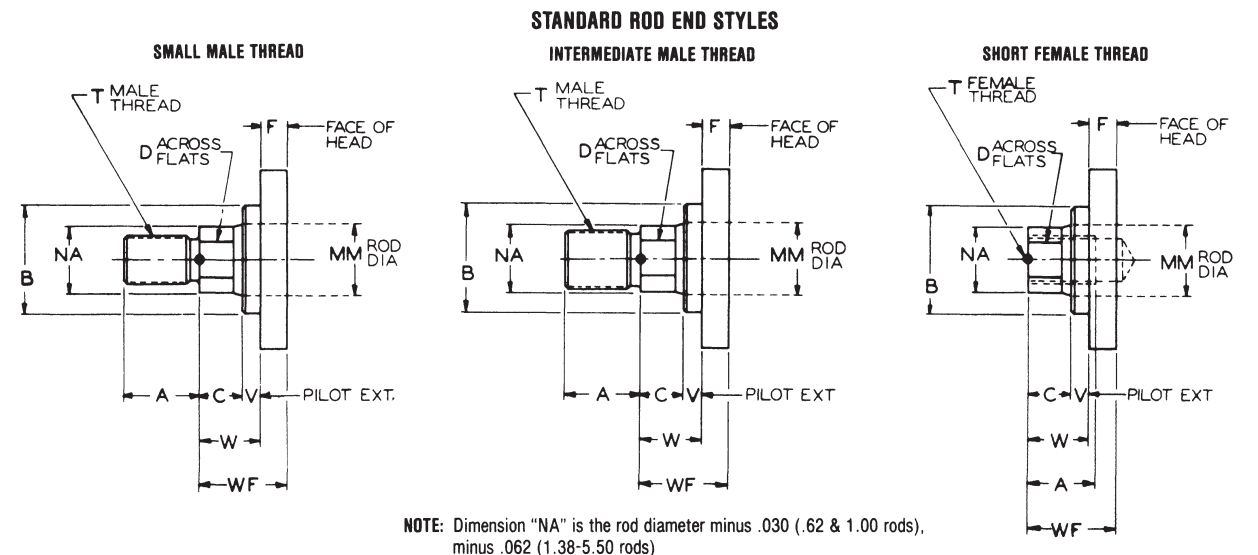
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (750-16)	1/2	.38	.438	1.75	1.50	.31	5.00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (750-16)	1/2	.62	.562	1.75	1.50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (750-16)	1/2	.62	.562	1.75	1.50	.44	5.38	3.00	2.55	4.62	5.62
3.25	4.50	#12 (1.062-12)	3/4	.75	.587	2.00	1.75	.56	6.25	3.50	3.25	5.88	7.12
4.00	5.00	#12 (1.062-12)	3/4	.88	.587	2.00	1.75	.56	6.62	3.75	3.82	6.38	7.62
5.00	6.50	#12 (1.062-12)	3/4	.88	.338	2.00	1.75	.75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1.312-12)	1	1.00	1.062	2.25	2.25	.88	8.38*	4.88	5.73	9.44	11.25
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	1.00	9.50	5.38	6.58	10.62	12.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	1.06	10.50	6.12	7.50	11.81	14.00

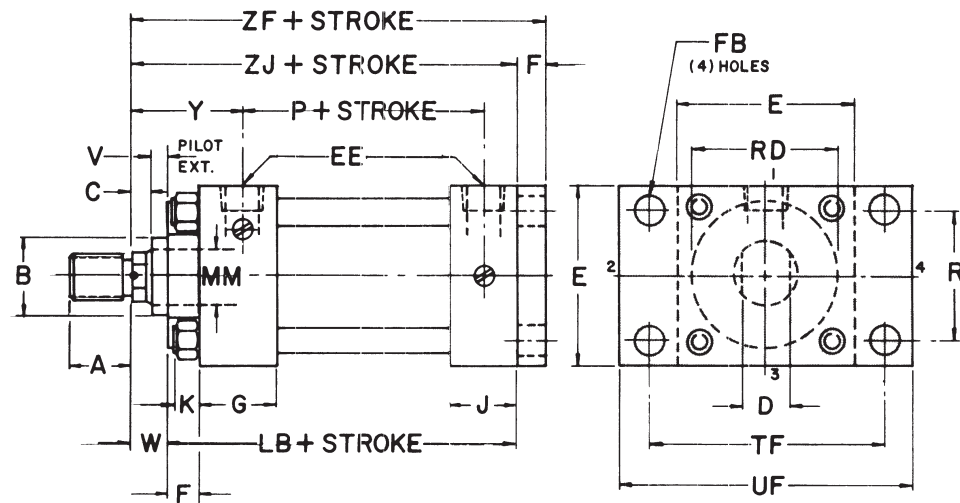
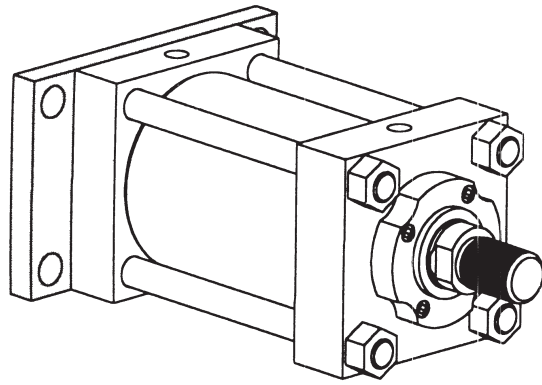
** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

CAUTION: This mounting style has reduced pressure ratings depending on application mode. For pressures which exceed those shown in the following page dimensional chart, HANNA recommends the use of ME5 mounting style, shown on page 20.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MF2 Cap Rectangular Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (750-16)	1/2	38	.438	1.75	1.50	31	5.00	2.88	1.63	3.43	4.25
	3.00	#8 (750-16)	1/2	62	.562	1.75	1.50	.44	5.25	2.88	2.05	4.12	5.12
	2.50	3.50	#8 (750-16)	1/2	62	.562	1.75	1.50	.44	5.38	3.00	2.55	4.62
3.25	4.50	#12 (1.062-12)	3/4	75	.687	2.00	1.75	.56	6.25	3.50	3.25	5.88	7.12
	4.00	5.00	#12 (1.062-12)	3/4	.88	.687	2.00	1.75	.56	6.62	3.75	3.82	6.38
5.00	6.50	#12 (1.062-12)	3/4	.88	.938	2.00	1.75	.75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1.312-12)	1	1.00	1.062	2.25	2.25	.88	8.38*	4.88	5.73	9.44	11.25
	8.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	1.00	9.50	5.38	6.58	10.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	1.06	10.50	6.12	7.50	11.81	14.00

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

CAUTION: This mounting style has reduced pressure ratings depending on application mode. For pressures which exceed those shown in the following page dimensional chart, HANNA recommends the use of ME6 mounting style, shown on page 22.

MF2

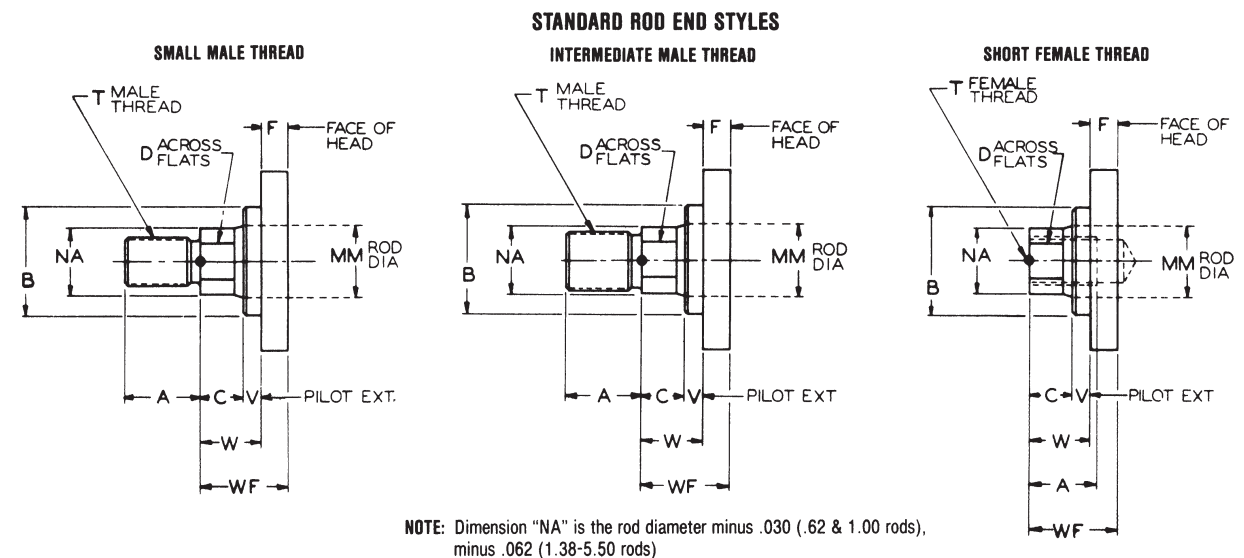
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	Y	ZF	ZJ	PSI RATING†
									SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	38	.50	.62	-	44-20	50-20	44-20	25	62	2.00	6.00	5.62	1650
	F	1.00	1.12	1.500	50	.88	1.00	-	75-16	88-14	75-16	.50	1.00	2.38	6.38	6.00	1650
2.00	F	1.00	1.12	1.500	50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.62	6.00	2575
	G	1.38	1.62	2.000	62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.88	6.25	2575
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.75	6.12	2060
	G	1.38	1.62	2.000	62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	7.00	6.38	2060
	H	1.75	2.00	2.375	75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	7.25	6.62	2060
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.88	7.12	1800
	H	1.75	2.00	2.375	75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	8.12	7.38	1800
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	8.25	7.50	1800
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	25	1.00	3.00	8.50	7.62	1650
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	25	1.12	3.12	8.62	7.75	1650
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	8.88	8.00	1650
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	9.12	8.25	1220
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	9.38	8.50	1220
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	3.38	9.38	8.50	1220
	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	3.38	9.38	8.50	1220
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.50	10.62	9.62	1120
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.50	10.62	9.62	1120
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.50	10.62	9.62	1120
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.50	10.62	9.62	1120
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.81	11.75	10.75	850
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.81	11.75	10.75	850
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.81	11.75	10.75	850
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	3.81	11.75	10.75	850
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	3.81	11.75	10.75	850
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.94	12.75	11.75	600
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.94	12.75	11.75	600
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	3.94	12.75	11.75	600
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	3.94	12.75	11.75	600
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	3.94	12.75	11.75	600

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

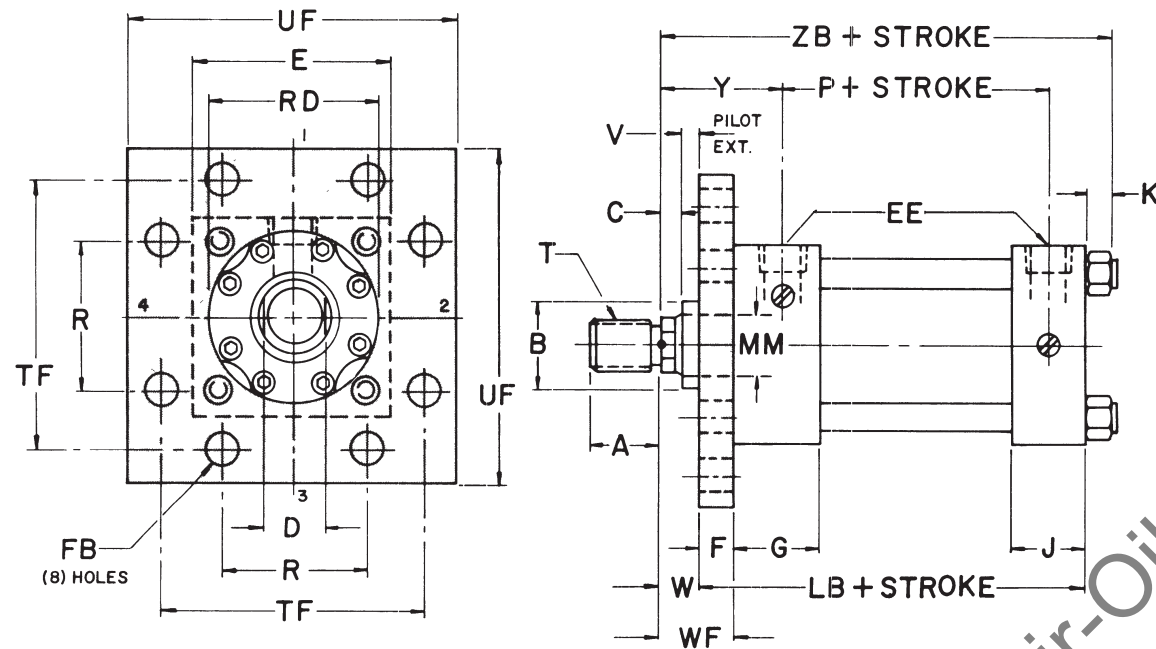
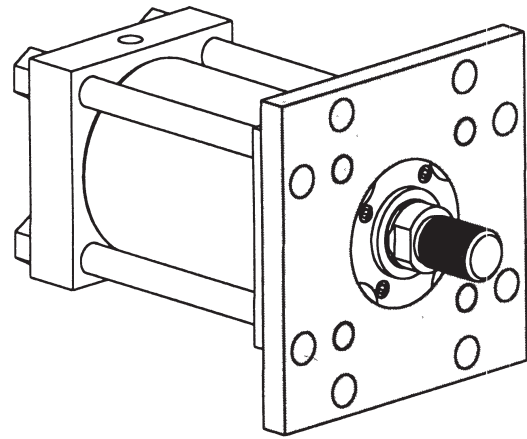
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MF5 Head Square Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (.750-16)	1/2	38	438	1.75	1.50	.31	5.00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (.750-16)	1/2	62	562	1.75	1.50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (.750-16)	1/2	62	562	1.75	1.50	.44	5.38	3.00	2.55	4.62	5.62
3.25	4.50	#12 (1.062-12)	3/4	75	687	2.00	1.75	.56	6.25	3.50	3.25	5.88	7.12
4.00	5.00	#12 (1.062-12)	3/4	88	687	2.00	1.75	.56	6.62	3.75	3.82	6.38	7.62
5.00	6.50	#12 (1.062-12)	3/4	88	938	2.00	1.75	.75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1.312-12)	1	1.00	1.062	2.25	2.25	.88	8.38	4.88	5.73	9.44	11.25
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	1.00	9.50	5.38	6.58	10.62	12.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	1.06	10.50	6.12	7.50	11.81	14.00

** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

CAUTION: This mounting style has reduced pressure ratings depending on application mode. For pressures which exceed those shown in the following page dimensional chart, HANNA recommends the use of ME5 mounting style, shown on page 20.

MF5

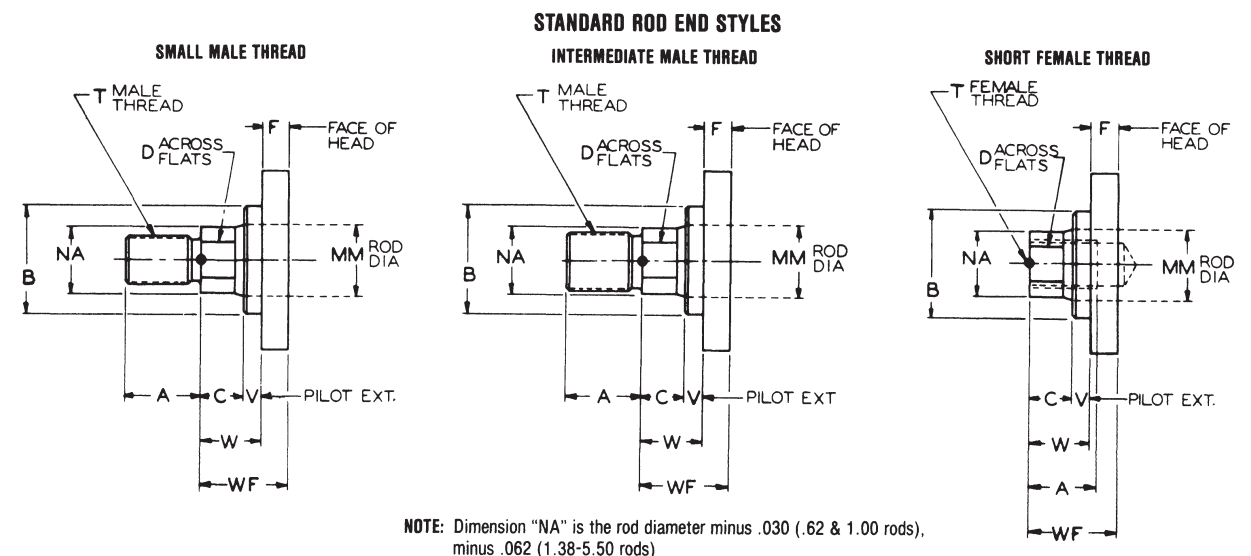
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	50-20	.44-20	25	.62	1.00	2.00	5.94	2900
	F	1.00	1.12	1.500	.50	.88	1.00	-	75-16	88-14	.75-16	50	1.00	1.38	2.38	6.31	2500
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	88-14	.75-16	25	.75	1.38	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	38	1.00	1.62	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	88-14	.75-16	25	.75	1.38	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	38	1.00	1.62	2.62	6.81	3000
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	50	1.25	1.88	2.88	7.06	2675
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	25	.88	1.62	2.75	7.69	2825
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	38	1.12	1.88	3.00	7.94	2625
	J	2.00	2.25	2.625	.88	1.69	2.00	-	1.50-12	1.75-12	1.50-12	38	1.25	2.00	3.12	8.06	2500
5.00	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	25	1.00	1.88	3.00	8.19	2650
	J	2.00	2.25	2.625	.88	1.69	2.00	-	1.50-12	1.75-12	1.50-12	25	1.12	2.00	3.12	8.31	2550
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	-	1.88-12	2.25-12	1.88-12	38	1.38	2.25	3.38	8.56	2300
	J	2.00	2.25	2.625	.88	1.69	2.00	-	1.50-12	1.75-12	1.50-12	25	1.12	2.00	3.12	9.00	1825
7.00	K	2.50	3.00	3.125	1.00	2.06	2.50	-	1.88-12	2.25-12	1.88-12	38	1.38	2.25	3.38	9.25	1700
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	38	1.38	2.25	3.38	9.25	1050
8.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	25	1.25	2.25	3.50	10.50	1000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	2.25	3.50	10.50	1000
9.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	2.25	3.81	11.75	775
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	2.25	3.81	11.75	775
10.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	2.25	3.81	11.75	775
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	25	1.25	2.25	3.81	11.75	650
11.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	25	1.25	2.25	3.81	11.75	650
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	25	1.25	2.25	3.94	12.81	650
12.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	25	1.25	2.25	3.94	12.81	650
	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	25	1.25	2.25	3.94	12.81	500
13.00	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	25	1.25	2.25	3.94	12.81	500
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	25	1.25	2.25	3.94	12.81	500

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

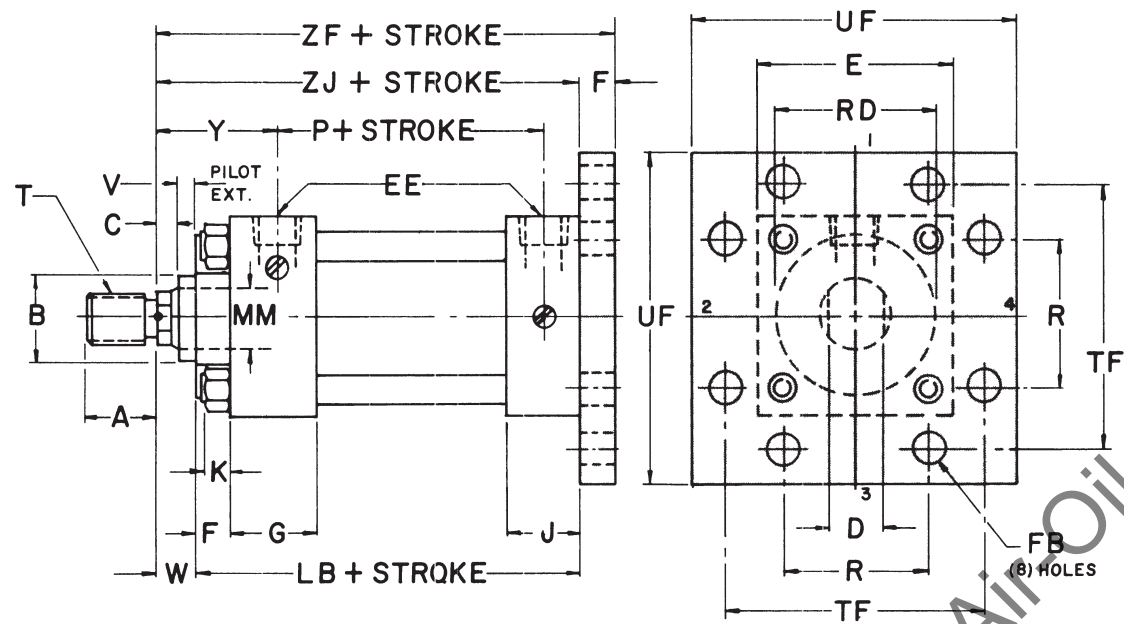
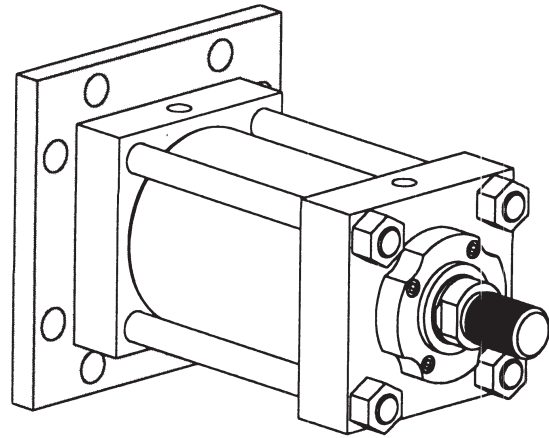
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MF6 Cap Square Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (750-16)	1/2	38	438	1.75	1.50	31	5.00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (750-16)	1/2	62	562	1.75	1.50	44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (750-16)	1/2	62	562	1.75	1.50	44	5.38	3.00	2.55	4.62	5.62
3.25	4.50	#12 (1 062-12)	3/4	75	687	2.00	1.75	56	6.25	3.50	3.25	5.88	7.12
4.00	5.00	#12 (1 062-12)	3/4	88	687	2.00	1.75	56	6.62	3.75	3.82	6.38	7.62
5.00	6.50	#12 (1 062-12)	3/4	88	938	2.00	1.75	75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1 312-12)	1	100*	1.062	2.25	2.25	88	8.38*	4.88	5.73	9.44	11.25
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	100	9.50	5.38	6.58	10.62	12.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	106	10.50	6.12	7.50	11.81	14.00

*With (K) Rod F = 88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

CAUTION: This mounting style has reduced pressure ratings depending on application mode. For pressures which exceed those shown in the following page dimensional chart, HANNA recommends the use of ME6 mounting style, shown on page 22.

MF6

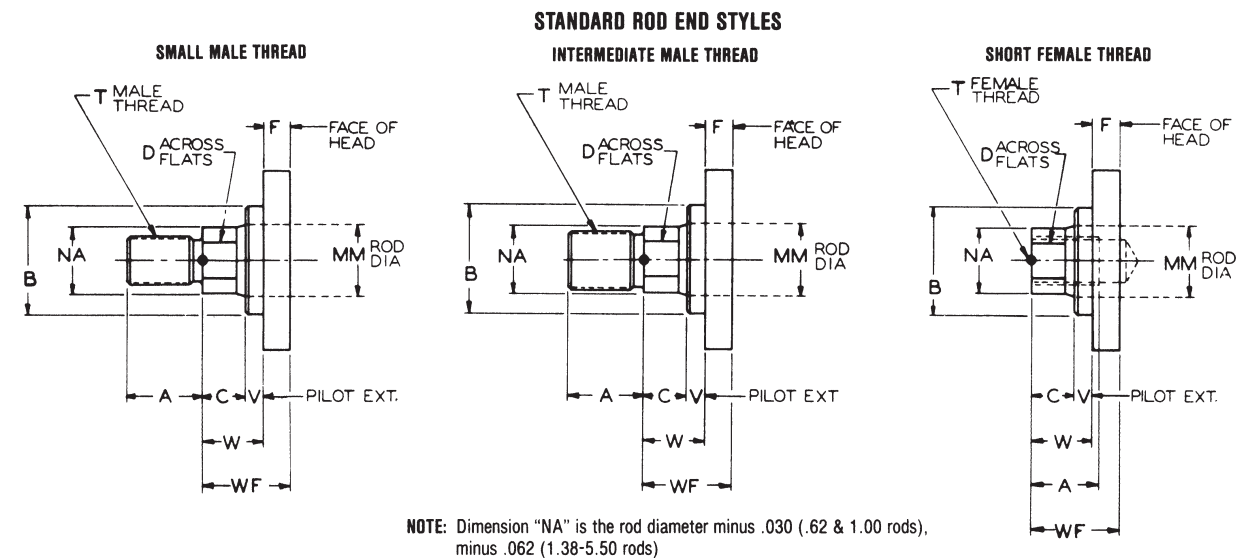
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	Y	ZJ	ZF	PSI RATING†
	ROD DIA. CODE	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	.44-20	.25	.62	2.00	5.62	6.00	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.50	1.00	2.38	6.00	6.38	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.00	6.62	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.25	6.88	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.12	6.75	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.38	7.00	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.62	7.25	3000
3.25	F	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.12	7.88	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.38	8.12	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	7.50	8.25	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	3.00	7.62	8.50	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	7.75	8.62	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	8.00	8.88	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	8.25	9.12	2450
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	8.50	9.38	2450
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	3.38	8.50	9.38	2450
	M	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	3.38	8.50	9.38	2450	
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.50	9.62	10.62	1925
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.50	9.62	10.62	1925
	M	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.50	9.62	10.62	1925	
	N	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.50	9.62	10.62	1925	
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.81	10.75	11.75	1475
	M	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.81	10.75	11.75	1475	
	N	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.81	10.75	11.75	1475	
	P	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	3.81	10.75	11.75	1475	
8.00	R	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	3.81	10.75	11.75	1475	
	M	3.50	4.250	1.00	3.00	3.50	6.38	2.25-12	3.25-12	2.50-12	.25	1.25	3.94	11.75	12.75	1200	
	N	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.94	11.75	12.75	1200	
	P	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	3.94	11.75	12.75	1200	
	S	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	3.94	11.75	12.75	1200	

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **CAUTION:** PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

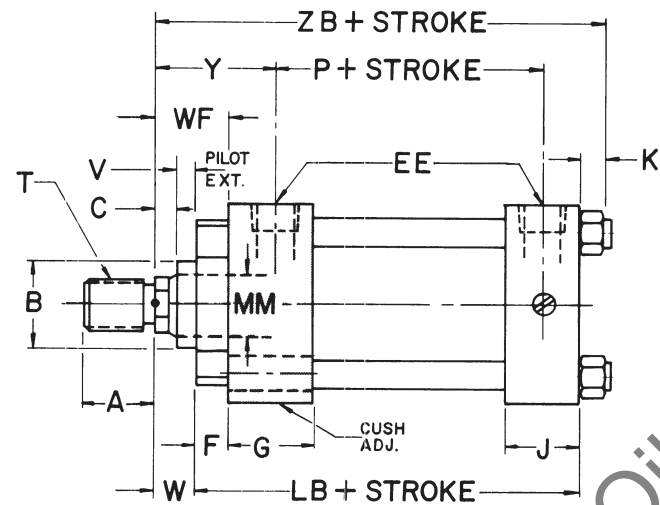
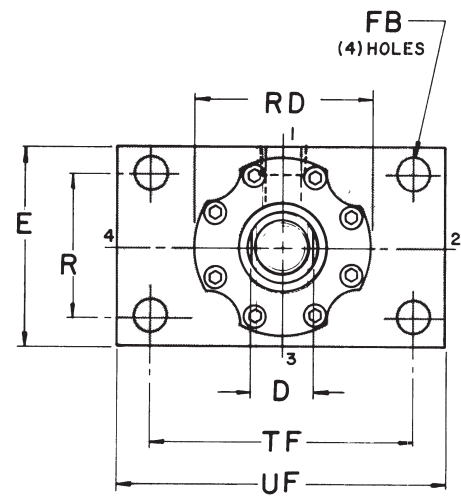
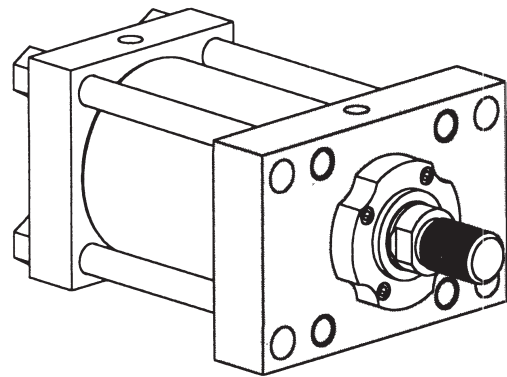
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores ME5 Head Flange Mount

(For 10.00" - 14.00" Bores, see Page 38)



ME5

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA.	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	2.00	.44-20	50-20	.44-20	.25	.62	1.00	2.00	5.94	3000
	F	1.00	1.12	1.500	.50	.88	1.00	2.38	.75-16	.88-14	.75-16	.50	1.00	1.38	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	2.38	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	2.88	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	2.38	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	3.25	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.25	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	7.06	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	1.62	2.75	7.69	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	1.88	3.00	8.19	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	2.00	3.12	8.31	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	2.25	3.38	8.56	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	2.00	3.12	9.00	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	2.25	3.38	9.25	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	2.25	3.38	9.25	3000
6.00	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	2.25	3.38	9.25	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.25	3.50	10.50	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	2.25	3.81	11.75	3000
7.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	2.25	3.81	11.75	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.25	3.81	11.75	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	2.25	3.81	11.75	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	2.25	3.81	11.75	3000
8.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	2.25	3.94	12.81	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	2.25	3.94	12.81	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	2.25	3.94	12.81	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	2.25	3.94	12.81	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	2.25	3.94	12.81	3000

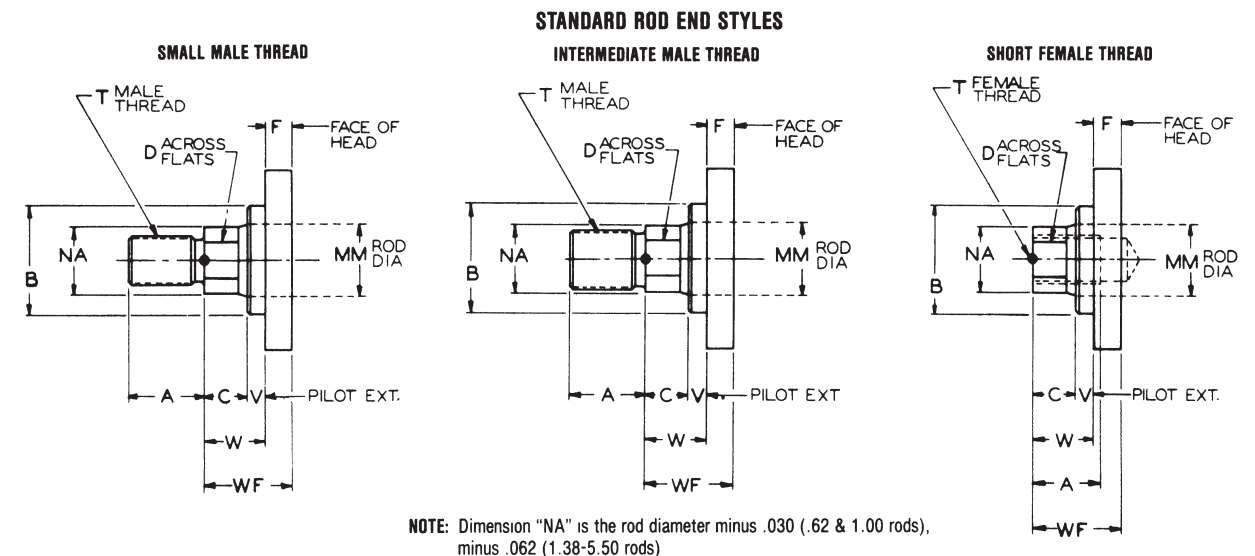
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (750-16)	1/2	.38	.438	1.75	1.50	.31	5.00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (750-16)	1/2	.62	.562	1.75	1.50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (750-16)	1/2	.62	.562	1.75	1.50	.44	5.38	3.00	2.55	4.62	5.62
3.25	4.50	#12 (1.062-12)	3/4	.75	.687	2.00	1.75	.56	6.25	3.50	3.25	5.88	7.12
4.00	5.00	#12 (1.062-12)	3/4	.88	.687	2.00	1.75	.56	6.62	3.75	3.82	6.38	7.62
5.00	6.50	#12 (1.062-12)	3/4	.88	.938	2.00	1.75	.75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1.312-12)	1	1.00*	1.062	2.25	2.25	.88	8.38*	4.88	5.73	9.44	11.25
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	1.00	9.50	5.38	6.58	10.62	12.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	1.06	10.50	6.12	7.50	11.81	14.00

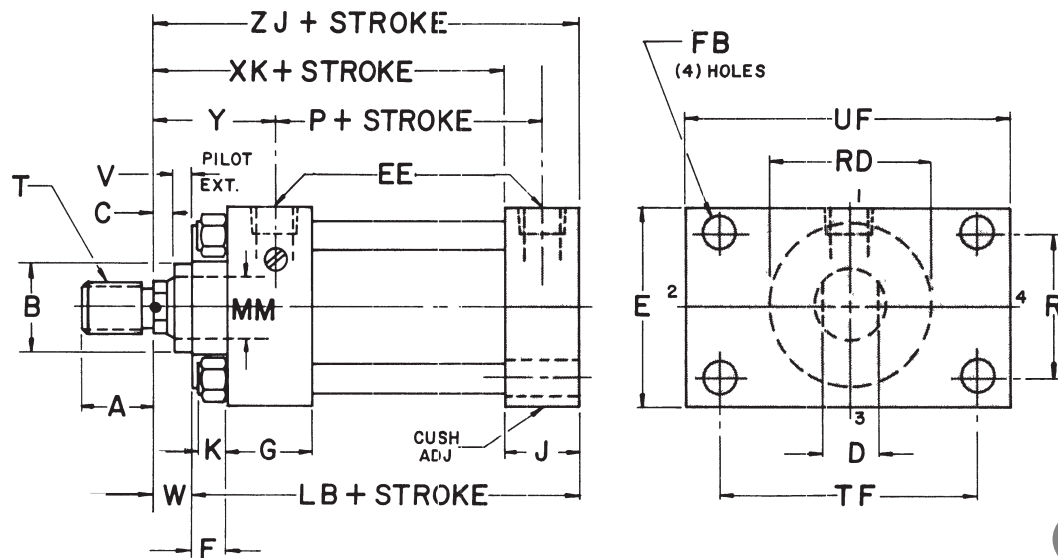
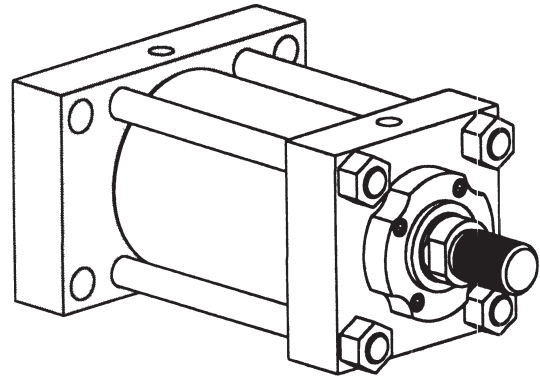
* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores ME6 Cap Flange Mount

(For 10.00" - 14.00" Bores, see Page 38)



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
		SAE STRAIGHT THREAD	NPTF**										
1.50	2.50	#8 (750-16)	1/2	.38	.438	1.75	1.50	.31	5.00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (750-16)	1/2	.62	.562	1.75	1.50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (.750-16)	1/2	.62	.562	1.75	1.50	.44	5.38	3.00	2.55	4.62	5.62
3.25	4.50	#12 (1.062-12)	3/4	.75	.687	2.00	1.75	.56	6.25	3.50	3.25	5.88	7.12
4.00	5.00	#12 (1.062-12)	3/4	.88	.687	2.00	1.75	.56	6.62	3.75	3.82	6.38	7.62
5.00	6.50	#12 (1.062-12)	3/4	.88	.938	2.00	1.75	.75	7.12	4.25	4.95	8.19	9.75
6.00	7.50	#16 (1.312-12)	1	1.00*	1.062	2.25	2.25	.88	8.38*	4.88	5.73	9.44	11.25
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	1.187	2.75	2.75	1.00	9.50	5.38	6.58	10.62	12.62
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	1.312	3.00	3.00	1.06	10.50	6.12	7.50	11.81	14.00

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

ME6

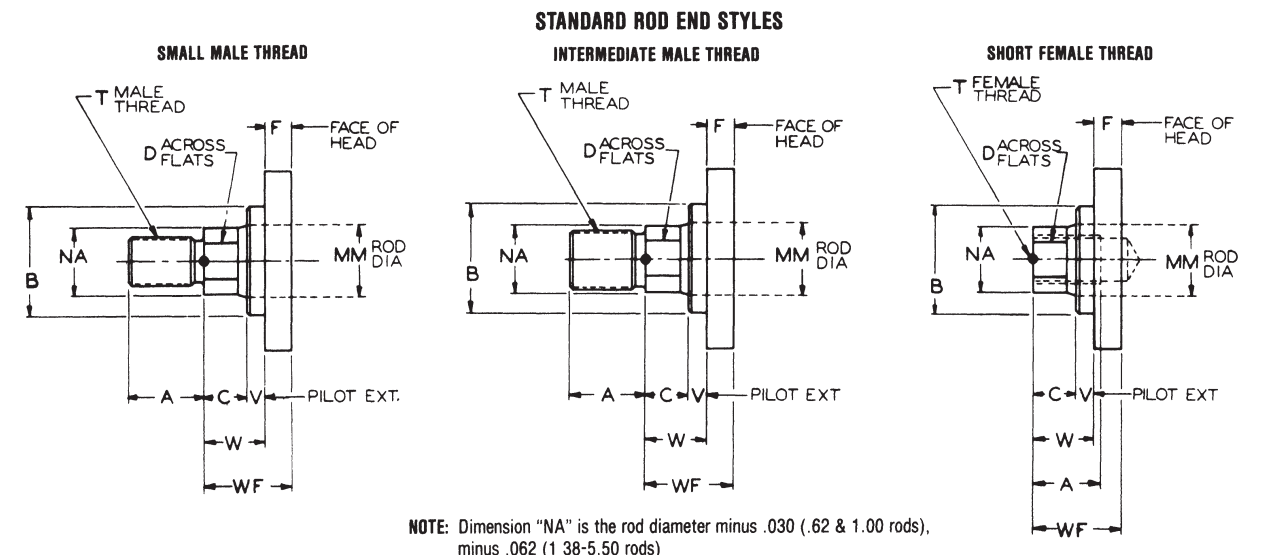
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	Y	XK	ZJ	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	62	75	1.125	38	.50	62	-	44-20	.50-20	44-20	25	62	2.00	4.12	5.62	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	75-16	50	1.00	2.38	4.50	6.00	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	75-16	.25	.75	2.38	4.50	6.00	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.75	6.25	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	75-16	.25	.75	2.38	4.62	6.12	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.88	6.38	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	5.12	6.62	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.75	5.38	7.12	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	5.62	7.38	3000
4.00	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	5.75	7.50	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	6.25	8.00	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	6.50	8.25	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	6.75	8.50	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	3.38	6.75	8.50	3000
6.00	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.50	7.38	9.62	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.50	7.38	9.62	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	3.81	8.00	10.75	3000
7.00	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	3.81	8.00	10.75	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.81	8.00	10.75	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.81	8.00	10.75	3000
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	3.94	8.75	11.75	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	3.94	8.75	11.75	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	3.94	8.75	11.75	3000

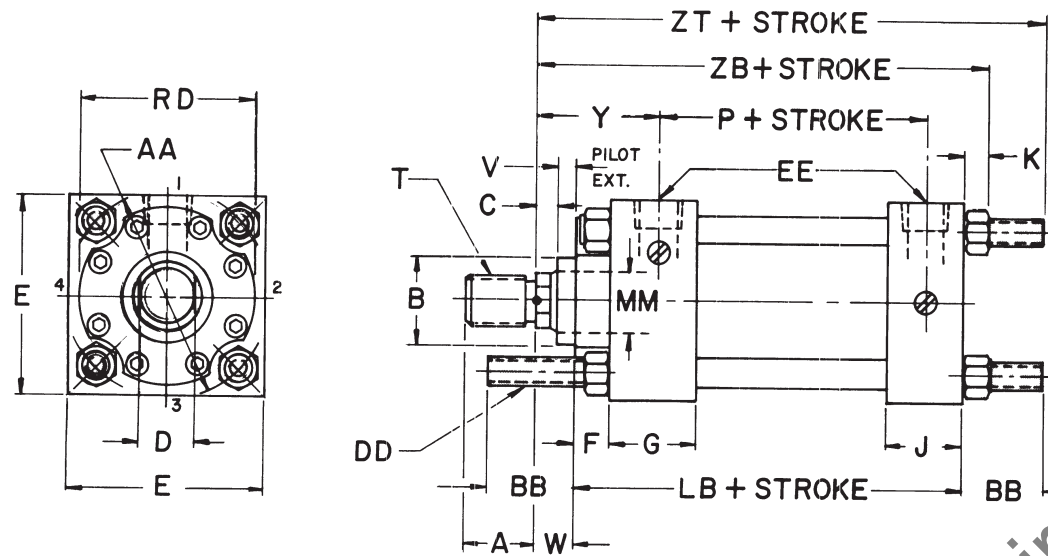
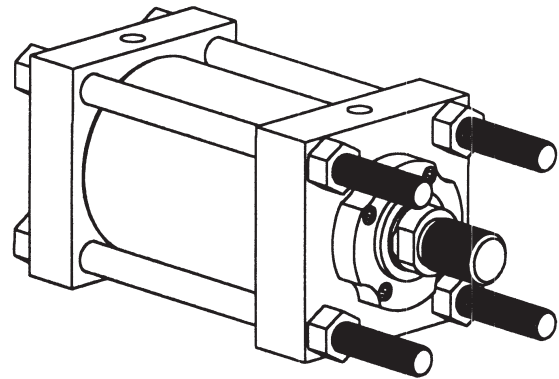
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



SERIES 2H 1.50"-8.00" Bores MX0, MX1, MX2, MX3, MX4 Tie Rod Mounts



These Dimensions are Constant Regardless of Rod Diameter

BORE	AA	BB	DD	E	EE		F	G	J	K	LB	P
					SAE STRAIGHT THREAD	NPTF**						
1.50	2.30	1.38	38-24	2.50	#8 (.750-16)	1/2	.38	1.75	1.50	.31	5.00	2.88
2.00	2.90	1.81	.50-20	3.00	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.25	2.88
2.50	3.60	1.81	50-20	3.50	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.38	3.00
3.25	4.60	2.31	.62-18	4.50	#12 (1.062-12)	3/4	.75	2.00	1.75	.56	6.25	3.50
4.00	5.40	2.31	.62-18	5.00	#12 (1.062-12)	3/4	.88	2.00	1.75	.56	6.62	3.75
5.00	7.00	3.19	88-14	6.50	#12 (1.062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25
6.00	8.10	3.62	1.00-14	7.50	#16 (1.312-12)	1	1.00*	2.25	2.25	.38	8.38*	4.88
7.00	9.30	4.12	1.12-12	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38
8.00	10.60	4.50	1.25-12	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

NOTE: Specify Tie Rod Extension, "BB" dimension if other than standard.
 MX0 = No Tie Rods Extended
 MX1 = 4 Tie Rods Extended Both Ends
 MX2 = 4 Tie Rods Extended Cap End
 MX3 = 4 Tie Rods Extended Head End
 MX4 = 2 Tie Rods Extended Both Ends

MX0, MX1, MX2, MX3, MX4

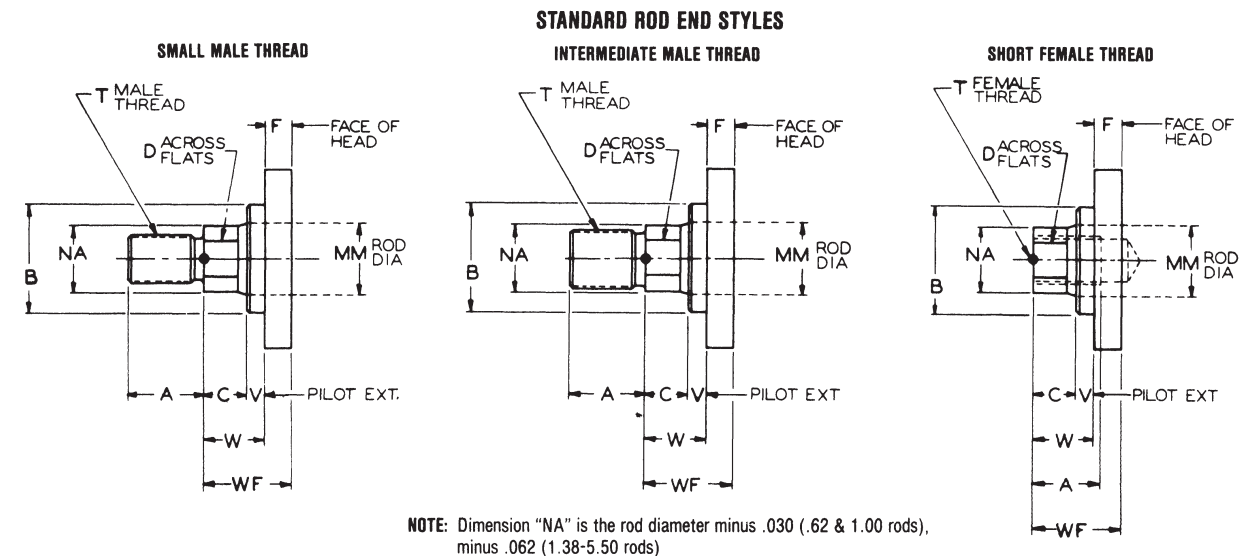
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	Y	ZB	ZT	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	50-20	.44-20	.25	.62	2.00	5.94	7.00	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	88-14	.75-16	.50	1.00	2.38	6.31	7.38	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	88-14	.75-16	.25	.75	2.38	6.44	7.81	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.69	8.06	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	88-14	.75-16	.25	.75	2.38	6.56	7.94	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.81	8.19	3000
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	7.06	8.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.69	9.44	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.94	9.69	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	8.06	9.81	3000
5.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.25	1.12	3.12	9.00	11.44	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	9.00	11.44	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.25	1.12	3.12	9.00	11.44	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.50	10.50	13.25	3000
7.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.50	10.50	13.25	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.81	11.75	14.87	3000
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	3.81	11.75	14.87	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	3.81	11.75	14.87	3000
8.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.94	12.81	16.25	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.94	12.81	16.25	3000
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	3.94	12.81	16.25	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	3.94	12.81	16.25	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

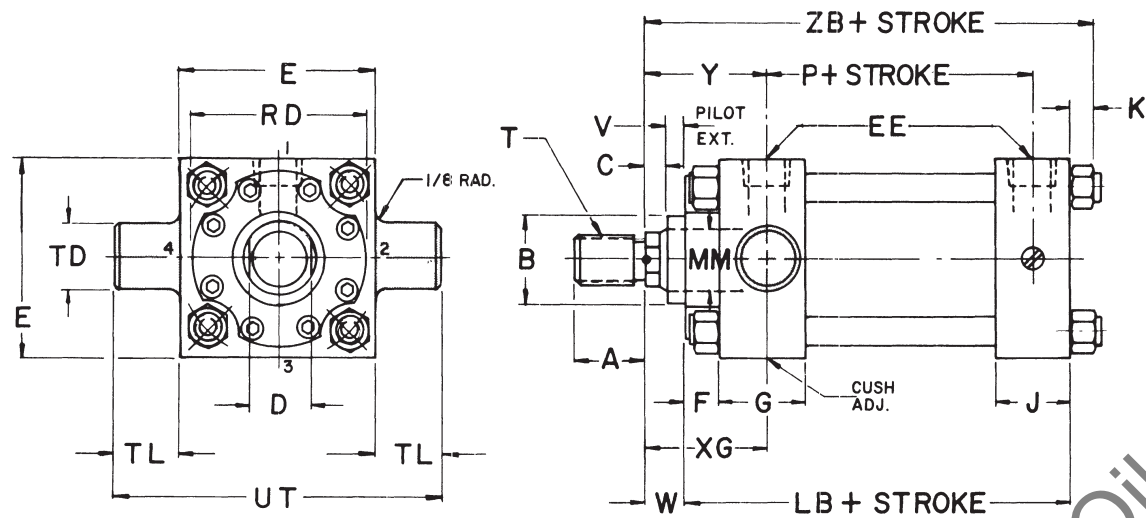
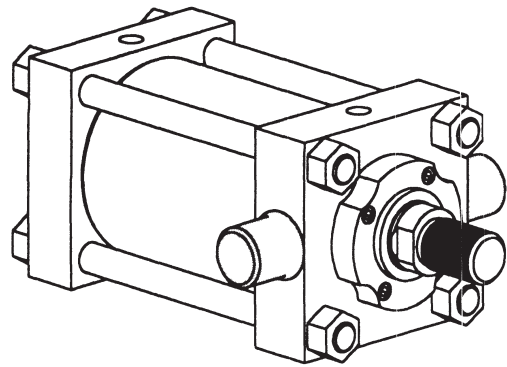
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MT1 Head Trunnion Mount

(For 10.00" - 14.00" Bores, see Page 38)



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	G	J	K	LB	P	TD +.000 -.002	TL	UT
		SAE STRAIGHT THREAD	NPTF**									
1.50	2.50	#8 (750-16)	1/2	.38	1.75	1.50	.31	5.00	2.88	1.000	1.00	4.50
2.00	3.00	#8 (750-16)	1/2	.62	1.75	1.50	.44	5.25	2.88	1.375	1.38	5.75
2.50	3.50	#8 (750-16)	1/2	.62	1.75	1.50	.44	5.38	3.00	1.375	1.38	6.25
3.25	4.50	#12 (1.062-12)	3/4	.75	2.00	1.75	.56	6.25	3.50	1.750	1.75	8.00
4.00	5.00	#12 (1.062-12)	3/4	.88	2.00	1.75	.56	6.62	3.75	1.750	1.75	8.50
5.00	6.50	#12 (1.062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25	1.750	1.75	10.00
6.00	7.50	#16 (1.312-12)	1	1.00*	2.25	2.25	.88	8.38*	4.88	2.000	2.00	11.50
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38	2.500	2.50	13.50
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12	3.000	3.00	15.50

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MT1

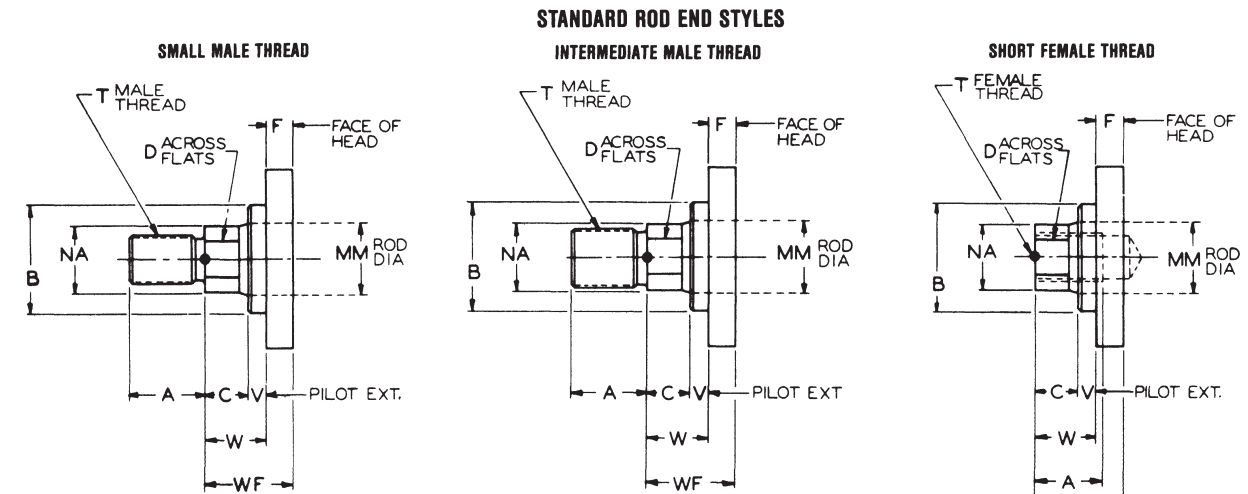
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XG	Y	ZB	PSI RATING†
	ROD DIA.	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	.44-20	.25	.62	1.88	2.00	5.94	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.50	1.00	2.25	2.25	6.31	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.81	3000
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	7.06	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.62	2.75	7.69	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	.88	2.62	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.00	3.12	8.06	3000
5.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	2.88	3.00	8.19	2150
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.00	3.12	8.31	2150
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.25	3.38	8.56	2150
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.00	3.12	9.00	1365
7.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.25	3.38	9.25	1365
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	3.25	3.38	9.25	1365
8.00	M	3.50	4.00	4.250	1.00	3.00	3.50	5.62	2.50-12	3.00-12	2.50-12	.38	1.38	3.25	3.38	9.25	1365
	N	4.00	4.50	4.750	1.00	3.38	4.00	6.38	3.00-12	3.50-12	3.00-12	.25	1.25	3.38	3.50	10.50	1250
9.00	M	3.50	4.00	4.250	1.00	3.00	3.50	5.62	2.50-12	3.00-12	2.50-12	.25	1.25	3.38	3.50	10.50	1250
	N	4.00	4.50	4.750	1.00	3.38	4.00	6.38	3.00-12	3.50-12	3.00-12	.25	1.25	3.38	3.50	10.50	1250
10.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.62	3.81	11.75	1425
	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	2.50-12	3.00-12	2.50-12	.25	1.25	3.62	3.81	11.75	1425
11.00	N	4.00	4.50	4.750	1.00	3.38	4.00	6.38	3.00-12	3.50-12	3.00-12	.25	1.25	3.62	3.81	11.75	1425
	P	4.50	5.00	5.250	1.00	3.88	4.50	7.50	3.25-12	3.75-12	3.25-12	.25	1.25	3.62	3.81	11.75	1425
12.00	R	5.00	5.50	5.750	1.00	4.25	5.00	7.50	3.50-12	4.00-12	3.50-12	.25	1.25	3.62	3.81	11.75	1425
	S	5.50	6.00	6.250	1.00	4.62	5.50	8.00	4.00-12	4.50-12	4.00-12	.25	1.25	3.62	3.81	11.75	1425
13.00	M	3.50	4.00	4.250	1.00	3.00	3.50	6.38	2.50-12	3.00-12	2.50-12	.25	1.25	3.75	3.94	12.81	1575
	N	4.00	4.50	4.750	1.00	3.38	4.00	6.38	3.00-12	3.50-12	3.00-12	.25	1.25	3.75	3.94	12.81	1575
14.00	P	4.50	5.00	5.250	1.00	3.88	4.50	8.00	3.25-12	3.75-12	3.25-12	.25	1.25	3.75	3.94	12.81	1575
	R	5.00	5.50	5.750	1.00	4.25	5.00	8.00	3.50-12	4.00-12	3.50-12	.25	1.25	3.75	3.94	12.81	1575
15.00	S	5.50	6.00	6.250	1.00	4.62	5.50	8.00	4.00-12	4.50-12	4.00-12	.25	1.25	3.75	3.94	12.81	1575

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

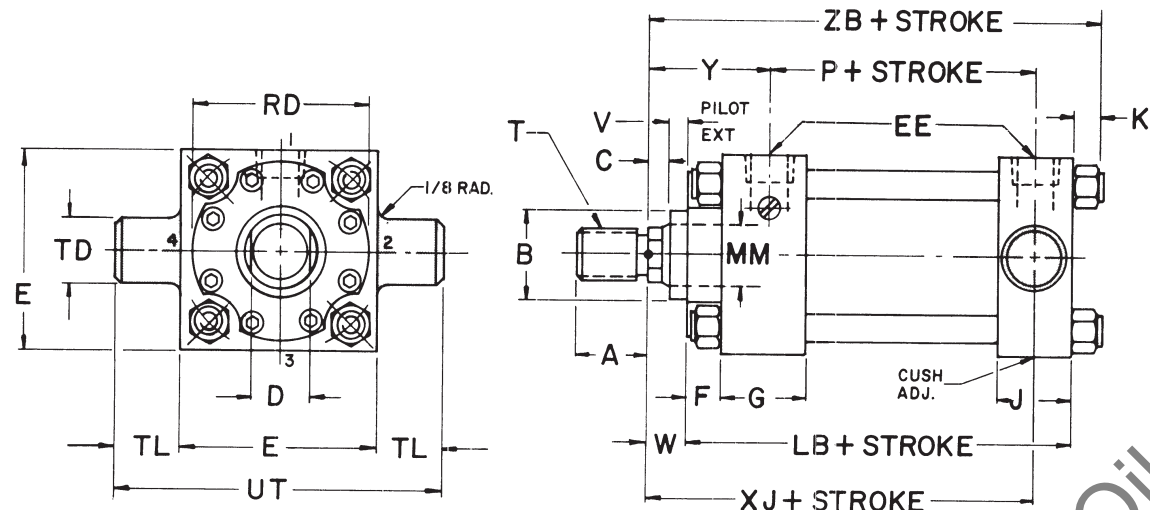
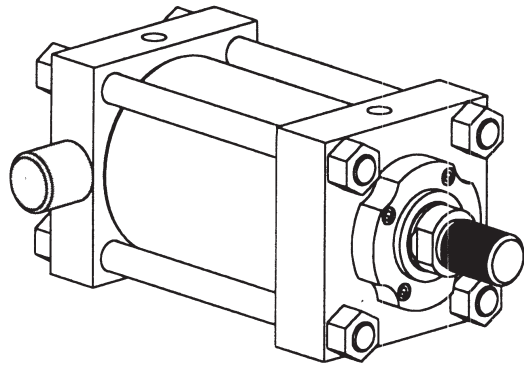
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MT2 Cap Trunnion Mount



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE		F	G	J	K	LB	P	TD +.000 -.002	TL	UT
		SAE STRAIGHT THREAD	NPTF**									
1.50	2.50	#8 (.750-16)	1/2	.38	1.75	1.50	.31	5.00	2.88	1.000	1.00	4.50
2.00	3.00	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.25	2.88	1.375	1.38	5.75
2.50	3.50	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.38	3.00	1.375	1.38	6.25
3.25	4.50	#12 (1.062-12)	3/4	.75	2.00	1.75	.56	6.25	3.50	1.750	1.75	8.00
4.00	5.00	#12 (1.062-12)	3/4	.88	2.00	1.75	.56	6.62	3.75	1.750	1.75	8.50
5.00	6.50	#12 (1.062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25	1.750	1.75	10.00
6.00	7.50	#16 (1.312-12)	1	1.00*	2.25	2.25	.88	8.38*	4.88	2.000	2.00	11.50
7.00	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38	2.500	2.50	13.50
8.00	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12	3.000	3.00	15.50

* With (K) Rod F = .88, LB = 8.25

** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MT2

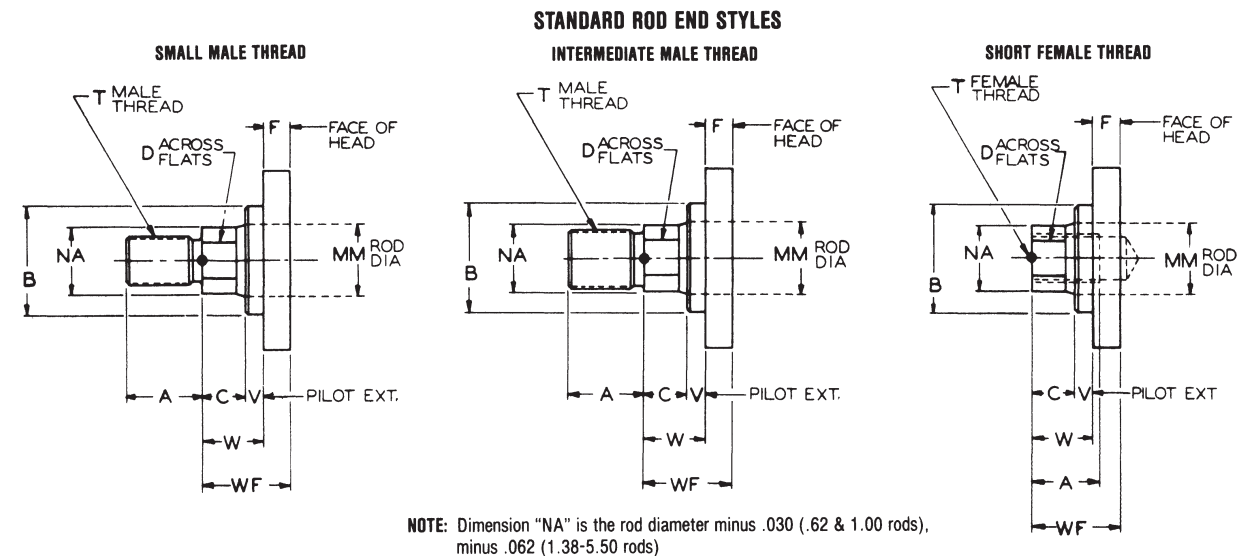
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XJ	Y	ZB	PSI RATING†
	ROD DIA. CODE	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	.44-20	.25	.62	4.88	2.00	5.94	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.50	1.00	5.25	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	5.25	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	5.50	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	5.38	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	5.62	2.62	6.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	5.88	2.88	7.06	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	6.25	2.75	7.69	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.50	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	6.62	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	6.75	3.00	8.19	2150
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	6.88	3.12	8.31	2150
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	7.38	3.12	9.00	1365
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	7.62	3.38	9.25	1365
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	7.62	3.38	9.25	1365
6.00	M	3.50	4.00	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	7.62	3.38	9.25	1365
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	8.38	3.50	10.50	1250
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	8.38	3.50	10.50	1250
7.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	9.38	3.81	11.75	1425
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	9.38	3.81	11.75	1425
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	9.38	3.81	11.75	1425
8.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	9.38	3.81	11.75	1425
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	9.38	3.81	11.75	1425
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	9.38	3.81	11.75	1425
8.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	10.25	3.94	12.81	1575
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	10.25	3.94	12.81	1575
	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	10.25	3.94	12.81	1575
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	10.25	3.94	12.81	1575
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	10.25	3.94	12.81	1575

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

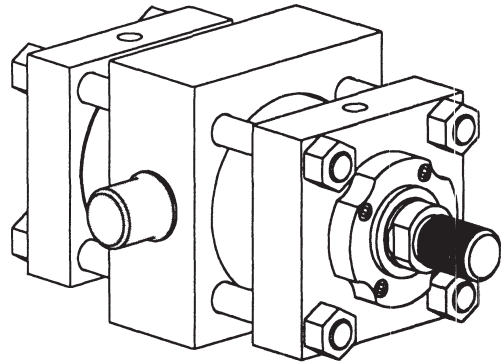
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



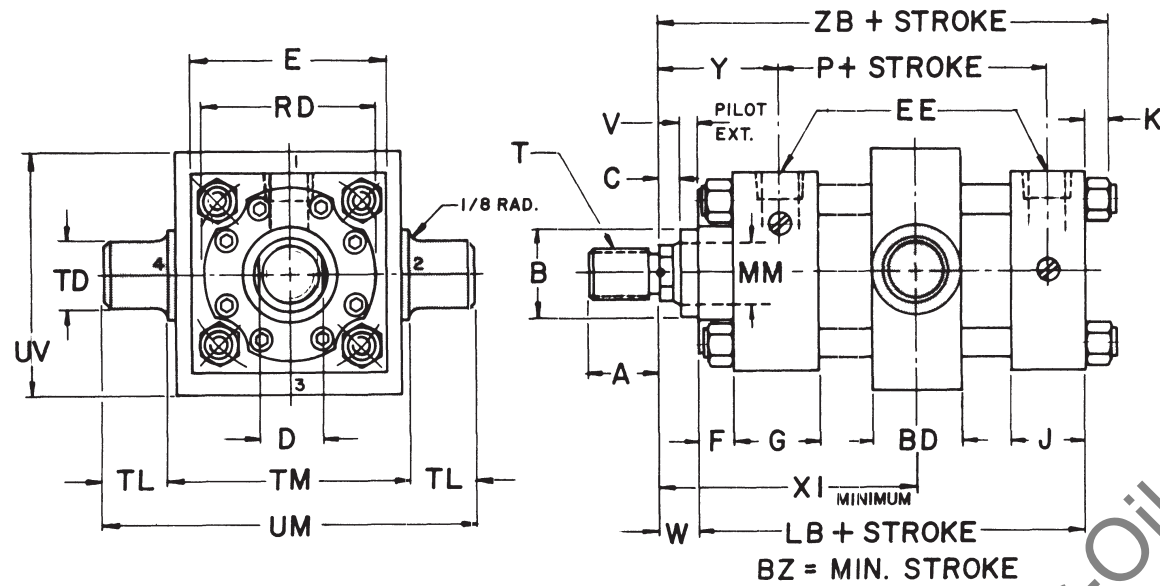
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MT4 Intermediate Fixed Trunnion Mount

(For 10.00" - 14.00" Bores, see Page 38)



NOTE: Trunnion location (XI) must be specified when ordering.



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

These Dimensions are Constant Regardless of Rod Diameter

BORE	BD	BZ	E	EE		F	G	J	K	LB	P	TD +.000 -.002	TL	TM	UM	UV
				SAE STRAIGHT THREAD	NPTF**											
1.50	1.25	.25	2.50	#8 (.750-16)	1/2	.38	1.75	1.50	31	5.00	2.88	1.000	1.00	2.50	4.50	2.50
2.00	1.50	.25	3.00	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.25	2.88	1.375	1.38	3.38	6.12	3.38
2.50	1.75	.38	3.50	#8 (.750-16)	1/2	.62	1.75	1.50	.44	5.38	3.00	1.375	1.38	4.25	7.00	4.25
3.25	2.50	.88	4.50	#12 (1.062-12)	3/4	.75	2.00	1.75	.56	6.25	3.50	1.750	1.75	5.00	8.50	5.00
4.00	3.00	1.12	5.00	#12 (1.062-12)	3/4	.88	2.00	1.75	.56	6.62	3.75	1.750	1.75	6.25	8.75	6.25
5.00	3.50	1.12	6.50	#12 (1.062-12)	3/4	.88	2.00	1.75	.75	7.12	4.25	1.750	1.75	7.75	11.25	7.75
6.00	4.00	1.25	7.50	#16 (1.312-12)	1	1.00*	2.25	2.25	.88	8.38*	4.88	2.000	2.00	9.25	13.25	9.25
7.00	4.50	1.62	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	2.75	1.00	9.50	5.38	2.500	2.50	11.25	16.25	11.50
8.00	5.50	2.12	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	3.00	1.06	10.50	6.12	3.000	3.00	12.25	18.25	12.50

* With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MT4

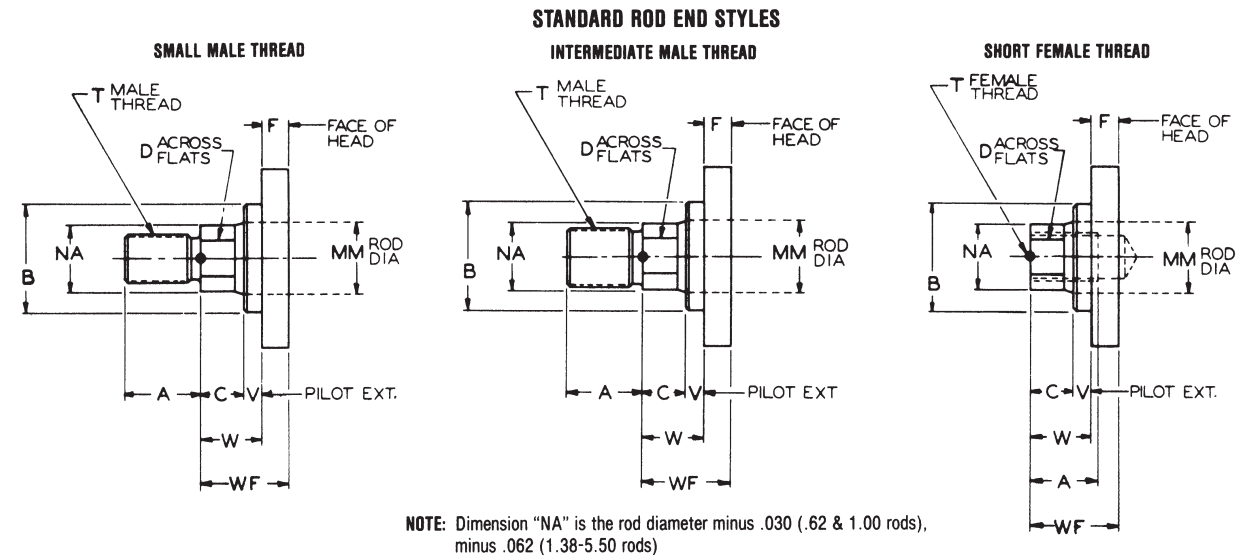
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XI (MIN)	Y	ZB	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	.44-20	.25	.62	3.50	2.00	5.94	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.50	1.00	3.88	2.38	6.31	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	4.00	2.38	6.44	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	4.25	2.62	6.69	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	4.12	2.38	6.56	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	4.38	2.62	6.81	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	4.62	2.88	7.06	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	5.00	2.75	7.69	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	5.25	3.00	7.94	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	5.38	3.12	8.06	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	5.50	3.00	8.19	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	5.62	3.12	8.31	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	5.88	3.38	8.56	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	5.88	3.12	9.00	1850
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	6.12	3.38	9.25	1850
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	6.12	3.38	9.25	1850
	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	6.12	3.38	9.25	1850
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	6.62	3.50	10.50	1660
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	6.62	3.50	10.50	1660
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	6.62	3.50	10.50	1660
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	6.62	3.50	10.50	1660
7.00	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	7.38	3.81	11.75	1900
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	7.38	3.81	11.75	1900
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	7.38	3.81	11.75	1900
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	7.38	3.81	11.75	1900
8.00	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	7.38	3.81	11.75	1900
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	8.12	3.94	12.81	2100
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	8.12	3.94	12.81	2100
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	8.12	3.94	12.81	2100
8.00	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	8.12	3.94	12.81	2100
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	8.12	3.94	12.81	2100
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	8.12	3.94	12.81	2100

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

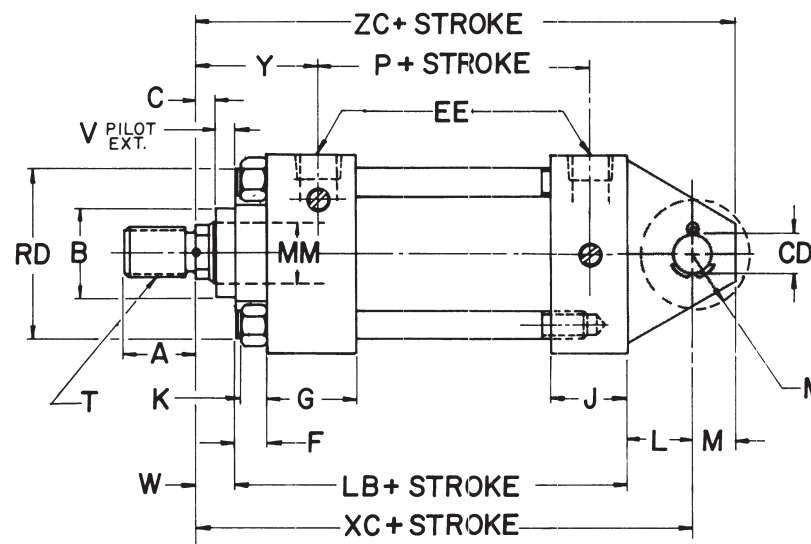
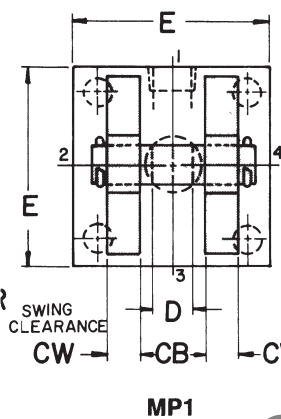
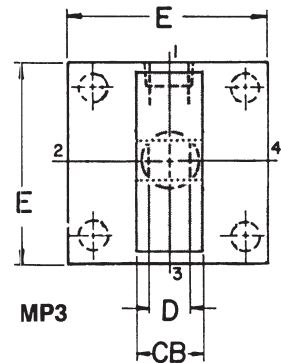
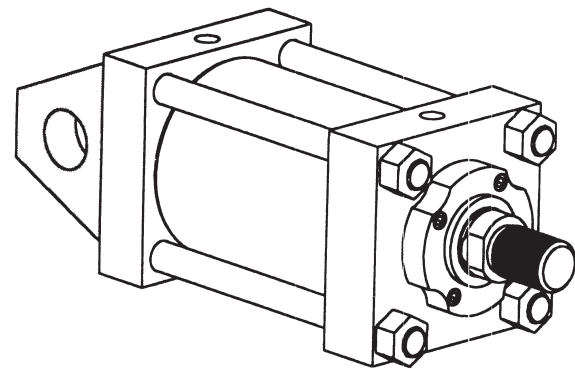
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores
MP1 Fixed Double Ear Clevis Mount (For 10.00" - 14.00" Bores, see Page 38)
MP3 Fixed Single Ear Clevis Mount



Dimensions are Affected by the Rod Diameter

MP1, MP3

BORE	CYLINDER	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XC	Y	ZC	PSI RATING†
										SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	.62	-	.44-20	.50-20	.44-20	.25	.62	6.38	2.00	6.88	3000
	F	1.00	1.12	1.500	.50	.88	1.00	1.00	-	75-16	88-14	75-16	.50	1.00	6.75	2.38	7.25	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	1.00	-	.75-16	.88-14	.75-16	.25	.75	7.25	2.38	8.00	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.50	2.62	8.25	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	1.00	-	.75-16	.88-14	.75-16	.25	.75	7.38	2.38	8.12	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.62	2.62	8.38	3000
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	1.75	3.50	1.00-14	1.25-12	1.00-14	.25	.88	8.62	2.75	9.62	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	9.00	3.12	10.00	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	9.75	3.00	11.12	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	9.88	3.12	11.25	3000
5.00	K	3.00	3.50	3.125	1.00	2.06	2.50	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	10.75	3.38	12.50	3000
	L	3.50	4.00	3.750	1.00	2.62	3.00	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	10.75	3.38	12.50	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	12.12	3.50	14.12	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	12.12	3.50	14.12	3000
7.00	M	3.50	4.00	4.250	1.00	3.00	3.50	3.50	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	12.12	3.50	14.12	3000
	N	4.00	4.50	4.750	1.00	3.38	4.00	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	13.75	3.81	16.25	3000
8.00	P	4.50	5.00	5.250	1.00	3.88	4.50	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	13.75	3.81	16.25	3000
	R	5.00	5.50	5.750	1.00	4.25	5.00	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	13.75	3.81	16.25	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	8.62	2.75	9.62	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.88	3.00	9.88	3000
4.00	J	2.00	2.25	2.625	.88	1.69	2.00	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	9.88	3.12	11.25	3000
	K	3.00	3.50	3.125	1.00	2.06	2.50	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	10.75	3.38	12.50	3000
5.00	L	3.50	4.00	4.250	1.00	3.00	3.50	3.50	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	12.12	3.50	14.12	3000
	M	4.00	4.50	4.750	1.00	3.38	4.00	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	13.75	3.81	16.25	3000
6.00	N	4.50	5.00	5.250	1.00	3.88	4.50	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	13.75	3.81	16.25	3000
	P	5.00	5.50	5.750	1.00	4.25	5.00	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	13.75	3.81	16.25	3000
7.00	M	3.50	4.00	4.250	1.00	3.00	3.50	3.50	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	12.12	3.50	14.12	3000
	N	4.00	4.50	4.750	1.00	3.38	4.00	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	13.75	3.81	16.25	3000
8.00	P	4.50	5.00	5.250	1.00	3.88	4.50	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	13.75	3.81	16.25	3000
	R	5.00	5.50	5.750	1.00	4.25	5.00	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	13.75	3.81	16.25	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

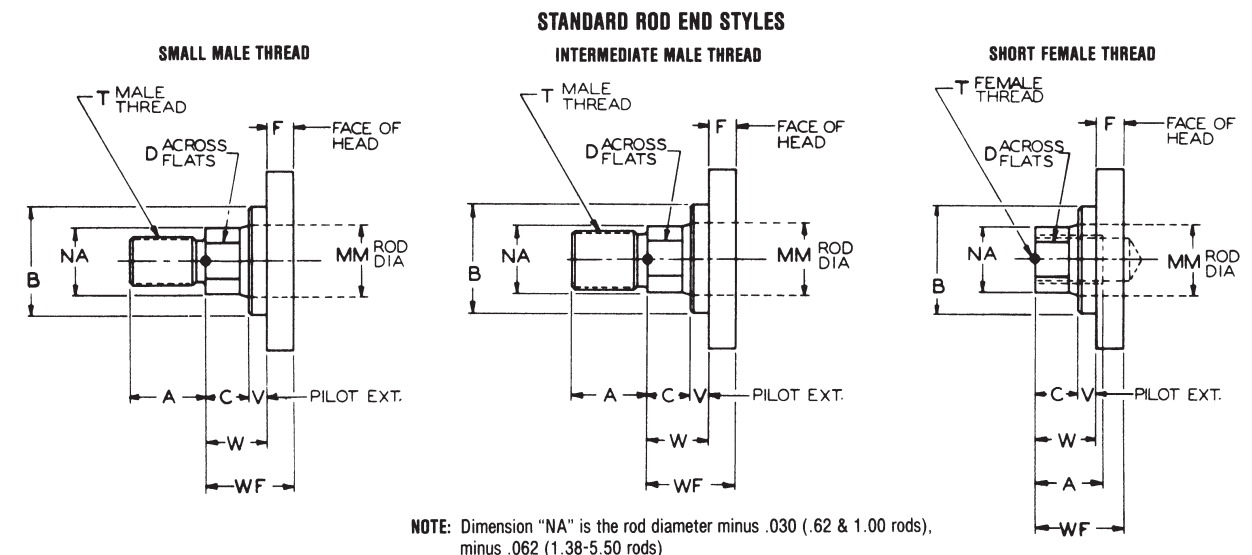
These Dimensions are Constant Regardless of Rod Diameter

BORE	CB†	CD††	CW	E	EE		F	G	J	K	L	LB	M	MM	P
					SAE STRAIGHT THREAD	NPTF**									
1.50	.75	.50	.50	2.50	#8 (.750-16)	1/2	.38	1.75	1.50	.31	.75	5.00	.50	.62	2.88
2.00	1.25	.75	.62	3.00	#8 (.750-16)	1/2	.62	1.75	1.50	.44	1.25	5.25	.75	.88	2.88
2.50	1.25	.75	.62	3.50	#8 (.750-16)	1/2	.62	1.75	1.50	.44	1.25	5.38	.75	.88	3.00
3.25	1.50	1.00	.75	4.50	#12 (1.062-12)	3/4	.75	2.00	1.75	.56	1.50	6.25	1.00	1.25	3.50
4.00	2.00	1.38	1.00	5.00	#12 (1.062-12)	3/4	.88	2.00	1.75	.56	2.12	6.62	1.38	1.75	3.75
5.00	2.50	1.75	1.25	6.50	#12 (1.062-12)	3/4	.88	2.00	1.75	.75	2.25	7.12	1.75	2.12	4.25
6.00	2.50	2.00	1.25	7.50	#16 (1.312-12)	1	1.00*	2.25	2.25	.88	2.50	8.38*	2.00	2.38	4.88
7.00	3.00	2.50	1.50	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	2.75	1.00	3.00	9.50	2.50	2.94	5.38
8.00	3.00	3.00	1.50	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	3.00	1.06	3.25	10.50	2.75	3.19	6.12

†CB tolerances are +.016, +.047 for MP1; and ±.005 for MP3 ††CD tolerances are +.003, +.005 for MP3.
 * With (K) Rod F = .88, LB = 8.25 ** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

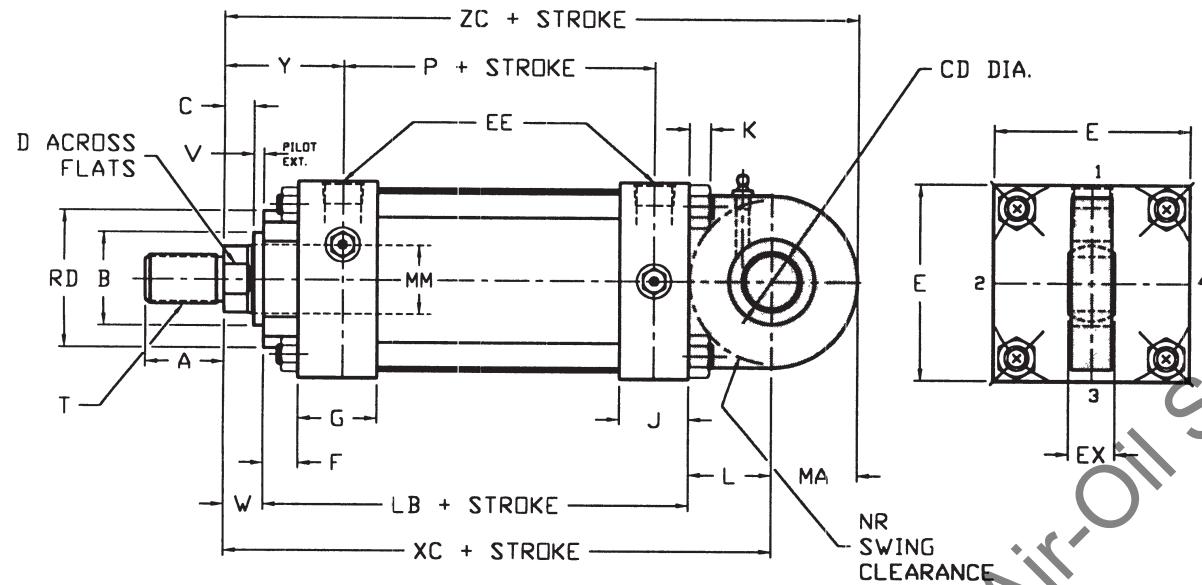
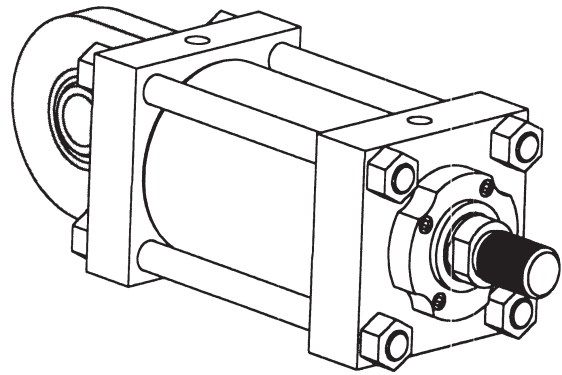
NOTE: Some bore and rod combinations have reduced pressure ratings on the tension stroke when used with a mounting bracket.

NOTE: Pivot pin supplied with MP1 cylinder; Pivot pin *not* supplied with MP3 cylinder.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-6.00" Bores MPU3 Spherical Bearing Mount



These Dimensions Are Constant Regardless of Rod Diameter

BORE	CD -0.0005	E	EE		EX	F	G	J	K	L	LB	MA	NR	P
			SAE STRAIGHT THREAD	NPTF**										
1.50	0.5000	2.50	#8 (.750-16)	1/2	.44	.38	1.75	1.50	.31	.75	5.00	.88	.62	2.88
2.00	0.7500	3.00	#8 (.750-16)	1/2	.66	.62	1.75	1.50	.44	1.25	5.25	1.25	1.00	2.88
2.50	0.7500	3.50	#8 (.750-16)	1/2	.66	.62	1.75	1.50	.44	1.25	5.38	1.25	1.00	3.00
3.25	1.0000	4.50	#12 (1.062-12)	3/4	.88	.75	2.00	1.75	.56	1.50	6.25	1.62	1.25	3.50
4.00	1.3750	5.00	#12 (1.062-12)	3/4	1.19	.88	2.00	1.75	.56	2.12	6.62	2.19	1.62	3.75
5.00	1.7500	6.50	#12 (1.062-12)	3/4	1.53	.88	2.00	1.75	.75	2.25	7.12	2.81	2.06	4.25
6.00	2.0000	7.50	#16 (1.312-12)	1	1.75	1.00*	2.25	2.25	.88	2.50	8.33*	3.19	2.38	4.88

*With (K) Rod F = .88, LB = 8.25 **NPTF ports will be furnished as standard unless SAE straight thread ports are specified

MPU3

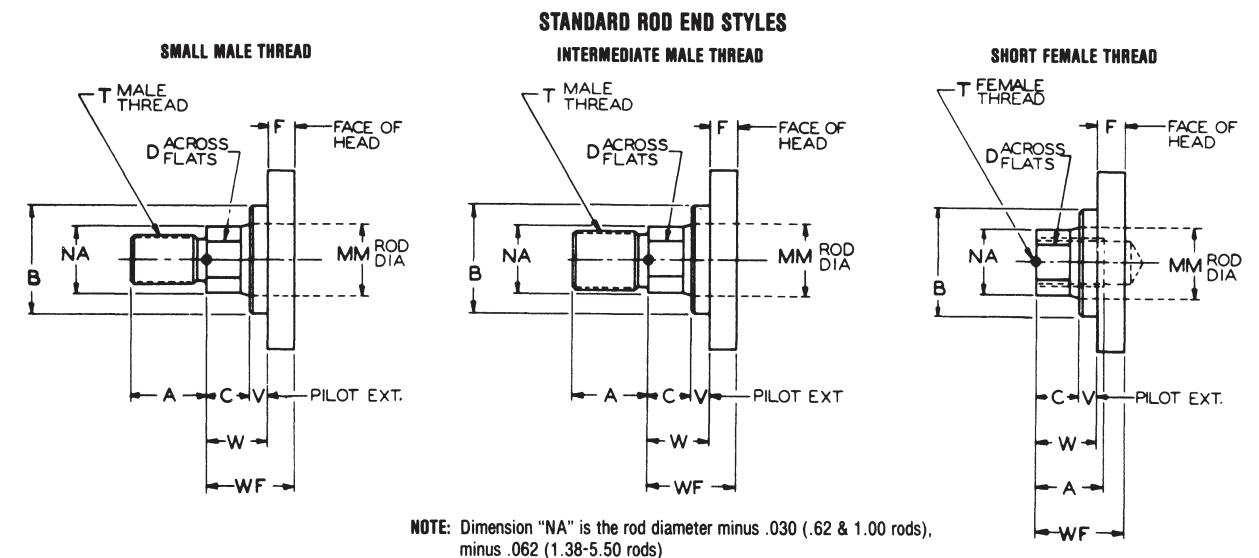
Dimensions Are Affected by Rod Diameter

BORE	ROD DIA CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	XC	Y	ZC	PSI RATING†
									SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	44-20	.50-20	.44-20	.25	.62	6.38	2.00	7.25	1250
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-15	.50	1.00	6.75	2.38	7.62	1250
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	7.25	2.38	8.50	2200
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.50	2.62	8.75	2200
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	7.38	2.38	8.62	1450
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	7.62	2.62	8.88	1450
2.50	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.88	2.88	9.12	1450
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.00-14	1.25-12	1.00-14	.25	.88	8.62	2.75	10.25	1500
3.25	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.88	3.00	10.50	1500
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	9.00	3.12	10.62	1500
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	9.75	3.00	11.94	1850
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	9.88	3.12	12.06	1850
4.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	10.12	3.38	12.31	1850
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	10.50	3.12	13.31	2000
5.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	10.75	3.38	13.56	2000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	10.75	3.38	13.56	2000
5.00	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	10.75	3.38	13.56	2000
	M	3.50	3.50	4.250	1.00	3.00	3.50	5.62	2.50-12	3.25-12	2.50-12	.38	1.38	10.75	3.38	13.56	2000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	12.12	3.50	15.31	1500
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	12.12	3.50	15.31	1500
6.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	12.12	3.50	15.31	1500
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	12.12	3.50	15.31	1500

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

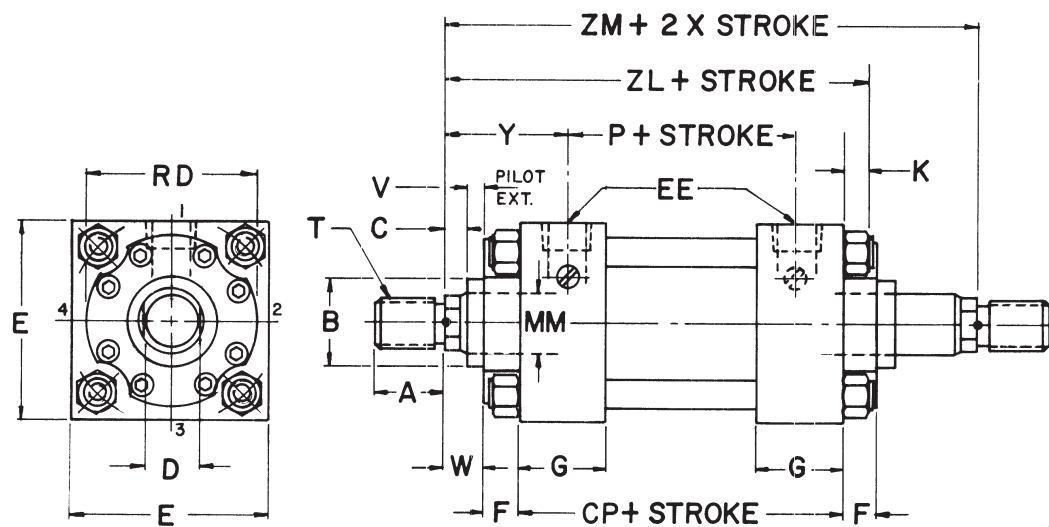
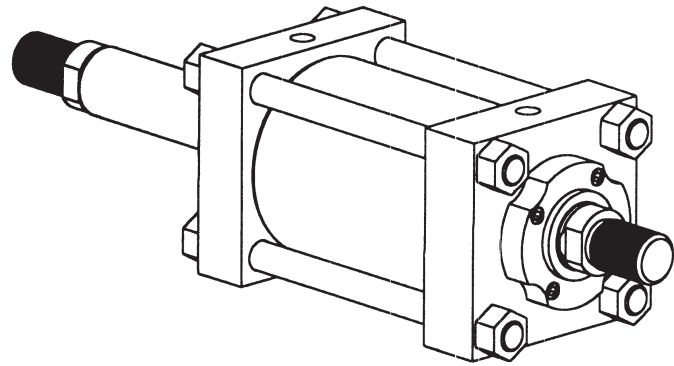
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50"-8.00" Bores MXO-D Double Rod End†



These Dimensions are Constant Regardless of Rod Diameter

BORE	CP	E	EE		F	G	K	P
			SAE STRAIGHT THREAD	NPTF**				
1.50	4.88	2.50	#8 (750-16)	1/2	.38	1.75	.31	2.88
2.00	4.88	3.00	#8 (750-16)	1/2	.62	1.75	.44	2.88
2.50	5.00	3.50	#8 (750-16)	1/2	.62	1.75	.44	3.00
3.25	5.75	4.50	#12 (1.062-12)	3/4	.75	2.00	.56	3.50
4.00	6.00	5.00	#12 (1.062-12)	3/4	.88	2.00	.56	3.75
5.00	6.50	6.50	#12 (1.062-12)	3/4	.88	2.00	.75	4.25
6.00	7.38	7.50	#16 (1.312-12)	1	1.00*	2.25	.88	4.88
7.00	8.50	8.50	#20 (1.625-12)	1 1/4	1.00	2.75	1.00	5.38
8.00	9.50	9.50	#24 (1.875-12)	1 1/2	1.00	3.00	1.06	6.12

* With (K) Rod F = .88

** NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

† Available in MS2, MS3, MS4, MS7, MF1, MF5, ME5, MT1, MT4, see single rod pages for mounting dimensions and appropriate P.S.I. Ratings.

For Models MS2 and MS3 (1.50" thru 5.00" bores), add .25" to Dimension "SS."
For Models MS7 and MS4, consult factory for Dimensions "SE" and "SN."

MXO-D

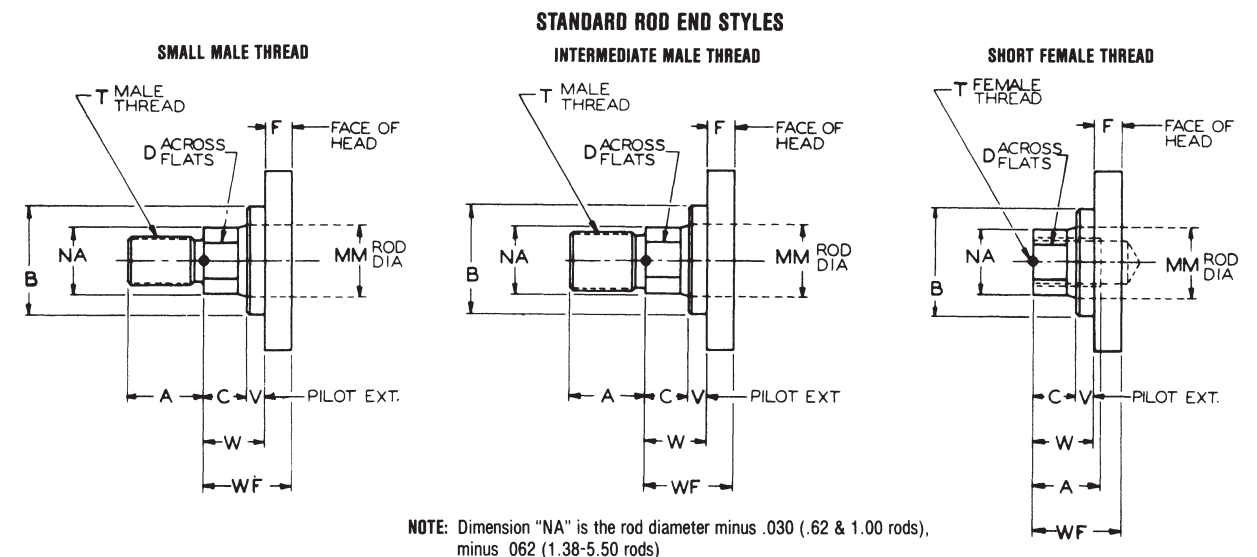
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD)			V	W	Y	ZL	ZM	PSI RATING†
	ROD DIA. CODE	ROD DIA.							SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.62	-	.44-20	.50-20	44-20	.25	.62	2.00	6.19	6.88	3000
	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.50	1.00	2.38	6.94	7.62	3000
2.00	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.69	7.62	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	7.56	8.12	3000
2.50	F	1.00	1.12	1.500	.50	.88	1.00	-	.75-16	.88-14	.75-16	.25	.75	2.38	6.81	7.75	3000
	G	1.38	1.62	2.000	.62	1.12	1.38	-	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	7.69	8.25	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	7.94	8.75	3000
3.25	G	1.38	1.62	2.000	.62	1.12	1.38	3.50	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.94	9.00	3000
	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	8.19	9.50	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	3.88	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	8.31	9.75	3000
4.00	H	1.75	2.00	2.375	.75	1.50	1.75	3.50	1.25-12	1.50-12	1.25-12	.25	1.00	3.00	8.44	9.75	3000
	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	8.56	10.00	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	8.81	10.50	3000
5.00	J	2.00	2.25	2.625	.88	1.69	2.00	4.25	1.50-12	1.75-12	1.50-12	.25	1.12	3.12	9.25	10.50	3000
	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.38	9.50	11.00	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	3.38	9.50	11.00	3000
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	4.25	1.88-12	2.25-12	1.88-12	.38	1.38	3.50	10.50	11.88	3000
	L	3.00	3.50	3.750	1.00	2.62	3.00	6.38	2.25-12	2.75-12	2.25-12	.25	1.25	3.50	10.50	11.88	3000
	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.50	10.50	11.88	3000
7.00	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.81	11.75	13.00	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	7.50	3.25-12	4.25-12	3.25-12	.25	1.25	3.81	11.75	13.00	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	7.50	3.50-12	4.75-12	3.50-12	.25	1.25	3.81	11.75	13.00	3000
8.00	M	3.50	3.50	4.250	1.00	3.00	3.50	6.38	2.50-12	3.25-12	2.50-12	.25	1.25	3.94	12.81	14.00	3000
	N	4.00	4.00	4.750	1.00	3.38	4.00	6.38	3.00-12	3.75-12	3.00-12	.25	1.25	3.94	12.81	14.00	3000
	P	4.50	4.50	5.250	1.00	3.88	4.50	8.00	3.25-12	4.25-12	3.25-12	.25	1.25	3.94	12.81	14.00	3000
	R	5.00	5.00	5.750	1.00	4.25	5.00	8.00	3.50-12	4.75-12	3.50-12	.25	1.25	3.94	12.81	14.00	3000
	S	5.50	5.50	6.250	1.00	4.62	5.50	8.00	4.00-12	5.25-12	4.00-12	.25	1.25	3.94	12.81	14.00	3000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

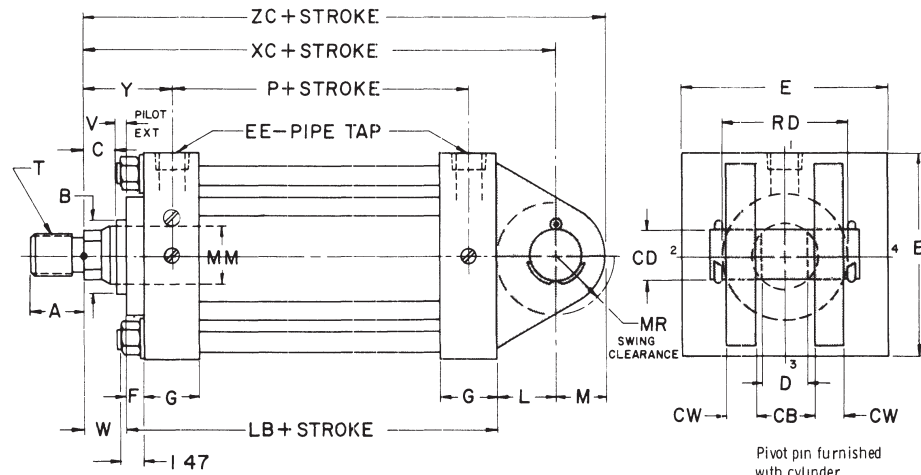
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

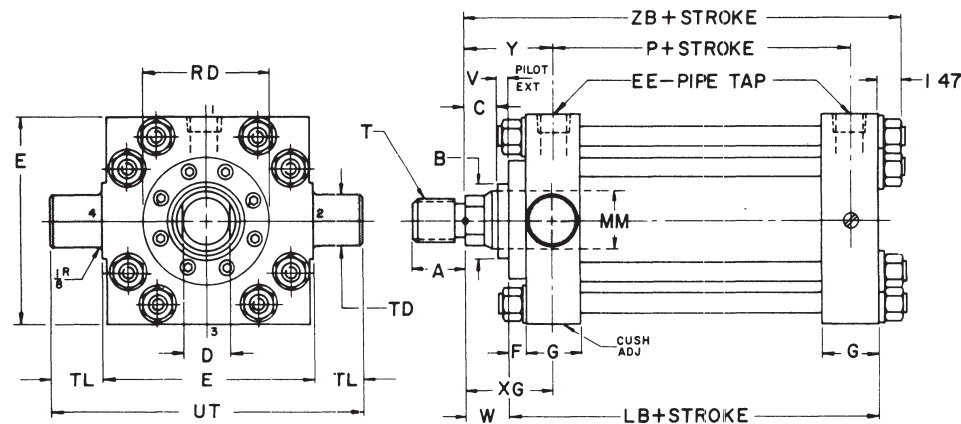


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

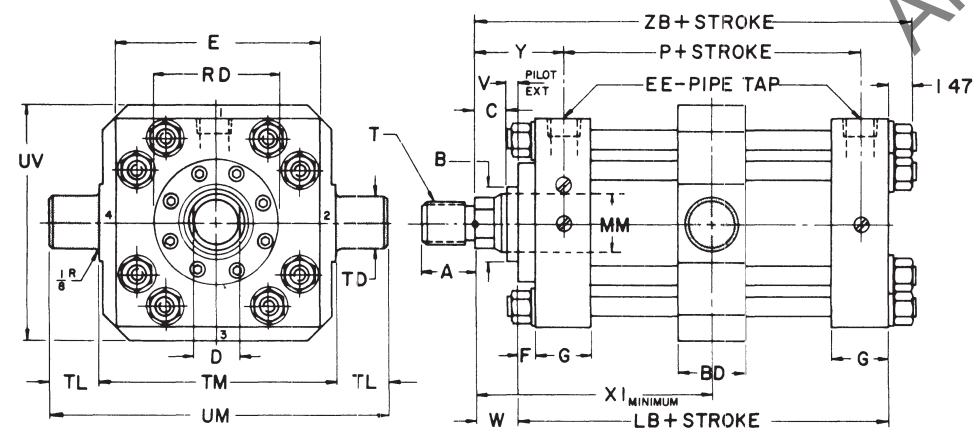
SERIES 2H 10.00"-14.00" Bores MP1 Fixed Clevis Mount



MT1 Head Trunnion Mount



MT4 Intermediate Fixed Trunnion Mount



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions

NOTE: Trunnion location [XI] must be specified when ordering

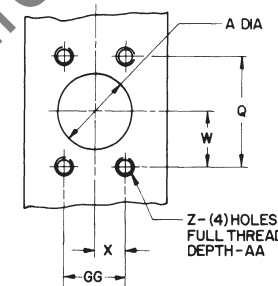
MP1, MT1, MT4

These Dimensions are Constant Regardless of Rod Diameter

BORE	BD	CB +.016 +.047	CD	CW	E	EE*	EE** S.A.E. FLANGE PORT	G	L	M	MR	P	TD +.000 -.002	TL	TM	UM	UT	UV
	N.P.T.F.		S.A.E. FLANGE PORT															
10.00	4.44	4.00	3.50	2.00	14	2	2	3.69	4.00	3.50	3.62	8.50	3.50	3.50	17.12	24.12	21	16
12.00	4.88	4.50	4.00	2.25	16	2½	2½	4.44	4.50	4.00	4.12	9.88	4.00	4.00	20.88	28.88	24	19.50
14.00	6.00	6.00	5.00	3.00	18	2½	2½	4.88	5.75	5.00	5.12	10.38	5.00	5.00	25.25	35.25	28	25.88

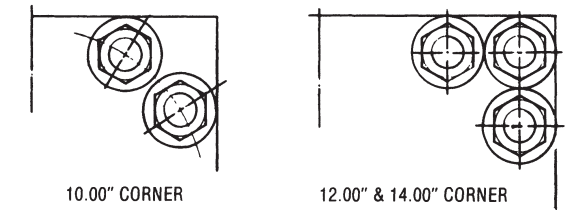
* N.P.T.F. Ports are furnished as standard.
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer.

OPTIONAL SAE FLANGE PORT PATTERN CODE 61 3000 P.S.I.

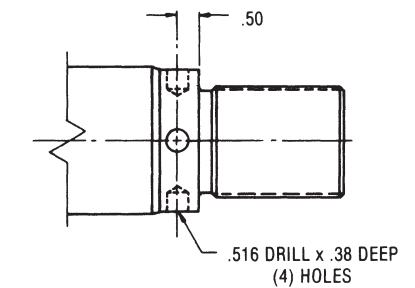


NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

TIE ROD CONSTRUCTION



SPANNER HOLES Furnished with 7, 8 & 10" Rod Diameters



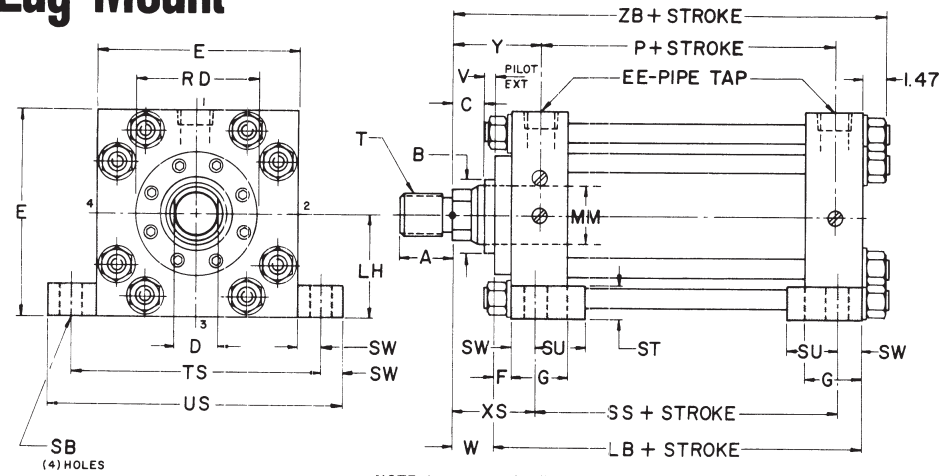
Dimensions are Affected by the Rod Diameter

BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	XC	XG	XI MIN.	Y	ZB	ZC	PSI RATING†		
																			MP1	MT1 MT2	MT4
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	19.06	4.75	8.94	4.75	16.53	22.56	3000	1365	1825
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	19.31	5.00	9.19	5.00	16.78	22.81	3000	1365	1825
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	.25	2.19	19.31	5.00	9.19	5.00	16.78	22.81	3000	1365	1825
10.00	7.00	T	7.00	7.750	1.00	*-1.06	1.06	13.19	10.00	5.50-12	1.38	2.38	19.56	5.25	9.44	5.25	17.03	23.06	3000	1365	1825
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	.25	2.19	22.19	5.38	10.06	5.50	19.16	26.19	3000	1250	1660
12.00	7.00	T	7.00	7.750	1.00	*-1.06	1.06	15.56	10.00	5.50-12	1.38	2.38	22.44	5.62	10.31	5.75	19.41	26.44	3000	1250	1660
12.00	8.00	U	8.00	8.750	1.00	*-1.12	1.12	15.62	11.00	6.00-12	1.31	2.31	22.44	5.62	10.31	5.75	19.41	26.44	3000	1250	1660
14.00	7.00	T	7.00	7.750	1.00	*-1.06	1.06	16.69	10.00	5.50-12	1.38	2.38	24.81	5.81	11.31	6.06	20.53	29.81	3000	1425	1900
14.00	8.00	U	8.00	8.750	1.00	*-1.12	1.12	16.75	11.00	6.00-12	1.31	2.31	24.81	5.81	11.31	6.06	20.53	29.81	3000	1425	1900
14.00	10.00	V	10.00	10.750	1.00	*-1.12	1.12	16.75	13.00	7.50-12	1.31	2.31	24.81	5.81	11.31	6.06	20.53	29.81	3000	1425	1900

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

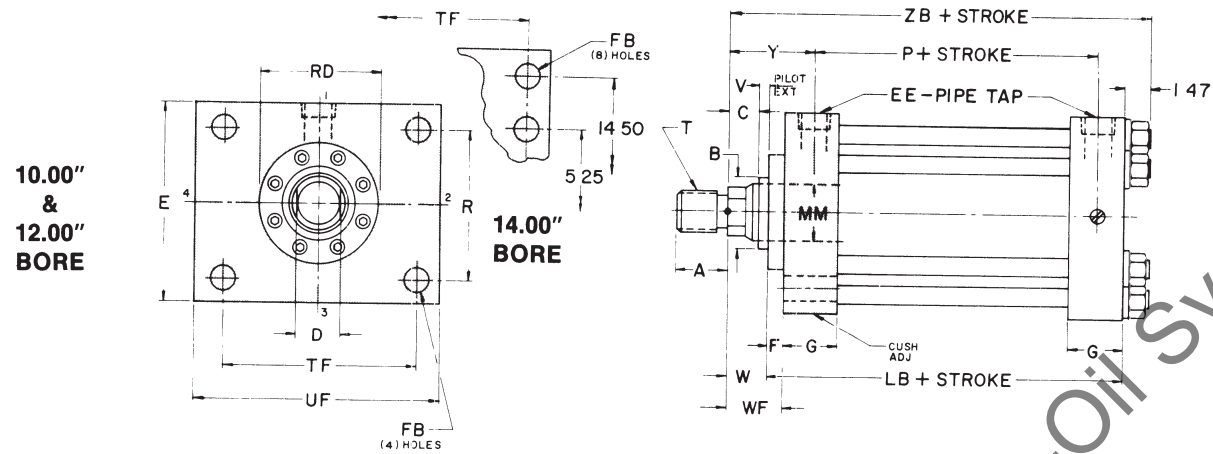
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

SERIES 2H 10.00"-14.00" Bores MS2 Side Lug Mount

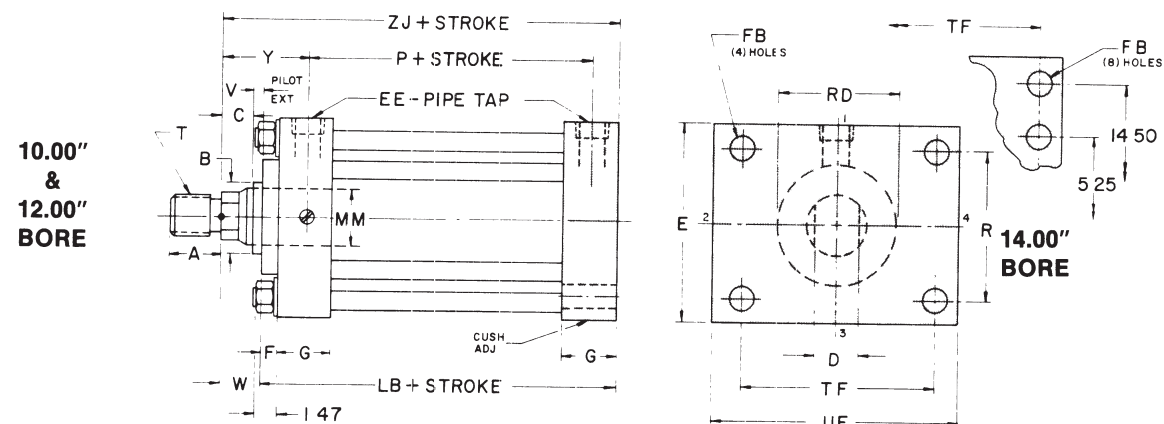


NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling

ME5 Head Flange Mount



ME6 Cap Flange Mount



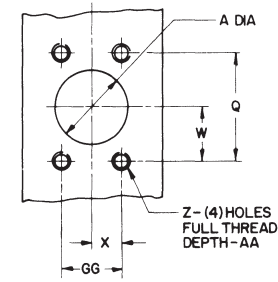
These Dimensions are Constant Regardless of Rod Diameter

MS2, ME5, ME6

BORE	EE*	EE**	E	FB	G	LH -.006 -.008	P	R	SB	SS	ST	SU	SW	TF	TS	UF	US
	N.P.T.F.	S.A.E. FLANGE PORT															
10.00	2	2	14	1.81	3.69	7.00	8.50	10.50	1.56	8.88	2.19	3.50	1.62	14	17.25	17.50	20.50
12.00	2½	2½	16	2.06	4.44	8.00	9.88	11.00	1.56	10.50	2.94	4.25	2.00	18	20.00	22	24.00
14.00	2½	2½	18	1.81	4.88	9.00	10.38	—	2.31	10.62	3.94	5.00	2.50	20.50	23.00	24	28.00

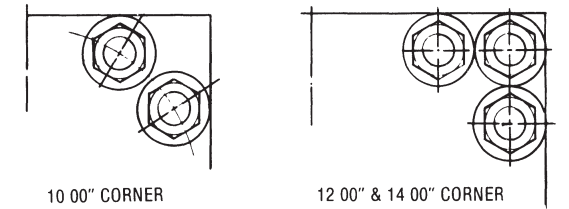
* N.P.T.F. Ports are furnished as standard
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer

OPTIONAL SAE FLANGE PORT PATTERN CODE 61 3000 P.S.I.

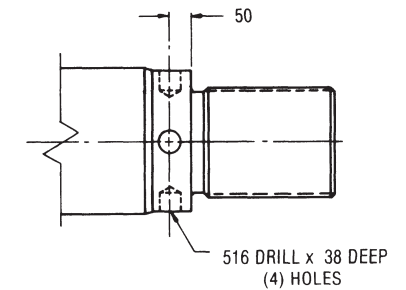


NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

TIE ROD CONSTRUCTION



SPANNER HOLES Furnished with 7, 8 & 10" Rod Diameters

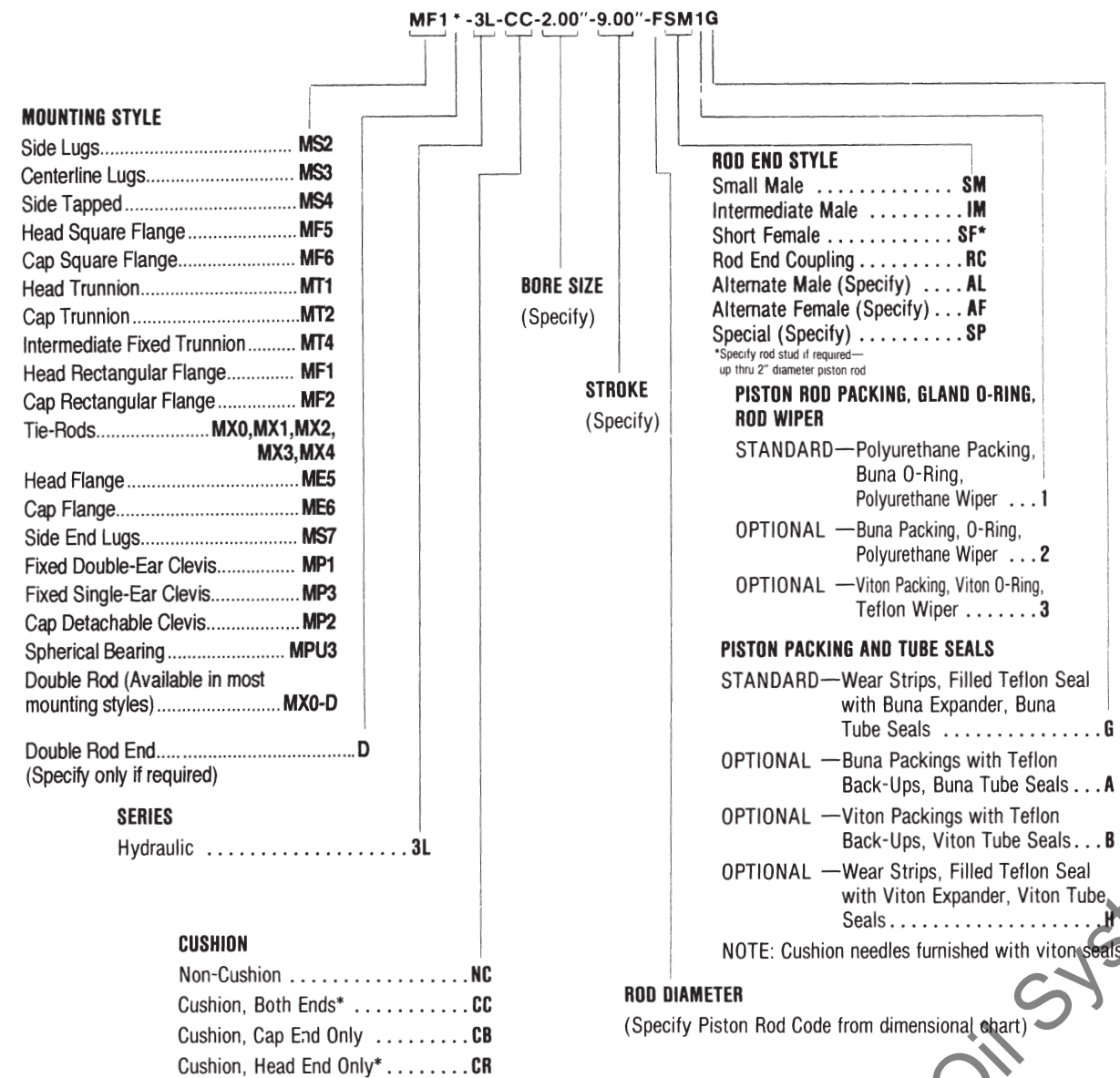


Dimensions are Affected by the Rod Diameter

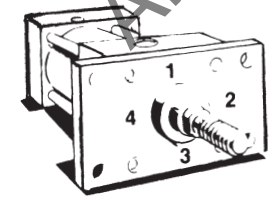
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	XS	Y	ZB	ZJ	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	2.94	4.56	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	3.19	4.81	5.00	16.78	15.31	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	.25	2.19	3.19	4.81	5.00	16.78	15.31	3000
10.00	7.00	T	7.00	7.750	1.00	*—	1.06	13.19	10.00	5.50-12	1.38	2.38	3.44	5.06	5.25	17.03	15.56	3000
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	.25	2.19	3.19	5.19	5.50	19.16	17.69	3000
12.00	7.00	T	7.00	7.750	1.00	*—	1.06	15.56	10.00	5.50-12	1.38	2.38	3.44	5.44	5.75	19.41	17.94	3000
12.00	8.00	U	8.00	8.750	1.00	*—	1.12	15.62	11.00	6.00-12	1.31	2.31	3.44	5.44	5.75	19.41	17.94	3000
14.00	7.00	T	7.00	7.750	1.00	*—	1.06	16.69	10.00	5.50-12	1.38	2.38	3.44	5.94	6.06	20.53	19.06	3000
14.00	8.00	U	8.00	8.750	1.00	*—	1.12	16.75	11.00	6.00-12	1.31	2.31	3.44	5.94	6.06	20.53	19.06	3000
14.00	10.00	V	10.00	10.750	1.00	*—	1.12	16.75	13.00	7.50-12	1.31	2.31	3.44	5.94	6.06	20.53	19.06	3000

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.



Port location: if other than position 1, must be specified. Mounting accessories must be specified if required. See Page 85.

1.50" thru 6.00" Bores		Description	Page No.	
Side Lug Mount MS2		Centerline Lug Mount MS3	MS3	Side Lug Mount..... 46 Centerline Lug Mount..... 48
Side Tapped Mount MS4		End Lug Mount MS7	MS7	Side Tapped Mount..... 50 End Lug Mount..... 52
Head Rectangular Flange Mount MF1		Cap Rectangular Flange Mount MF2	MF2	Head Rectangular Flange Mount..... 54 Cap Rectangular Flange Mount..... 56
Head Square Flange Mount MF5		Cap Square Flange Mount MF6	MF6	Head Square Flange Mount..... 58 Cap Square Flange Mount..... 60
Head Flange Mount ME5		Cap Flange Mount ME6	ME6	Head Flange Mount..... 62 Cap Flange Mount..... 64
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Head Trunnion Mount MT1		Cap Trunnion Mount MT2	MT2	Head Trunnion Mount..... 68 Cap Trunnion Mount..... 70
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MOUNTING ACCESSORIES, OPTIONS.....	94

HANNA
cylinders

Series 3L Medium-Duty Hydraulic Cylinders

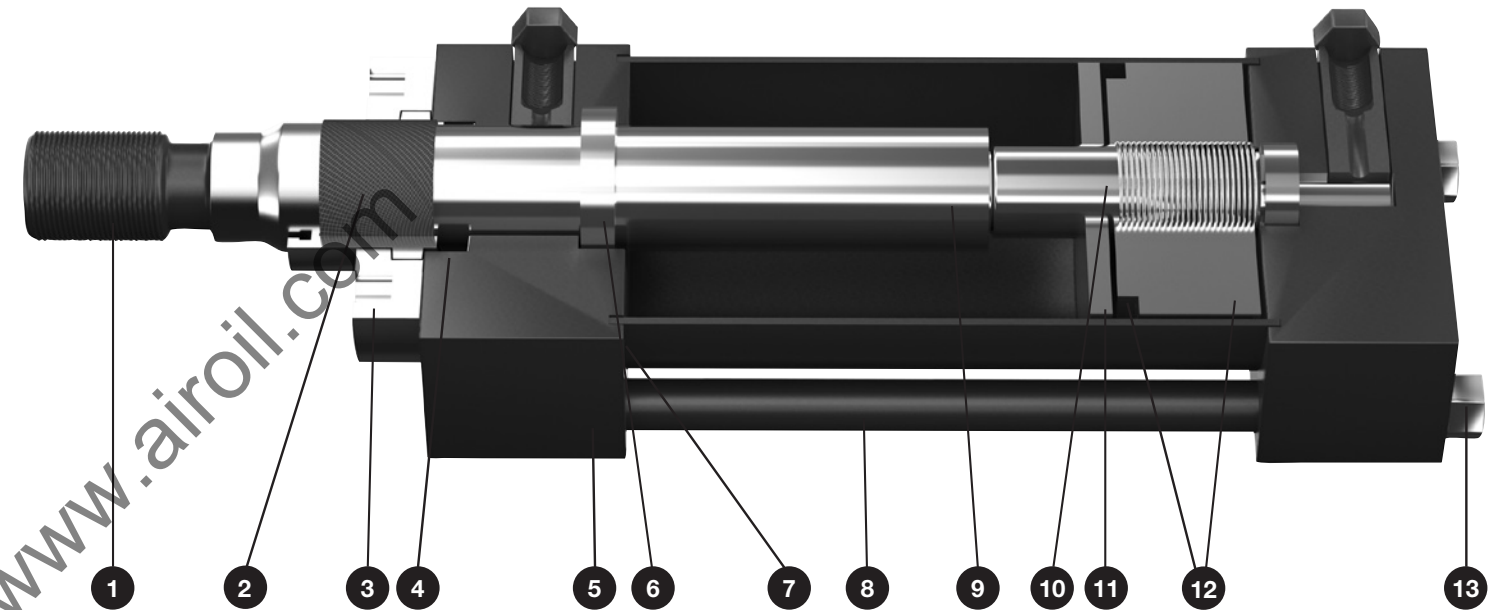
Hanna's Series 3L medium-pressure hydraulic cylinders are designed and built to meet today's exacting industrial requirements.

Extensive laboratory testing and countless field applications have proved conclusively that 3L cylinders provide millions of maintenance-free cycles. The reason: the combination of Hanna's unique Duralon® rod bearing and our glass-filled Teflon® piston seal with a bronze-impregnated bearing strip completely eliminates metal-to-metal contact at bearing surfaces.

Series 3L cylinders give you virtually unlimited flexibility in machinery design, with a full range of bore sizes (1.50" through 6.00") offered. Developed for pressure ratings of 600 to 1,800 p.s.i., Series 3L cylinders are available in 24 N.F.P.A. mounting styles.

When ordering, specify piston packing code "G" for moderate temperatures, and Code "H" for high temperature service.

Duralon is a Trademark of Rexnord, Inc.
Teflon and Dacron are Trademarks of DuPont Company



Series 3L Features and Benefits

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity. Studded rod ends are available.

2. Duralon Rod Bearing

Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings are capable of sustaining much higher compressive loads than either bronze or cast iron, have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

3. Gland Construction

Two-piece (gland plus retainer plate), bolted-on or full-face retainer design. Packings may be captive in the gland or located in the head.

4. Rod Seal

Series 3L cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance. Viton U-cup is available for higher temperature service.

5. Heads

Steel heads are precision-machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

6. Cushion Check Seals

With self-aligning, full-floating design, the cushion check seals are closely fitted to cushion sleeve and spear. The seals serve as both cushion seal and check valve, providing effective cushioning and fast breakaway.

7. Tube Seal

Buna-N O-ring seal. Viton available for higher temperature service.

8. Tubing

Steel tubing is precision-honed to a 16-20 micro-inch finish for close fit to piston bearing and tube wall. Chrome-plated for wear resistance.

9. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failures. The rods provide 100,000 minimum yield strength in diameters up to 3.50"; 59,000 average yield strength in 4.00" diameter and above. All sizes are hard chrome plated for scratch

and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish. Rods up to 4.00" diameter are also case hardened for dent resistance.

10. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

11. Piston

One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

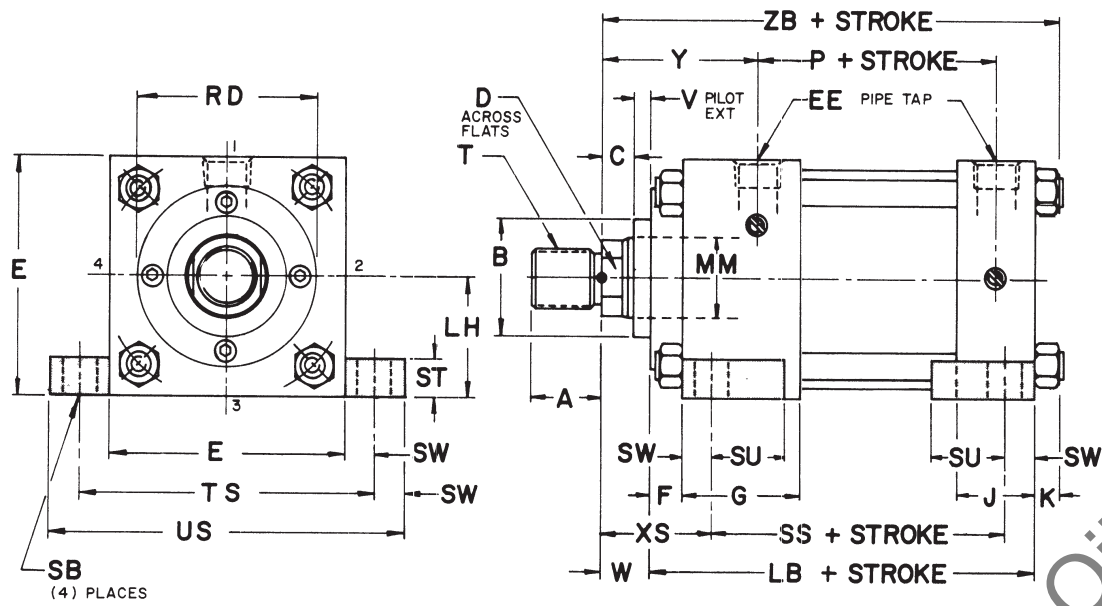
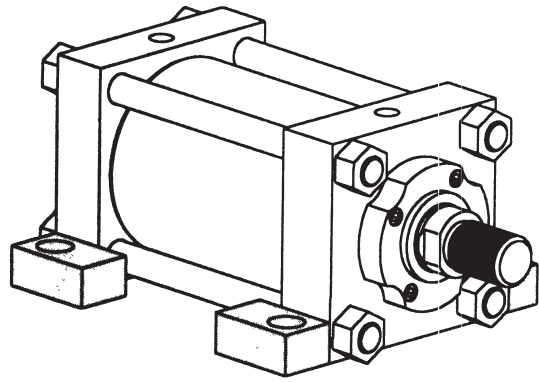
12. Piston Sealing System

Hanna's glass-filled, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with U-cup type seals. A bronze-filled Teflon bearing strip provides a non-metallic bearing point on the piston, assuring long life and extremely low friction.

13. Tie Rods

Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.

SERIES 3L 1.50"-6.00" Bores MS2 Side Lug Mount



NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	LH -.006 -.008	P	SB	SS	ST	SU	SW	TS ±.010	US
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	1.000	2.31	.438	2.88	.50	.94	.38	2.75	3.50
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	1.250	2.31	.438	2.88	.50	.94	.38	3.25	4.00
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	1.500	2.44	.438	3.00	.50	.94	.38	3.75	4.50
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	1.875	2.69	.562	3.25	.75	1.25	.50	4.75	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.250	2.69	.562	3.25	.75	1.25	.50	5.50	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.750	2.94	.812	3.12	1.00	1.56	.69	6.88	8.25
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.250	3.19	.812	3.62	1.00	1.56	.69	7.88	9.25

MS2

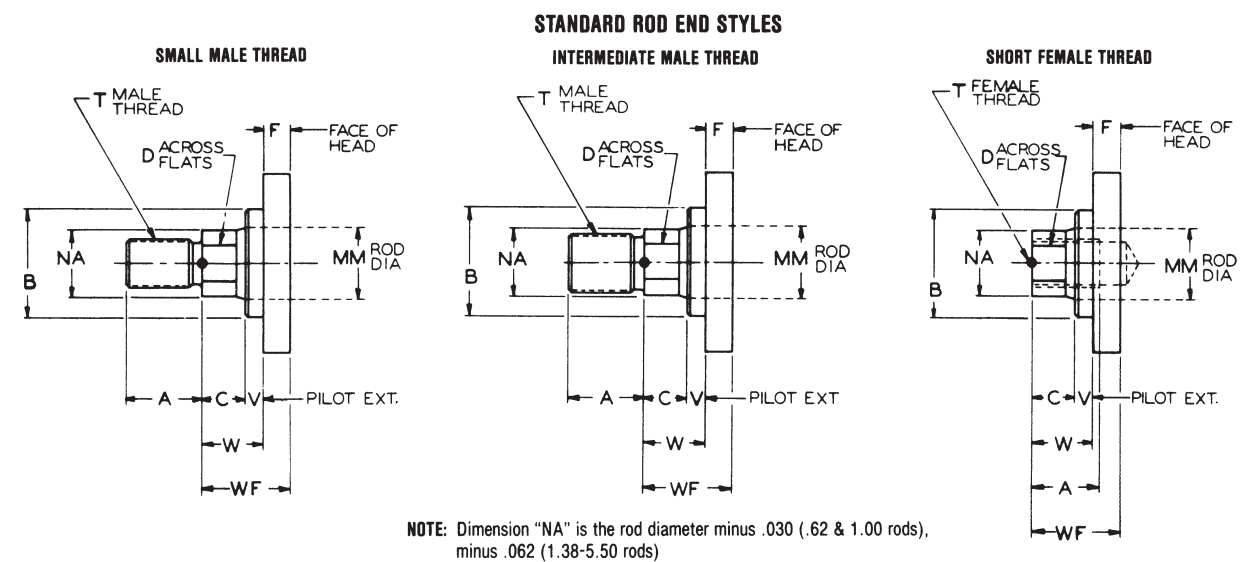
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XS	Y	ZB	PSI RATING†
	ROD DIA.	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.31	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.44	1400
3.25	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.00	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.25	2.75	5.94	1400
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	1.88	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.12	2.62	6.25	900
5.00	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.38	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.50	3.00	6.62	900
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	2.75	3.25	6.88	900
	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.06	2.38	6.31	750
7.50	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.31	2.62	6.56	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.56	2.88	6.81	1000
9.00	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.69	3.00	6.94	1000
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	2.94	3.25	7.19	1000
10.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	2.94	3.25	7.19	1000
	M	3.50	4.00	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	2.94	3.25	7.19	1000
12.00	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.31	2.75	7.06	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	2.56	3.00	7.31	750
15.00	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	2.69	3.12	7.44	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.50	2.94	3.38	7.69	750
18.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.50	2.94	3.38	7.69	750
	M	3.50	4.00	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.50	2.94	3.38	7.69	750
21.00	N	4.00	4.50	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.69	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

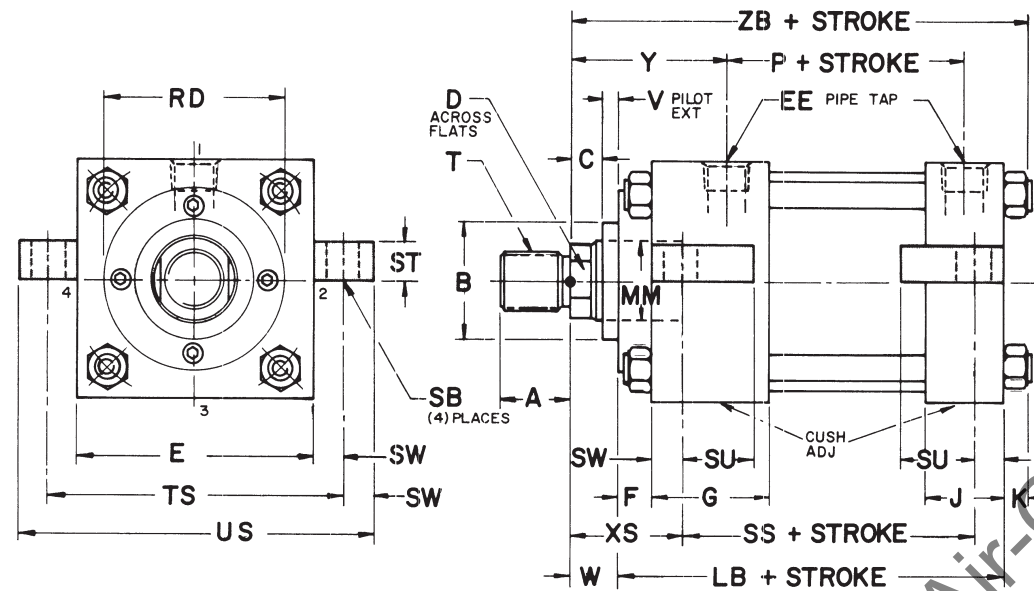
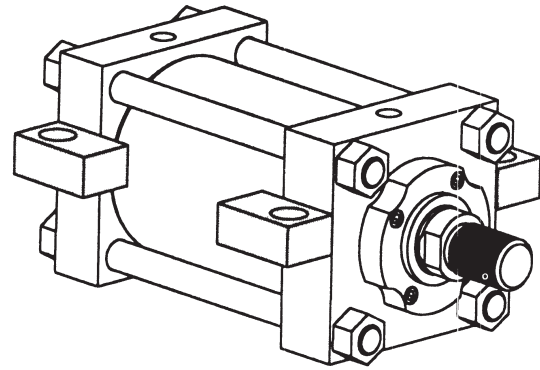
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MS3 Centerline Lug Mount



NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	P	SB	SS	ST	SU	SW	TS ±.010	US
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	4.38	2.88	50	.94	.38	2.75	3.50
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	4.38	2.88	50	.94	.38	3.25	4.00
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	4.38	3.00	.50	.94	.38	3.75	4.50
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	5.62	3.25	.75	1.25	.50	4.75	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	5.62	3.25	.75	1.25	.50	5.50	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	.812	3.12	1.00	1.56	.69	6.88	8.25
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	.812	3.62	1.00	1.56	.69	7.88	9.25

MS3

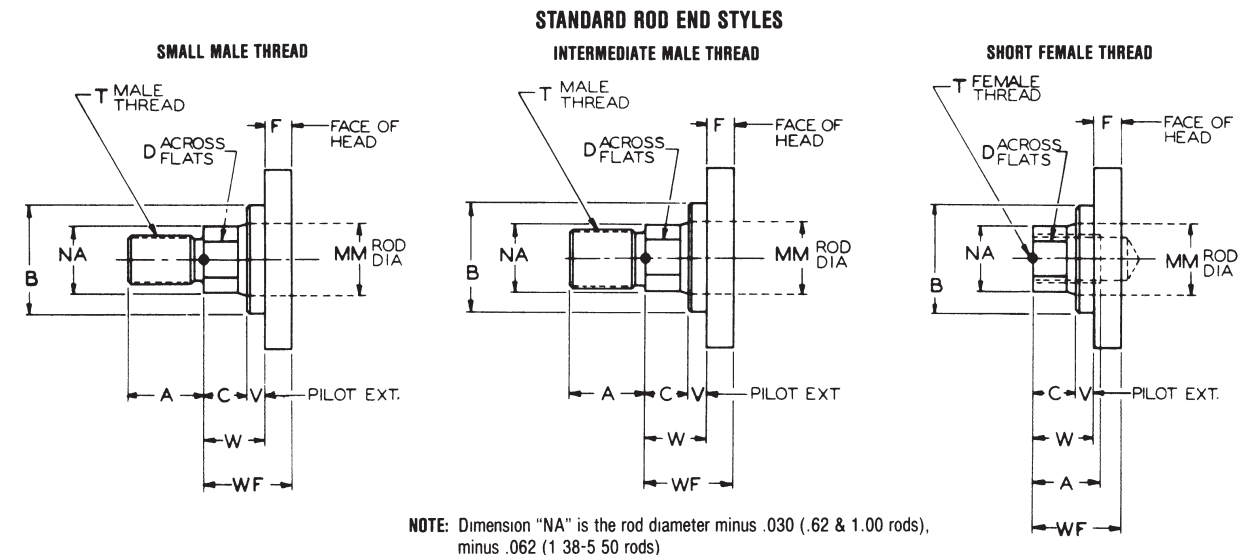
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XS	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	44-20	25	62	1.38	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	88-14	75-16	50	1.00	1.75	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	25	62	1.38	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	75-16	50	1.00	1.75	2.25	5.31	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	62	1.25	2.00	2.50	5.56	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	25	62	1.38	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	75-16	50	1.00	1.75	2.25	5.44	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	62	1.25	2.00	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	75	1.50	2.25	2.75	5.94	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	75-16	25	75	1.88	2.38	6.00	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	2.12	2.62	6.25	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	2.38	2.88	6.50	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	2.50	3.00	6.62	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	75-16	25	75	1.88	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	2.12	2.62	6.25	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	2.38	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	2.50	3.00	6.62	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	75-16	25	75	2.06	2.38	6.31	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	2.31	2.62	6.56	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	2.56	2.88	6.81	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	2.69	3.00	6.94	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	62	1.62	2.94	3.25	7.19	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	62	1.62	2.94	3.25	7.19	1000
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	62	1.62	2.94	3.25	7.19	1000
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	25	.88	2.31	2.75	7.06	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	38	1.12	2.56	3.00	7.31	750
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	38	1.25	2.69	3.12	7.44	750
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	50	1.50	2.94	3.38	7.69	750
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	50	1.50	2.94	3.38	7.69	750
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	50	1.50	2.94	3.38	7.69	750
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	50	1.50	2.94	3.38	7.69	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

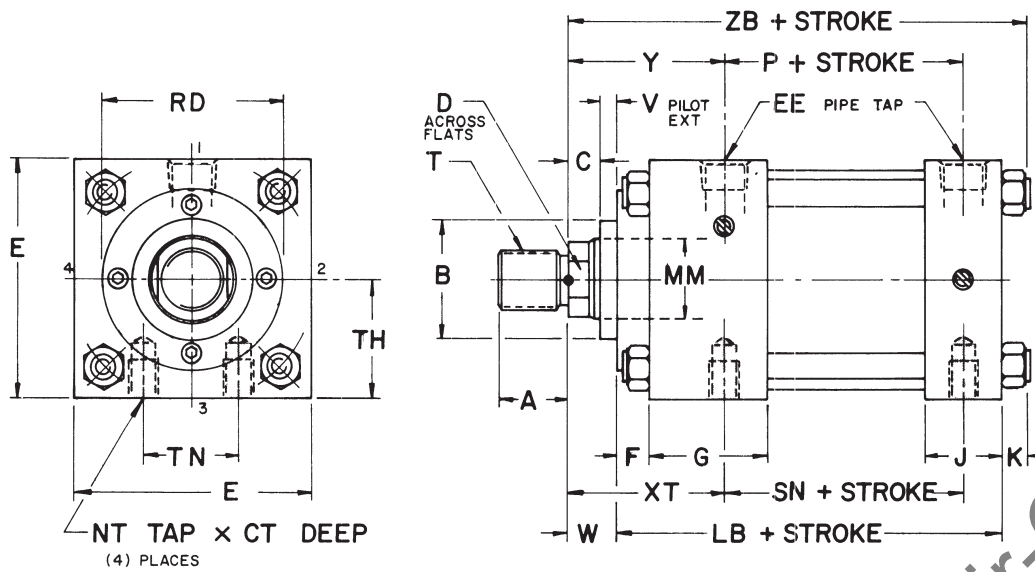
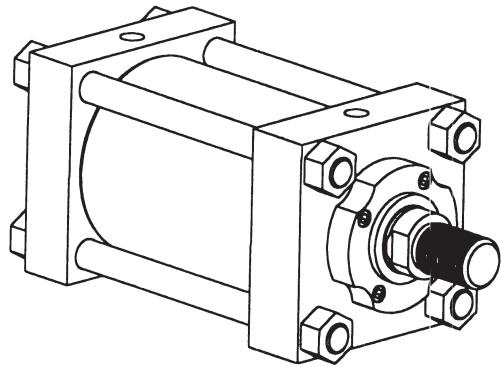
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.0 rods)

SERIES 3L 1.50"-6.00" Bores MS4 Side Tapped Mount



NOTE: For high loads thrust key is recommended.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	TH -.006 -.008	EE (NPTF)	F	G	J	K	LB	NT	P	SN	TN ±.010
1.50	2.00	1.000	3/8	.38	1.50	1.00	.25	4.00	25-20	2.31	2.25	.62
2.00	2.50	1.250	3/8	.38	1.50	1.00	.31	4.00	.31-18	2.31	2.25	.88
2.50	3.00	1.500	3/8	.38	1.50	1.00	.31	4.12	38-16	2.44	2.38	1.25
3.25	3.75	1.875	1/2	.62	1.75	1.25	.38	4.88	50-13	2.69	2.62	1.50
4.00	4.50	2.250	1/2	.62	1.75	1.25	.38	4.88	50-13	2.69	2.62	2.06
5.00	5.50	2.750	1/2	.62	1.75	1.25	.44	5.12	62-11	2.94	2.88	2.69
6.00	6.50	3.250	3/4	.75	2.00	1.50	.44	5.75	75-10	3.19	3.12	3.25

MS4

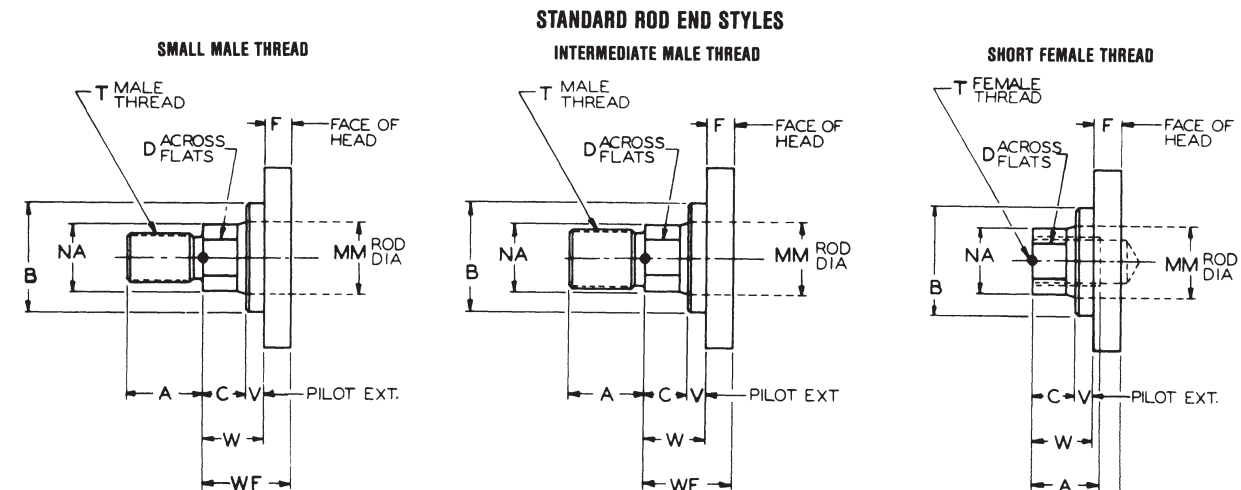
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	*CT	XT	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	.50-20	.44-20	.25	.38	1.94	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	-	-	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.38	1.94	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	.38	2.31	2.25	5.31	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	-	2.50	5.56	1800	
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.50	1.94	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	.50	2.31	2.25	5.44	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	.50	2.56	5.69	1400	
	J	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	-	2.75	5.94	1400	
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.50	2.44	2.38	6.00	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	.50	2.69	2.62	6.25	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	.50	2.94	2.88	6.50	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	.75	3.06	3.00	6.62	900
4.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	.75	3.31	3.00	6.88	900
	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.44	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	.75	2.69	2.62	6.25	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	.75	2.94	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	.75	3.06	3.00	6.62	900
5.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.00	3.31	3.25	7.19	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.00	3.31	3.25	7.19	1000
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.00	3.31	3.25	7.19	1000
	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	1.00	2.44	2.38	6.31	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.69	2.62	6.56	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.00	2.94	2.88	6.81	1000
6.00	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.00	3.06	3.00	6.94	1000
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.12	3.44	3.38	7.69	750
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.12	3.44	3.38	7.69	750
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.12	3.44	3.38	7.69	750
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.12	3.44	3.38	7.69	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

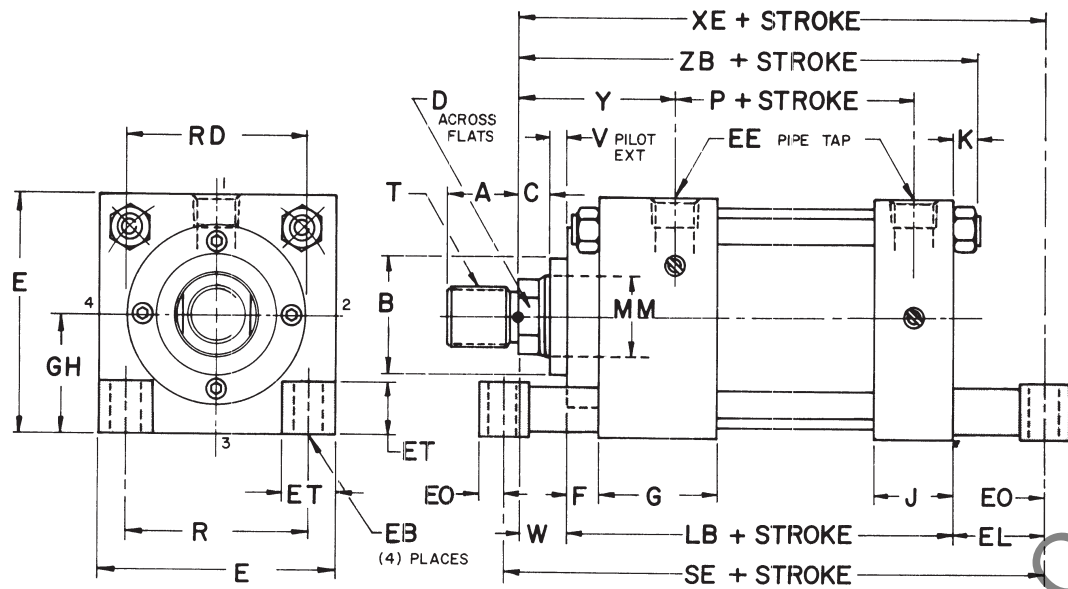
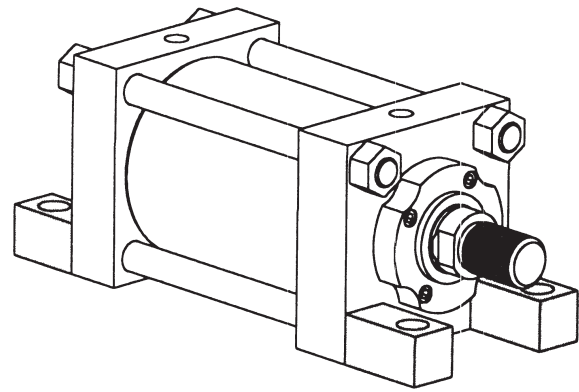
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MS7 End Lug Mount



NOTE Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	GH -.006 -.008	EB	EE (NPTF)	EL	EO	ET	F	G	J	K	LB	P	R ±.010	SE
1.50	2.00	1.000	.31	3/8	.75	.34	.56	.38	1.50	1.00	.25	4.00	2.31	1.43	5.50
2.00	2.50	1.250	.38	3/8	.94	.31	.62	.38	1.50	1.00	.31	4.00	2.31	1.84	5.88
2.50	3.00	1.500	.38	3/8	1.06	.31	.81	.38	1.50	1.00	.31	4.12	2.44	2.19	6.25
3.25	3.75	1.875	.44	1/2	.38	.38	1.00	.62	1.75	1.25	.38	4.88	2.69	2.76	6.62
4.00	4.50	2.250	.44	1/2	1.00	.38	1.19	.62	1.75	1.25	.38	4.88	2.69	3.32	6.88
5.00	5.50	2.750	.56	1/2	1.06	.50	1.40	.62	1.75	1.25	.44	5.12	2.94	4.10	7.25
6.00	6.50	3.250	.56	3/4	1.00	.50	1.62	.75	2.00	1.50	.44	5.75	3.19	4.88	7.75

CAUTION: Check for interference between rod attachment and mounting lug. If necessary, specify longer than standard "C" dimension.

MS7

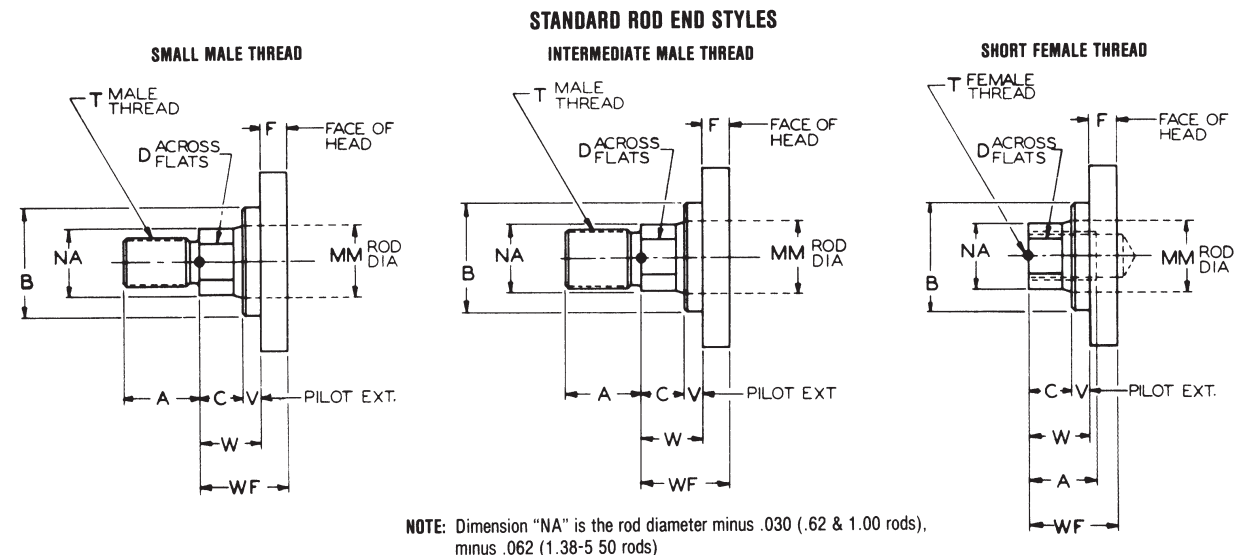
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XE	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	.50-20	.44-20	.25	.62	5.38	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	5.75	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	5.56	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	5.94	2.25	5.31	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	6.19	2.50	5.56	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	5.81	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	6.19	2.25	5.44	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	6.44	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	6.69	2.75	5.94	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	6.50	2.38	6.00	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	6.75	2.62	6.25	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.00	2.88	6.50	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	7.12	3.00	6.62	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	6.62	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	6.88	2.62	6.25	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.12	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	7.25	3.00	6.62	900
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	7.50	3.25	6.88	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	6.94	2.38	6.31	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	7.19	2.62	6.56	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.44	2.88	6.81	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	7.56	3.00	6.94	1000
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	7.81	3.25	7.19	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	7.81	3.25	7.19	1000
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	7.81	3.25	7.19	1000
6.00	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	7.62	2.75	7.06	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	7.88	3.00	7.31	750
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	8.00	3.12	7.44	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.50	8.25	3.38	7.69	750
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.50	8.25	3.38	7.69	750
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	8.25	3.38	7.69	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

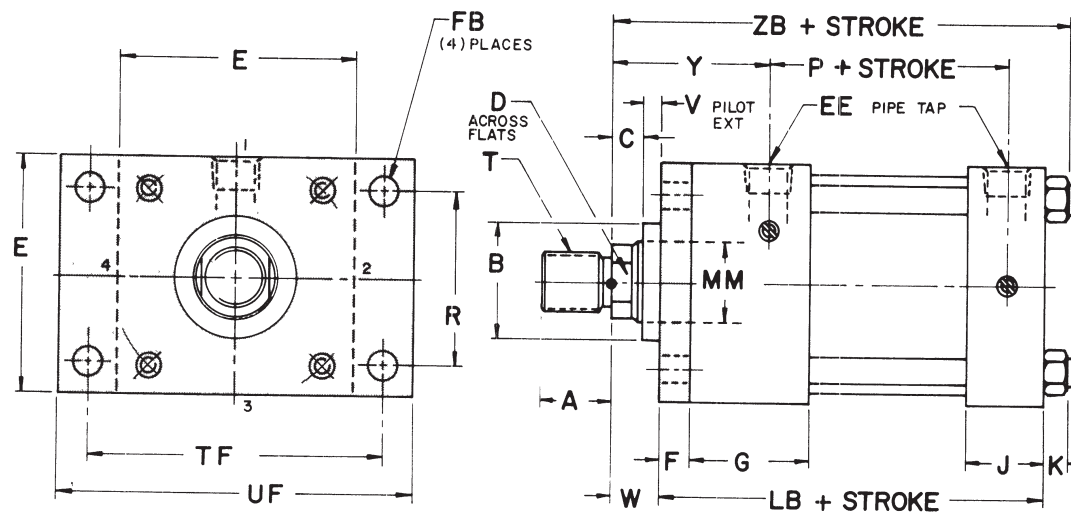
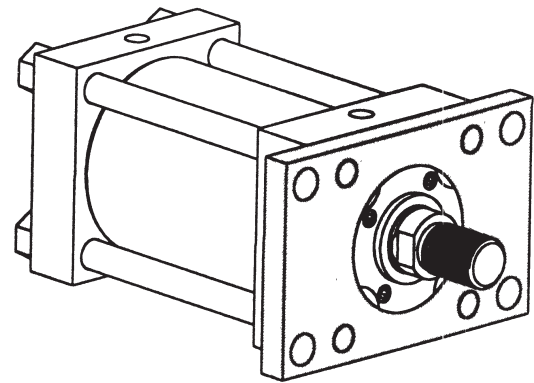
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods).

SERIES 3L 1.50"-6.00" Bores MF1 Head Rectangular Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

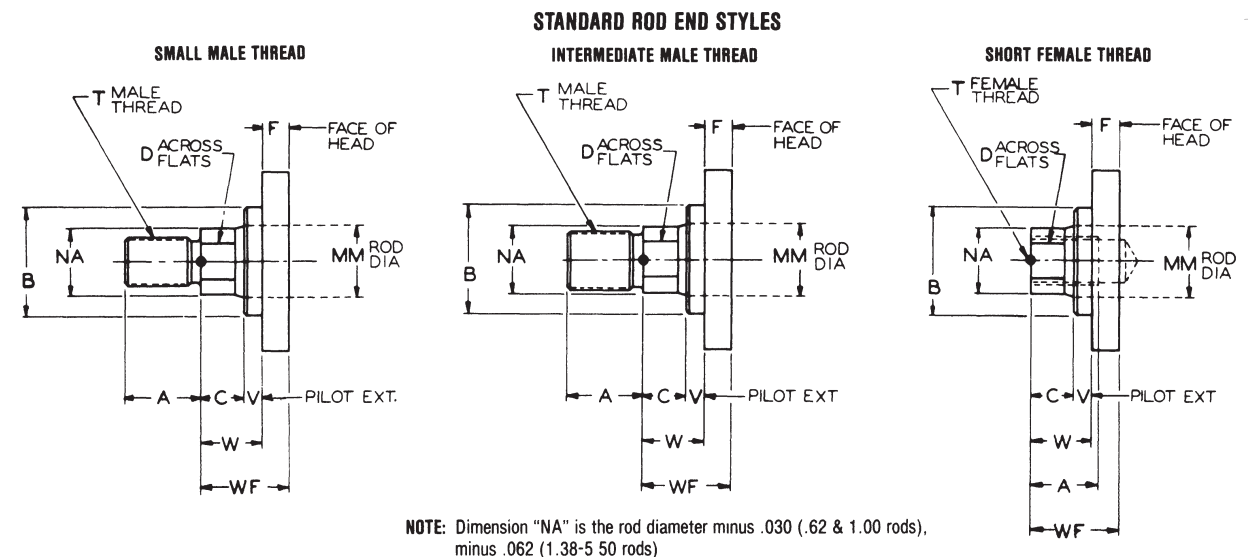
MF1

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	44-20	.50-20	44-20	.25	.62	1.00	1.88	4.88	1100
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.25	850
2.00	D	.62	.75	1.125	.38	.50	44-20	.50-20	44-20	.25	.62	1.00	1.88	4.94	800
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.31	800
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.56	400
2.50	D	.62	.75	1.125	.38	.50	44-20	.50-20	44-20	.25	.62	1.00	1.88	5.06	700
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.44	500
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	500
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	300
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	1200
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	1200
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	800
4.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	500
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	6.88	500
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	750
5.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	550
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	500
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	400
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	200
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	2.25	3.25	7.19	200
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.31	700
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.56	550
6.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.31	600
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	7.44	600
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	500
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.25	3.38	7.69	400
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	300
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	300

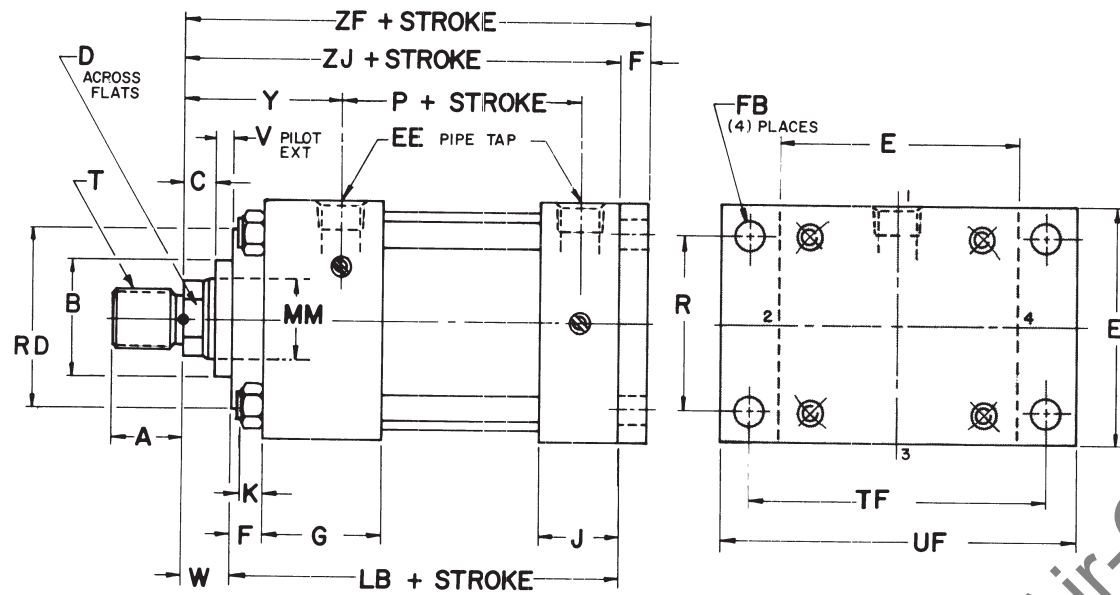
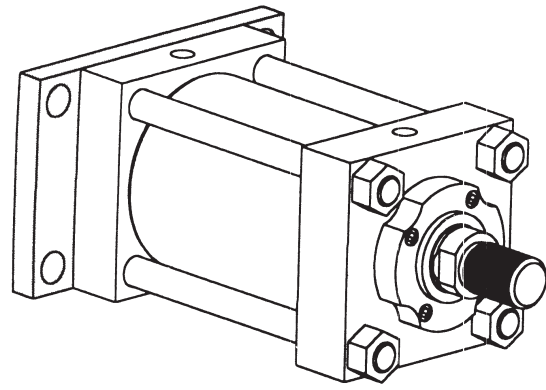
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MF2 Cap Rectangular Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

MF2

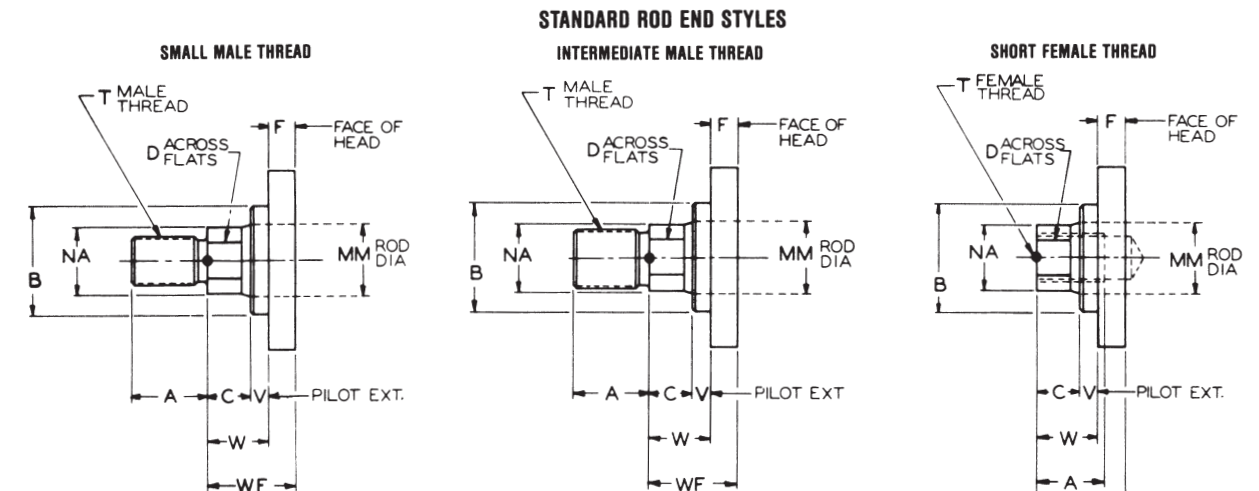
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	Y	ZF	ZJ	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	.50-20	.44-20	.25	.62	1.88	5.00	4.62	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	2.25	5.38	5.00	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.88	5.00	4.62	1500
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	5.38	5.00	1500
	G	1.38	1.62	2.000	.62	1.12	-	-	1.25-12	1.00-14	.62	1.25	2.50	5.62	5.25	1500
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.88	5.12	4.75	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	5.50	5.12	1000
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	5.75	5.38	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	6.00	5.62	1000
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	6.25	5.62	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.50	5.88	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.75	6.12	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.88	6.25	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	6.25	5.62	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.50	5.88	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.75	6.12	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.88	6.25	900
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	7.12	6.50	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	6.50	5.88	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.75	6.12	750
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	7.00	6.38	750
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	7.12	6.50	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	7.38	6.75	750
6.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	3.25	7.38	6.75	750
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	3.25	7.38	6.75	750
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	8.00	7.25	750
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.38	6.62	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.62	6.88	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

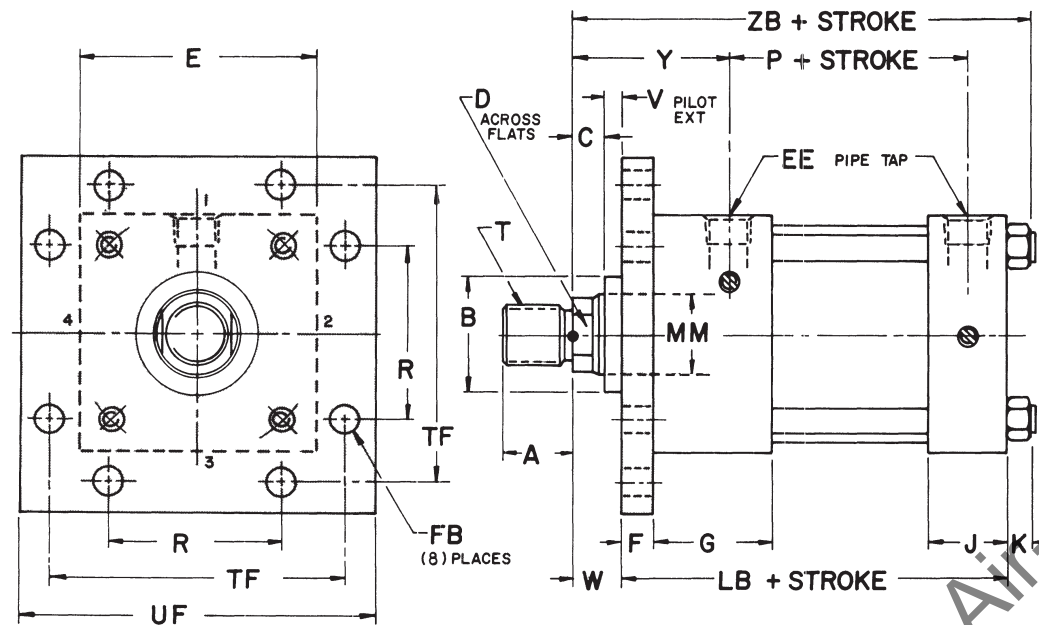
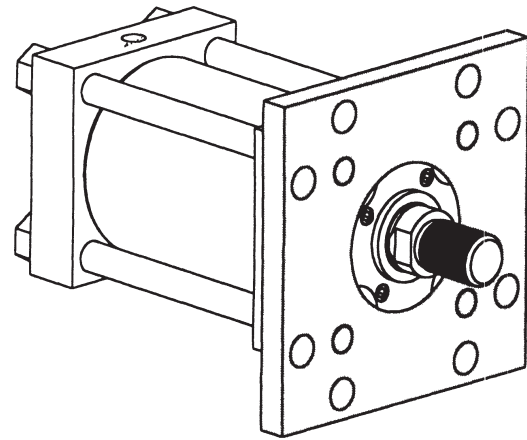
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MF5 Head Square Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

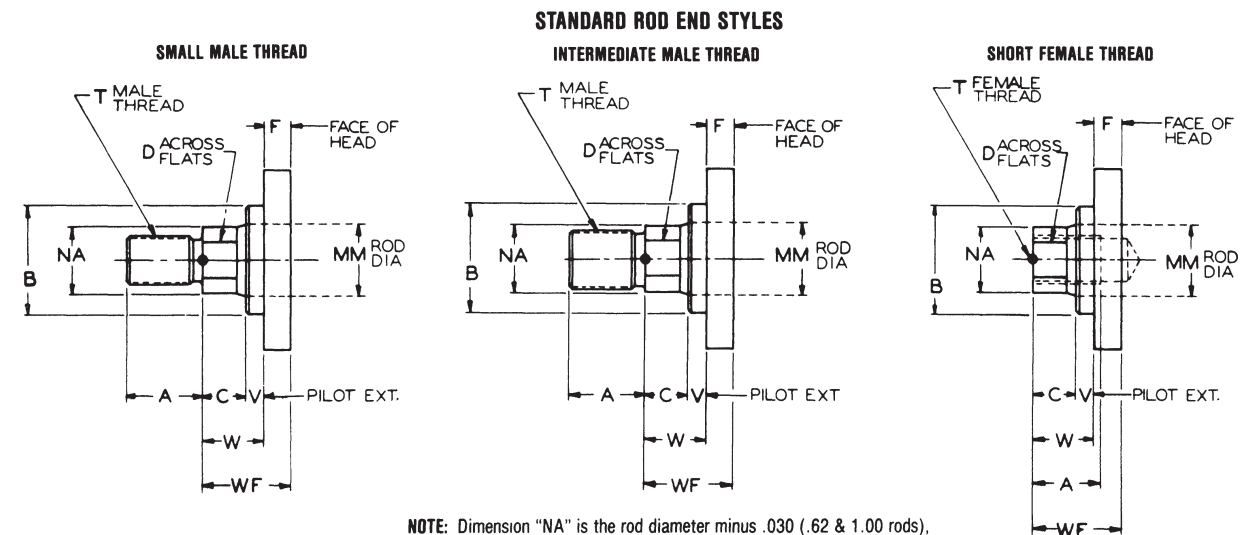
MF5

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER			A	B -.001 -.003	C	D	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62		.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.88	1800
	F	1.00		1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.25	1800
2.00	D	.62		.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.94	1800
	F	1.00		1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.31	1800
2.50	G	1.38		1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	1000
	H	1.75		2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	1000
	G	1.38		1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	1000
	H	1.75		2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	1000
3.25	F	1.00		1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	1300
	G	1.38		1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	1300
	H	1.75		2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	1300
	J	2.00		2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	1300
4.00	F	1.00		1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	900
	G	1.38		1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	900
	H	1.75		2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	900
	K	2.50		2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	900
5.00	J	2.00		2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	750
	K	2.50		3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	750
	L	3.00		3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	550
	M	3.50		4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	2.25	3.25	7.19	550
	F	1.00		1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.31	750
	G	1.38		1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.56	750
6.00	H	1.75		2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	750
	J	2.00		2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.12	7.44	750
	K	2.50		3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	750
	L	3.00		3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.25	3.38	7.69	750
	M	3.50		4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	600
	N	4.00		4.50	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	600

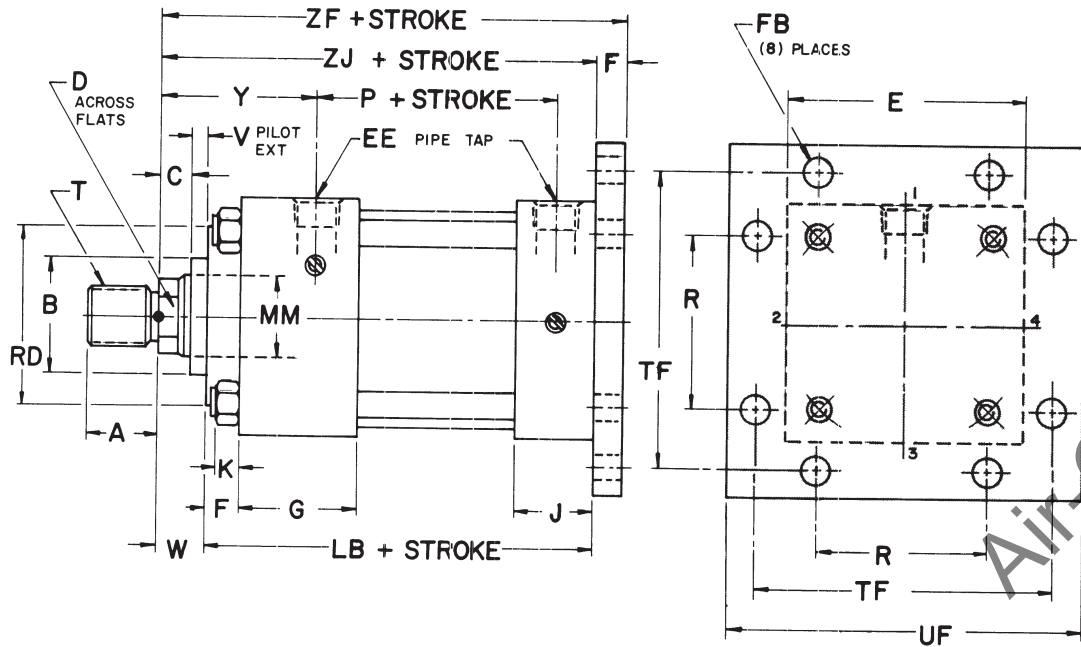
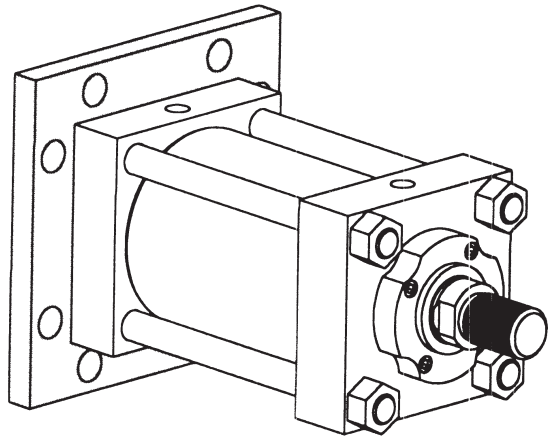
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MF6 Cap Square Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.552	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

MF6

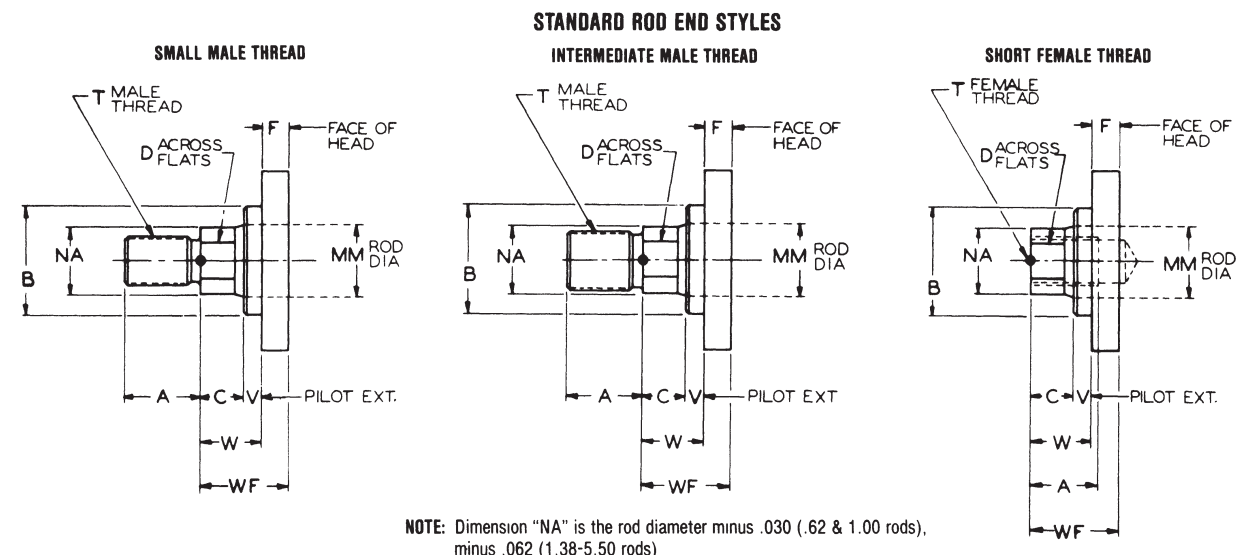
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	Y	ZF	ZJ	PSI RATING†
								SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	50-20	.44-20	.25	.62	1.88	5.00	4.62	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	88-14	.75-16	.50	1.00	2.25	5.38	5.00	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	.44-20	.25	.62	1.88	5.00	4.62	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	.75-16	.50	1.00	2.25	5.38	5.00	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	5.62	5.25	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	.44-20	.25	.62	1.88	5.12	4.75	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	.75-16	.50	1.00	2.25	5.50	5.12	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	5.75	5.38	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	6.00	5.62	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	2.38	6.25	5.62	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.50	5.88	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.75	6.12	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.88	6.25	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	2.38	6.25	5.62	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.50	5.88	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.75	6.12	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.88	6.25	900
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	7.12	6.50	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	2.38	6.50	5.88	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.75	6.12	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	7.00	6.38	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	7.12	6.50	1000
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	7.38	6.75	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	3.25	7.38	6.75	1000
6.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	2.38	6.50	5.88	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.12	3.00	7.62	6.88	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.62	6.88	750
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	7.75	7.00	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	8.00	7.25	750
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	8.00	7.25	750
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.50	3.38	8.00	7.25	750
N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	8.00	7.25	750	

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION IN INSTALLATION, OPERATION AND MAINTENANCE DATA section.

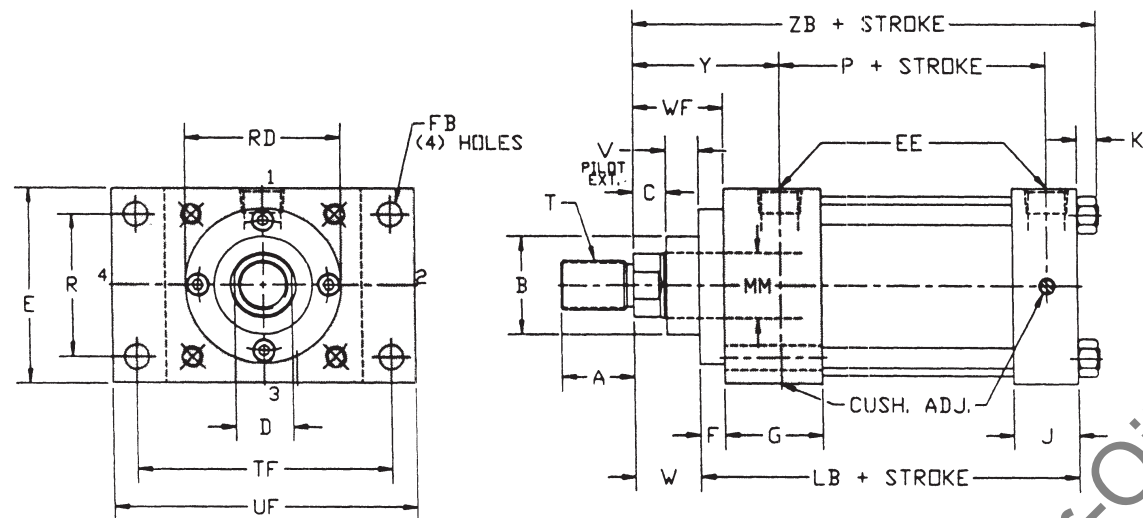
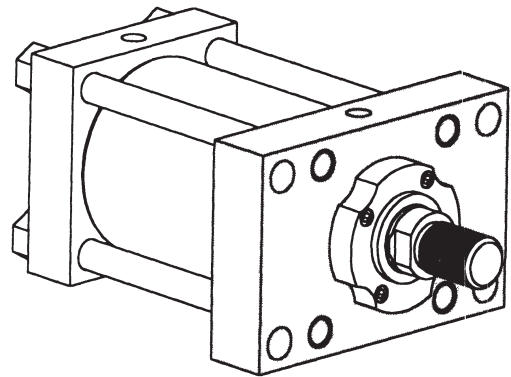
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores ME5 Head Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

ME5

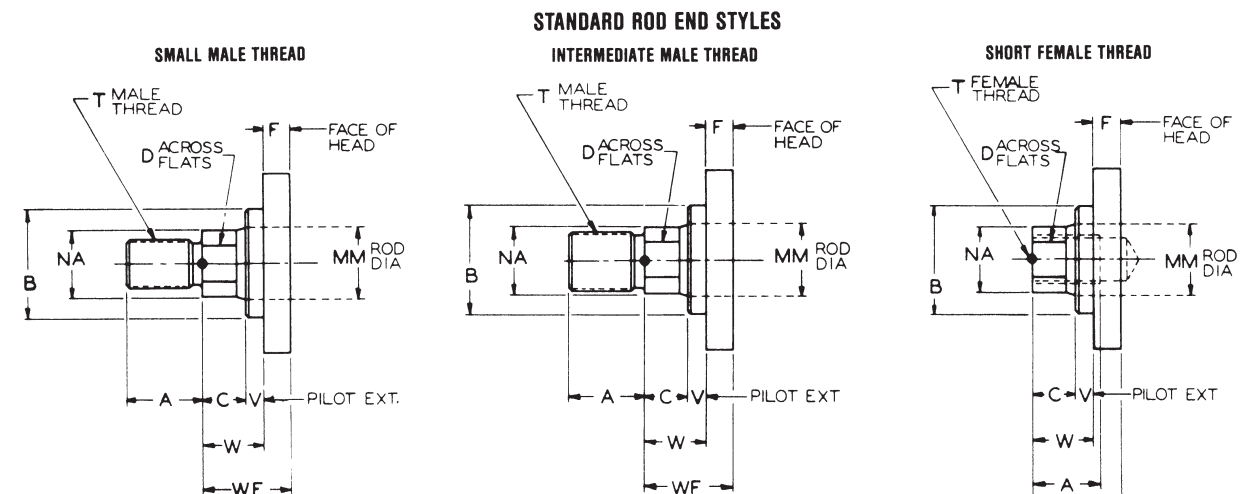
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER			A	B -.001 -.003	C	D	RD* ±.005	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.							SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	50-20	.44-20	.25	.62	1.00	1.88	4.88	1800	
	F	1.00	1.12	1.500	.50	.88	-	.75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.25	1800	
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	.44-20	.25	.62	1.00	1.88	4.94	1800	
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.31	1800	
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.56	1800	
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	.44-20	.25	.62	1.00	1.88	5.06	1000	
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.44	1400	
	G	1.38	1.62	2.000	.62	1.12	2.94	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	1400	
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	1400	
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	1.38	2.38	6.00	1300	
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	1300	
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	1300	
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	1300	
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	1.38	2.38	6.00	900	
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	900	
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	900	
	J	2.00	2.25	2.625	.88	1.69	4.12	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	900	
	K	2.50	3.00	3.125	1.00	2.06	4.12	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	6.88	900	
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	.75-16	.25	.75	1.38	2.38	6.31	750	
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.56	1000	
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	1000	
	J	2.00	2.25	2.625	.88	1.69	4.12	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	1000	
	K	2.50	3.00	3.125	1.00	2.06	4.12	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	1000	
	L	3.00	3.50	3.750	1.00	2.62	5.38	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	1000	
6.00	M	3.50	3.50	4.250	1.00	3.00	6.25	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	750	
	N	4.00	4.00	4.750	1.00	3.38	6.25	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	750	
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	1.62	2.75	7.06	750	
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.31	750	
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	7.44	750	
	K	2.50	3.00	3.125	1.00	2.06	5.25	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	750	

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

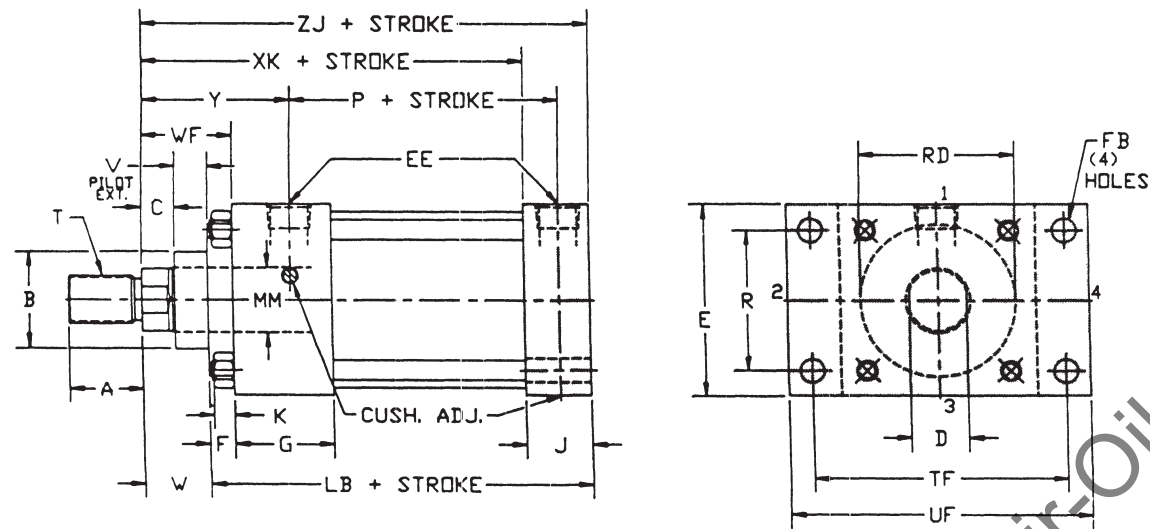
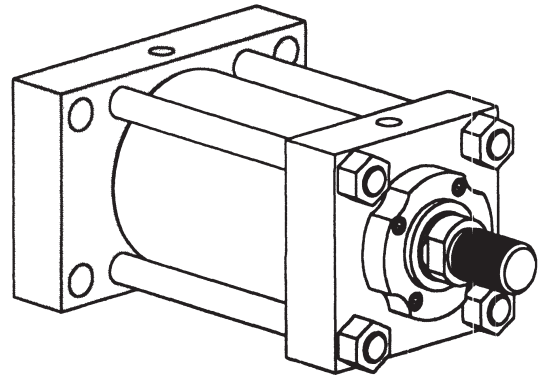
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores ME6 Cap Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

ME6

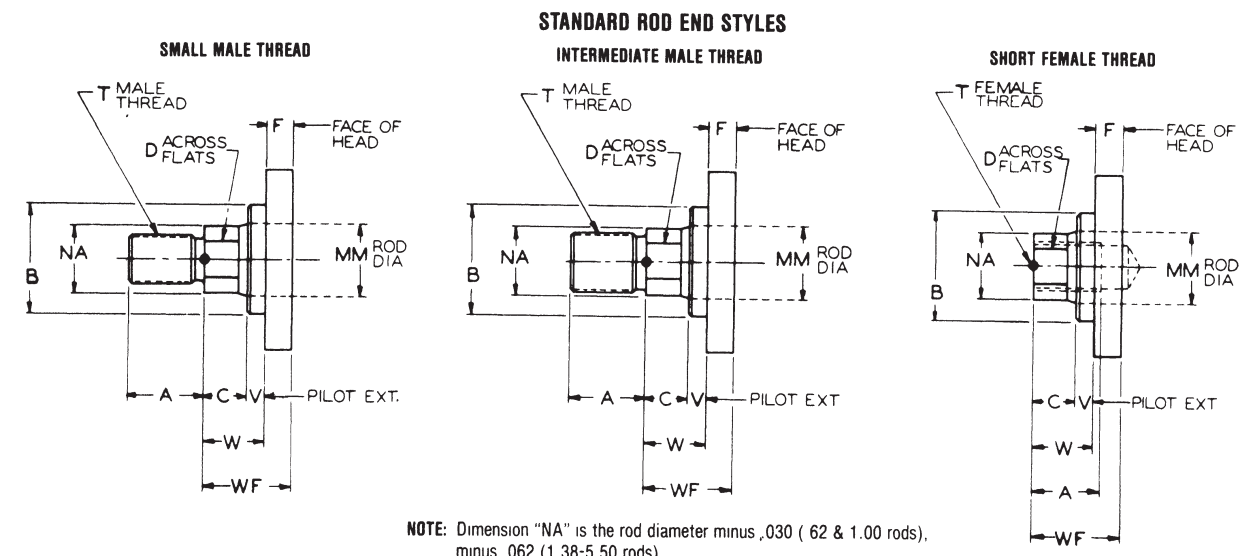
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	Y	XK	ZJ	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	.50-20	.44-20	.25	.62	1.88	3.62	4.62	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	2.25	4.00	5.00	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.88	3.62	4.62	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	4.00	5.00	1800
2.50	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	4.38	5.38	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	4.25	5.25	1400
	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	1.88	3.75	4.75	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	4.12	5.12	1400
3.25	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.62	5.88	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	4.88	6.12	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.00	6.25	1300
	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	4.38	5.62	1300
4.00	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.62	5.88	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	4.88	6.12	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.00	6.25	900
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	5.25	6.50	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	4.62	5.88	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.88	6.12	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.12	6.38	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.25	6.50	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	5.50	6.75	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	3.25	5.50	6.75	1000
	M	3.50	4.00	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	3.25	5.50	6.75	1000
	N	4.00	4.50	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	5.75	7.25	750
6.00	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.75	5.12	6.62	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	5.38	6.88	750
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	5.50	7.00	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	5.75	7.25	750
6.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	5.75	7.25	750
	M	3.50	4.00	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.50	3.38	5.75	7.25	750
	N	4.00	4.50	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	5.75	7.25	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

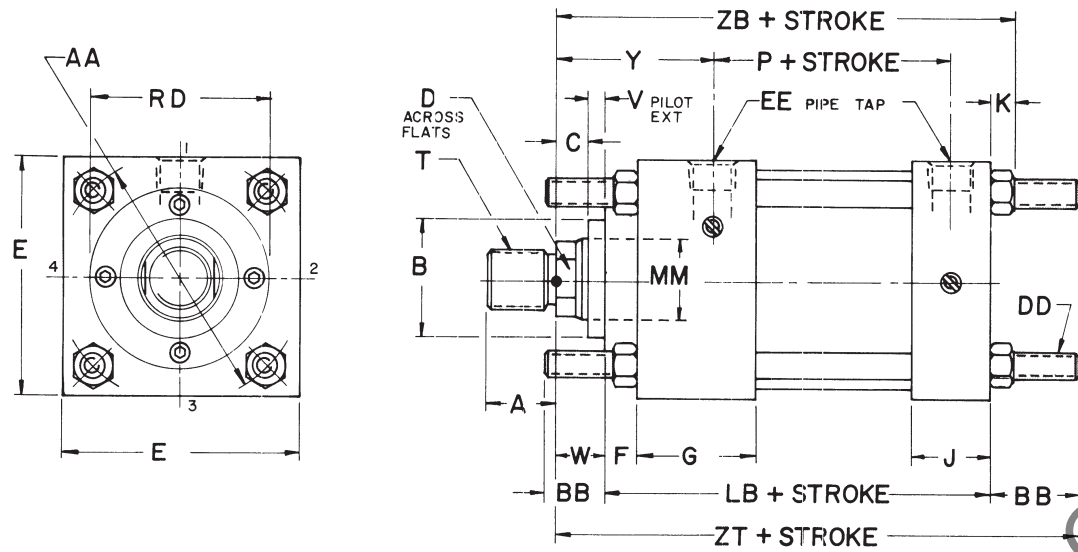
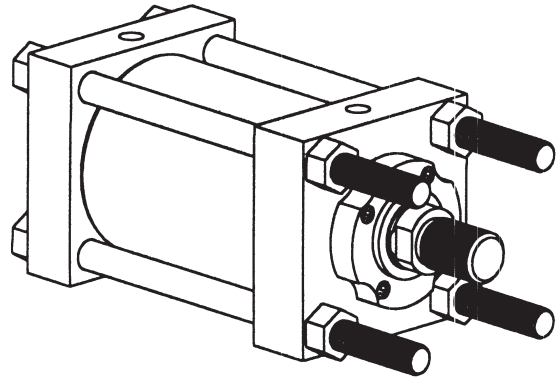
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MX0, MX1, MX2, MX3, MX4 Tie Rod Mounts



These Dimensions are Constant Regardless of Rod Diameter

BORE	AA	BB	DD	E	EE (NPTF)	F	G	J	K	LB	P
1.50	2.02	1.00	25-28	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31
2.00	2.60	1.12	31-24	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31
2.50	3.10	1.12	31-24	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44
3.25	3.90	1.38	38-24	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69
4.00	4.70	1.38	38-24	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69
5.00	5.80	1.81	50-20	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94
6.00	6.90	1.81	50-20	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19

NOTE: Specify Tie Rod Extension, "BB" dimension if other than standard
 MX0 = No Tie Rods Extended
 MX1 = 4 Tie Rods Extended Both Ends
 MX2 = 4 Tie Rods Extended Cap End
 MX3 = 4 Tie Rods Extended Head End
 MX4 = 2 Tie Rods Extended Both Ends

Dimensions are Affected by the Rod Diameter

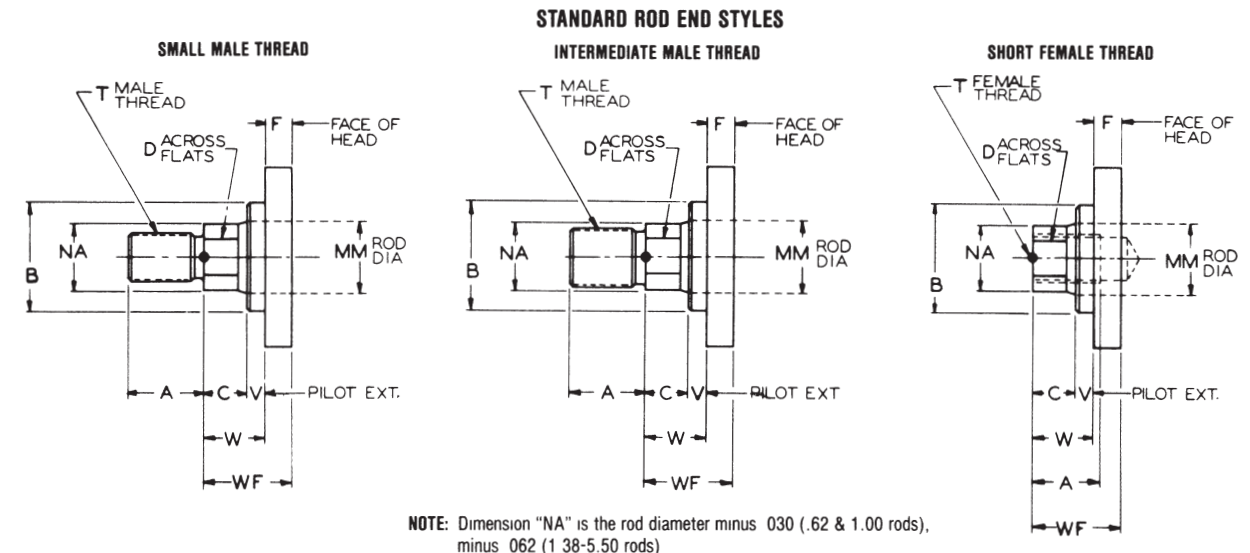
MX0, MX1, MX2, MX3, MX4

BORE	ROD DIA. CODE	MM ROD DIA.	A	B	C	D	RD*	T (THREAD)			V	W	Y	ZB	ZT	PSI RATING†
								SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	50-20	44-20	.25	.62	1.88	4.88	5.62	1800
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	1.00	1.00	2.25	5.25	6.00	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	44-20	.25	.62	1.88	4.94	5.75	1800
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	1.00	1.00	2.25	5.31	6.12	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	1.25	1.25	2.50	5.56	6.38	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	44-20	.25	.62	1.88	5.06	5.88	1000
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	1.00	1.00	2.25	5.44	6.25	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	1.25	1.25	2.50	5.69	6.50	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	1.50	1.50	2.75	5.94	6.75	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	.25	.75	2.38	6.00	7.00	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.25	7.25	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	1.25	1.25	2.88	6.50	7.50	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	1.50	1.38	3.00	6.62	7.62	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	.25	.75	2.38	6.00	7.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.25	7.25	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	1.25	1.25	2.88	6.50	7.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	1.50	1.38	3.00	6.62	7.62	900
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	1.62	1.62	3.25	6.88	7.88	900
5.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	.25	.75	2.38	6.31	7.69	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.56	7.94	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	1.25	1.25	2.88	6.81	8.19	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	1.50	1.38	3.00	6.94	8.31	1000
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	1.62	1.62	3.25	7.19	8.56	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	1.62	1.62	3.25	7.19	8.56	1000
6.00	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	1.62	1.62	3.25	7.19	8.56	1000
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	1.50	1.50	3.38	7.69	9.06	750
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.06	8.44	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.31	8.69	750
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	7.44	8.81	750
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	7.69	9.06	750
6.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	7.69	9.06	750
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.50	3.38	7.69	9.06	750
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	7.69	9.06	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

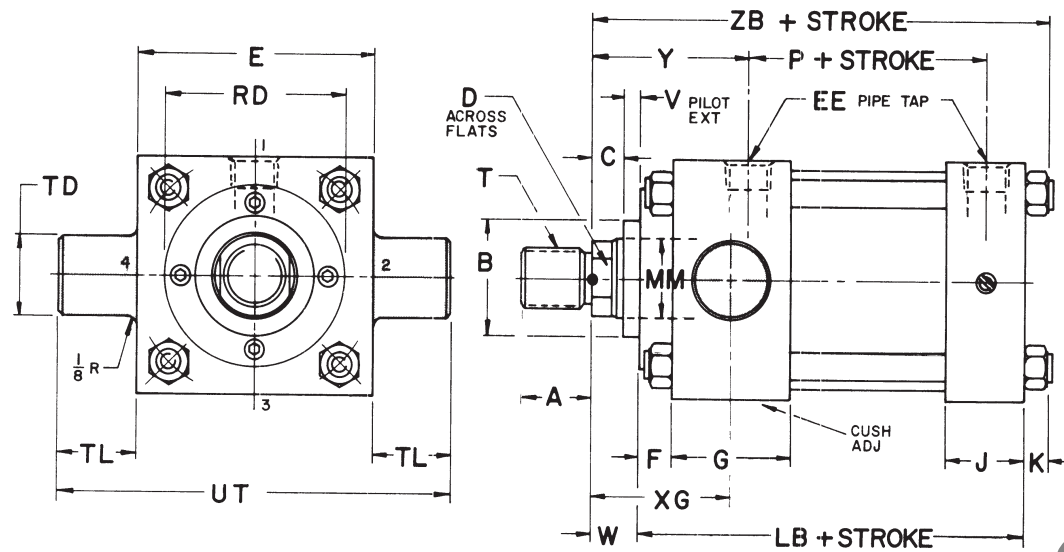
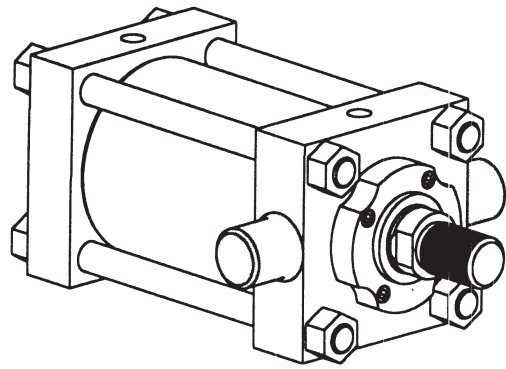
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MT1 Head Trunnion Mount



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 -.002	TL	UT
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	1.000	1.00	4.00
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	1.000	1.00	4.50
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	1.000	1.00	5.00
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	1.000	1.00	7.50
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	1.375	1.38	9.25

MT1

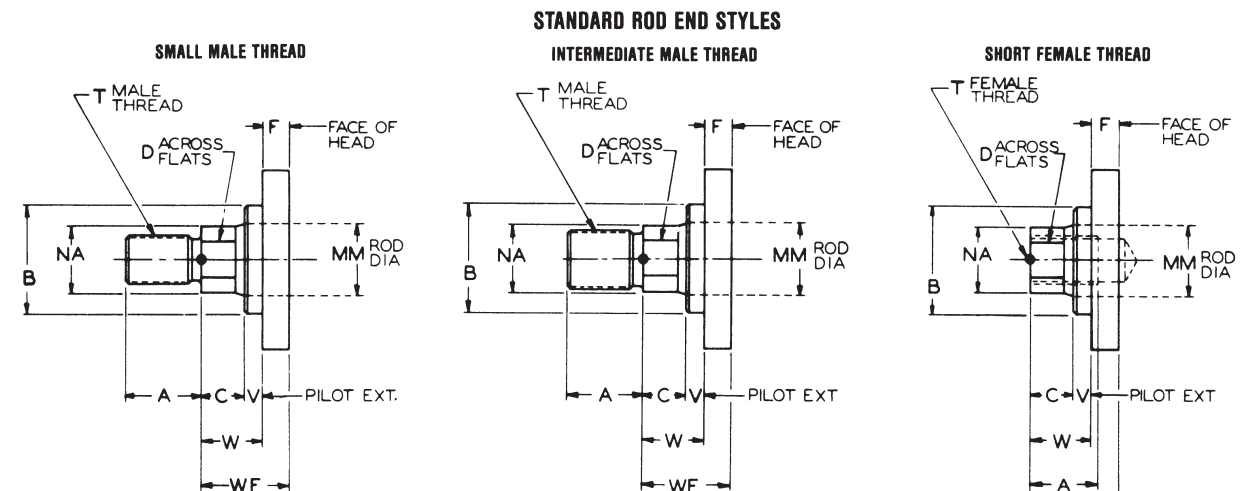
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XG	Y	ZB	PSI RATING†
								SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	.44-20	.25	.62	1.75	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	.25	.62	1.75	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.31	1800
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.38	2.50	5.56	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	.25	.62	1.75	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.44	1400
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.38	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.62	2.75	5.94	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.00	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.25	1300
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.50	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.62	1300
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.25	900
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.62	900
5.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.12	3.25	6.88	900
	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.31	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.56	1000
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.81	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.94	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.12	3.25	7.19	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	3.12	3.25	7.19	1000
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	3.12	3.25	7.19	1000
	N	4.00	4.00	4.750	1.00	3.00	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.25	3.38	7.69	750
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.62	2.75	7.06	750
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	2.88	3.00	7.31	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

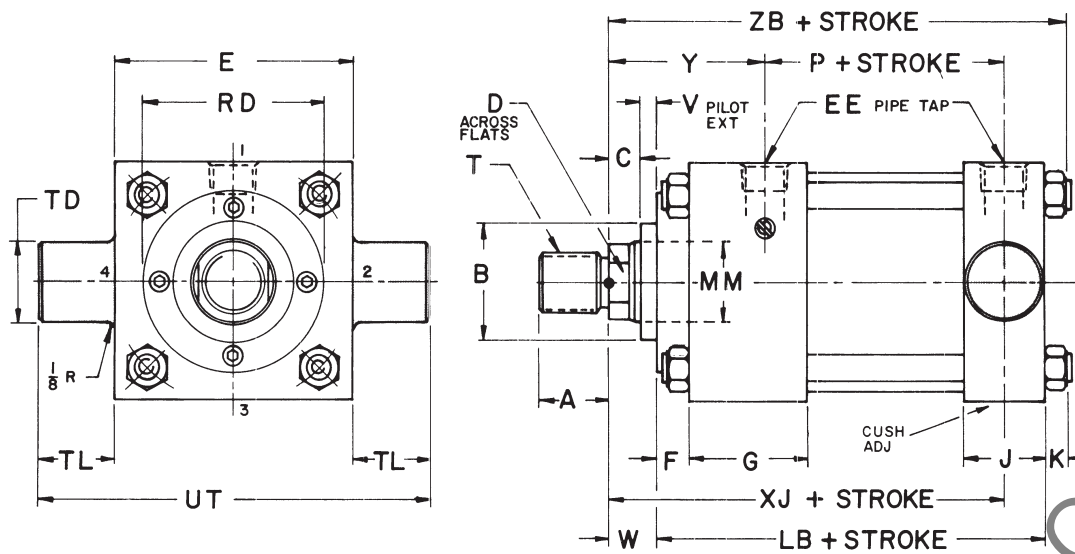
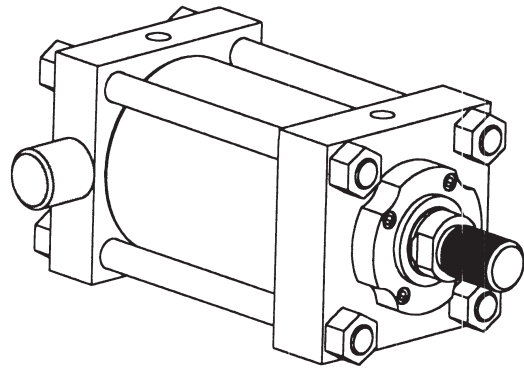
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MT2 Cap Trunnion Mount



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 -.002	TL	UT
1.50	2.00	3/8	.38	1.50	1.00	25	4.00	2.31	1.000	1.00	4.00
2.00	2.50	3/8	.38	1.50	1.00	31	4.00	2.31	1.000	1.00	4.50
2.50	3.00	3/8	.38	1.50	1.00	31	4.12	2.44	1.000	1.00	5.00
3.25	3.75	1/2	.62	1.75	1.25	38	4.88	2.69	1.000	1.00	5.75
4.00	4.50	1/2	.62	1.75	1.25	38	4.88	2.69	1.000	1.00	6.50
5.00	5.50	1/2	.62	1.75	1.25	44	5.12	2.94	1.000	1.00	7.50
6.00	6.50	3/4	.75	2.00	1.50	44	5.75	3.19	1.375	1.38	9.25

MT2

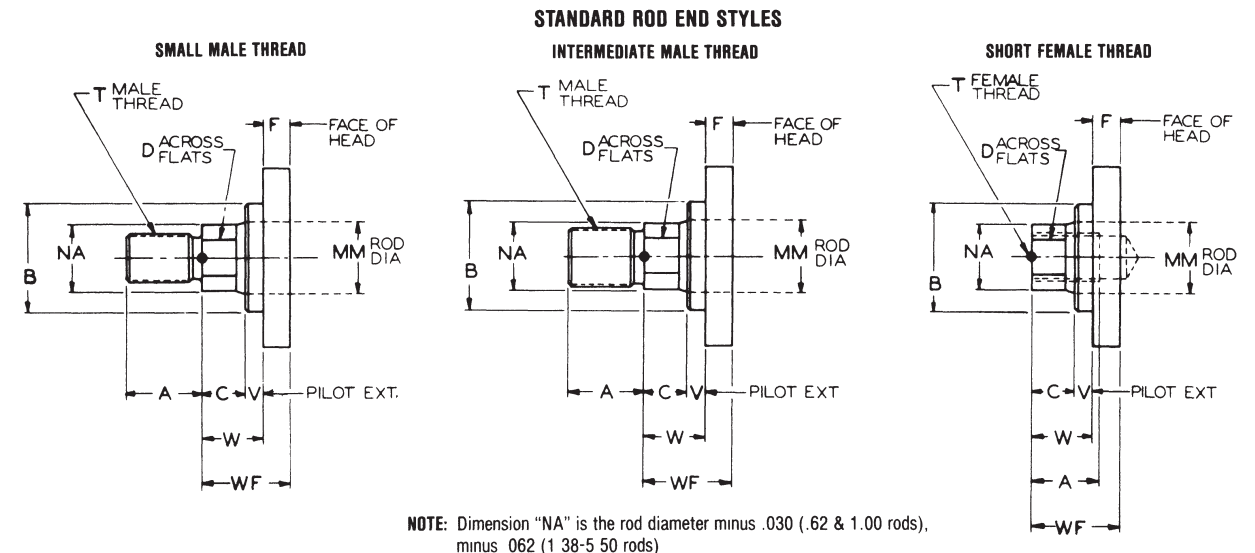
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XJ	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	44-20	.25	.62	4.12	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	.50	1.00	4.50	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	.25	.62	4.12	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	.50	1.00	4.50	2.25	5.31	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	.25	.62	4.25	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	.50	1.00	4.62	2.25	5.44	1400
3.25	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	4.88	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	5.12	2.75	5.94	1400
4.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	.25	.75	5.00	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	5.25	2.62	6.25	900
5.00	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	5.50	2.88	6.81	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	5.88	3.00	6.94	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	6.12	3.25	7.19	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	6.12	3.25	7.19	1000
6.00	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	6.12	3.25	7.19	1000
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.62	1.62	6.12	3.25	7.19	1000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

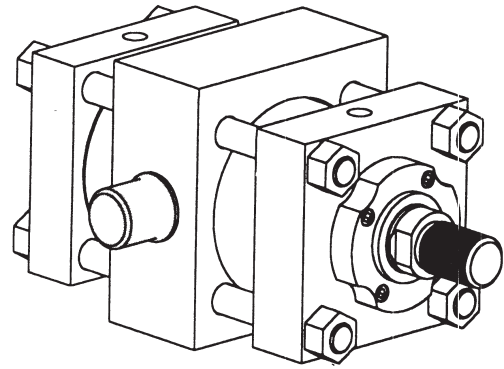
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

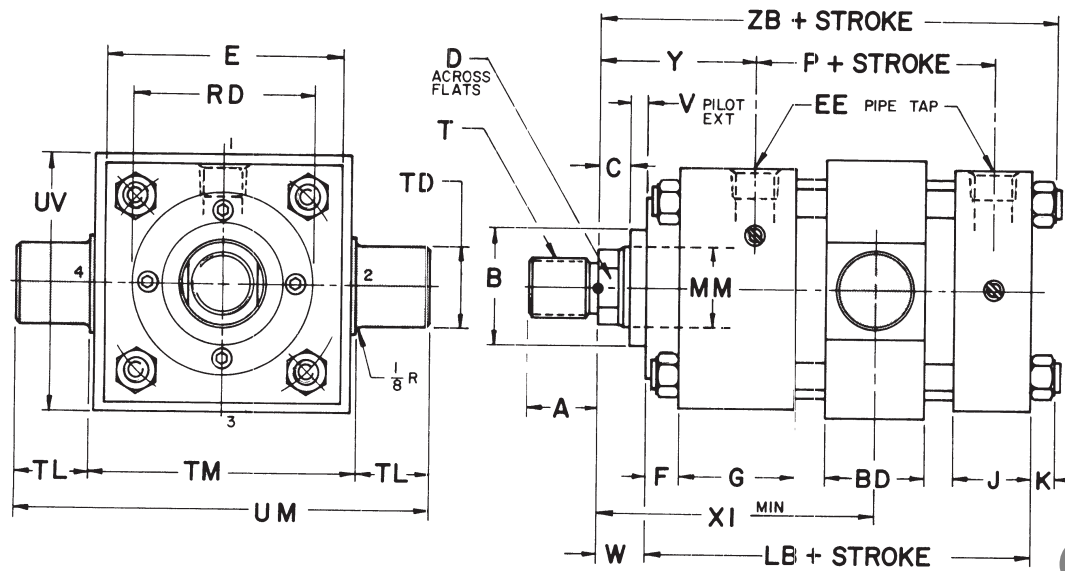


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MT4 Intermediate Fixed Trunnion Mount



NOTE: Trunnion location (XI) must be specified when ordering.



NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

These Dimensions are Constant Regardless of Rod Diameter

BORE	BD	BZ MIN. STROKE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 - .002	TL	TM	UM	UV
1.50	1.25	12	2.00	3/8	.38	1.50	1.00	25	4.00	2.31	1.000	1.00	2.50	4.50	2.50
2.00	1.50	38	2.50	3/8	.38	1.50	1.00	31	4.00	2.31	1.000	1.00	3.00	5.00	3.00
2.50	1.50	25	3.00	3/8	.38	1.50	1.00	31	4.12	2.44	1.000	1.00	3.50	5.50	3.50
3.25	2.00	75	3.75	1/2	.62	1.75	1.25	38	4.88	2.69	1.000	1.00	4.50	6.50	4.25
4.00	2.00	75	4.50	1/2	.62	1.75	1.25	38	4.88	2.69	1.000	1.00	5.25	7.25	5.00
5.00	2.00	50	5.50	1/2	.62	1.75	1.25	44	5.12	2.94	1.000	1.00	6.25	8.25	6.00
6.00	2.00	1.00	6.50	3/4	.75	2.00	1.50	44	5.75	3.19	1.375	1.38	7.62	10.38	7.00

MT4

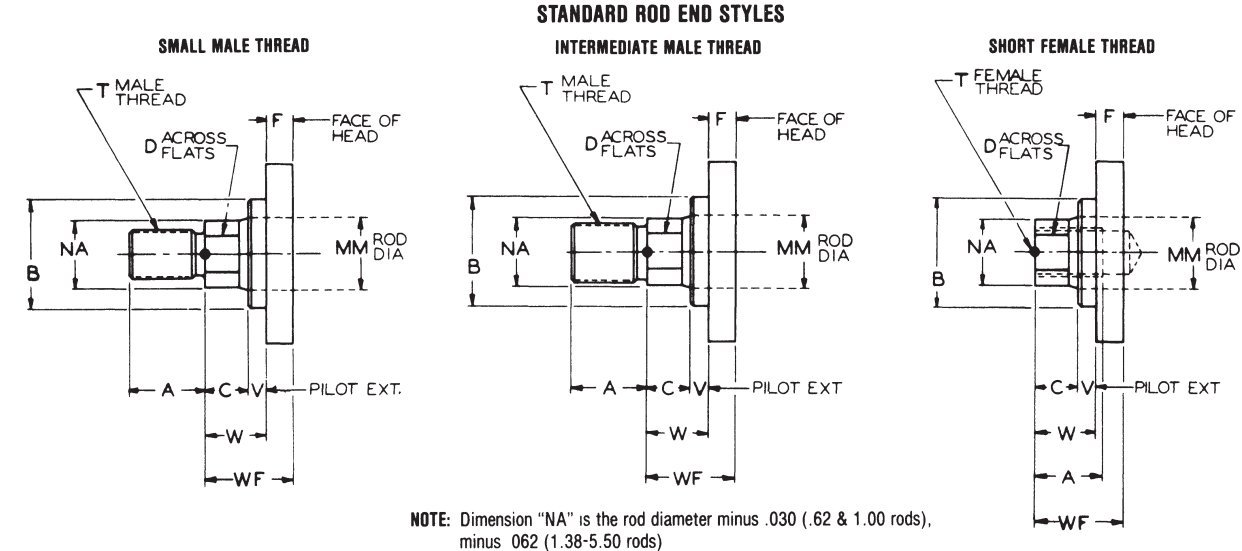
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XI (MIN)	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	.44-20	50-20	44-20	.25	.62	3.12	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	.50	1.00	3.50	2.25	5.25	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	.44-20	.50-20	.44-20	.25	.62	3.25	1.88	4.94	1800
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	3.62	2.25	5.31	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	.44-20	50-20	44-20	.25	.62	3.25	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	75-16	.50	1.00	3.62	2.25	5.44	1400
3.25	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	3.88	2.50	5.69	1400
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	4.12	2.75	5.94	1400
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	75-16	.25	.75	4.12	2.38	6.00	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	4.38	2.62	6.25	900
5.00	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	4.62	2.88	6.50	900
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	4.75	3.00	6.62	900
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	5.00	3.25	6.88	900
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	5.00	3.25	7.19	1000
7.00	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	5.00	3.25	7.19	1000
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	5.50	3.38	7.69	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

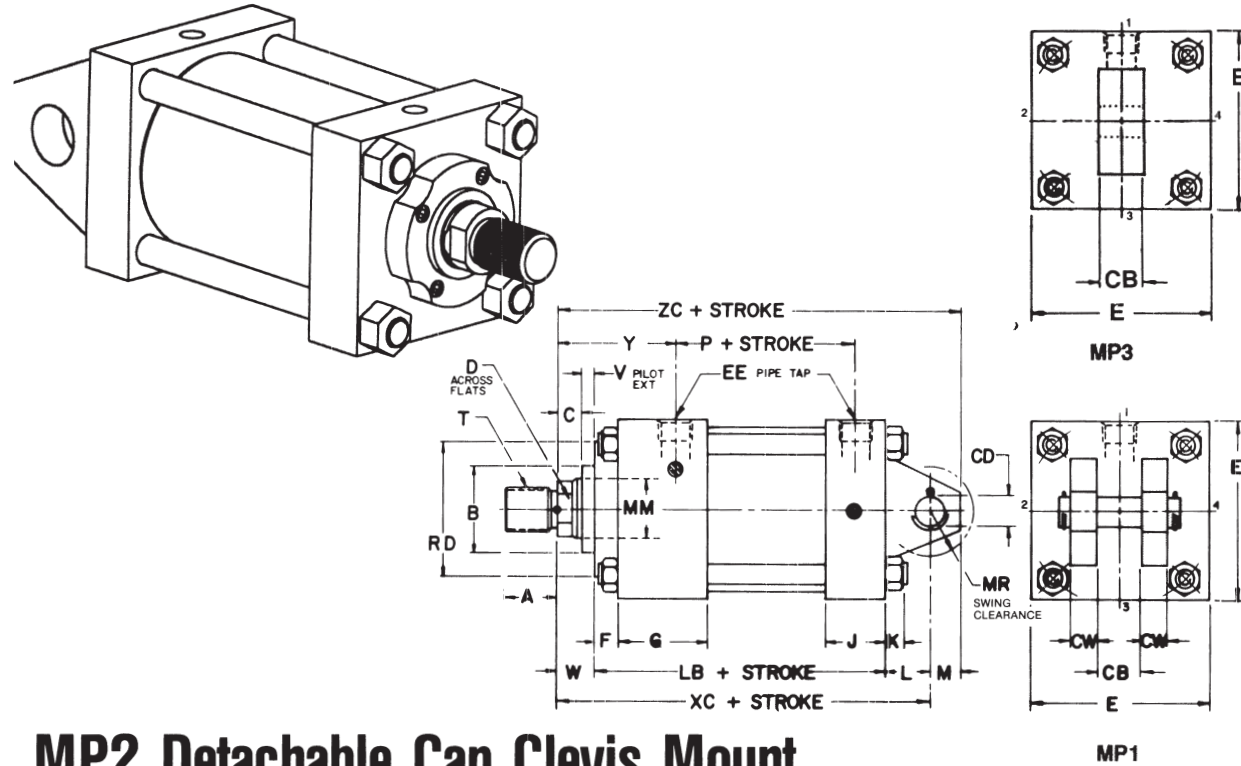
† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

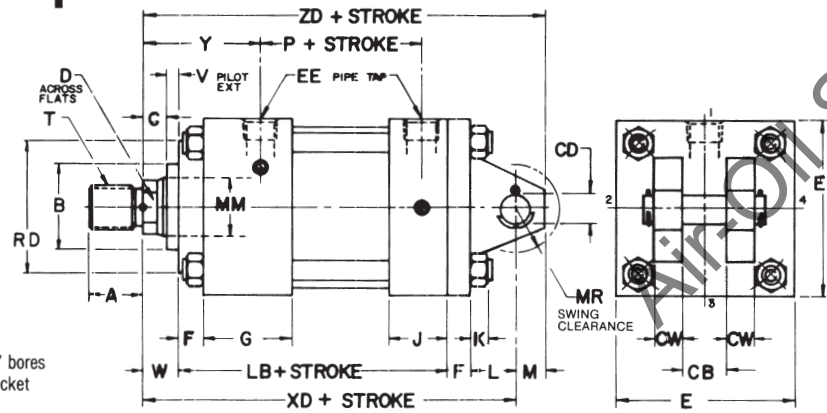


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores
MP1 Fixed Double Ear Clevis Mount
MP3 Fixed Single Ear Clevis Mount



MP2 Detachable Cap Clevis Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	CB †	CD ††	CW	E	EE (NPTF)	F	G	J	K	L	LB	M	MR	P
1.50	.750	.500	.50	2.00	3/8	.38	1.50	1.00	.25	.75	4.00	.50	.62	2.31
2.00	.750	.500	.50	2.50	3/8	.38	1.50	1.00	.31	.75	4.00	.50	.62	2.31
2.50	.750	.500	.50	3.00	3/8	.38	1.50	1.00	.31	.75	4.12	.50	.62	2.44
3.25	1.250	.750	.62	3.75	1/2	.62	1.75	1.25	.38	1.25	4.88	.75	1.12	2.69
4.00	1.250	.750	.62	4.50	1/2	.62	1.75	1.25	.38	1.25	4.88	.75	1.12	2.69
5.00	1.250	.750	.62	5.50	1/2	.62	1.75	1.25	.44	1.25	5.12	.75	1.12	2.94
6.00	1.500	1.000	.75	6.50	3/4	.75	2.00	1.50	.44	1.50	5.75	1.00	1.38	3.19

†CB tolerances are +.016, +.047 for MP1 and MP2; and ± .005 for MP3. ††CD tolerances are +.003, +.005 for MP3.
 NOTE: Pivot pin supplied with MP1 and MP2 cylinders; Pivot pin not supplied with MP3 cylinder.

MP1, MP2, MP3

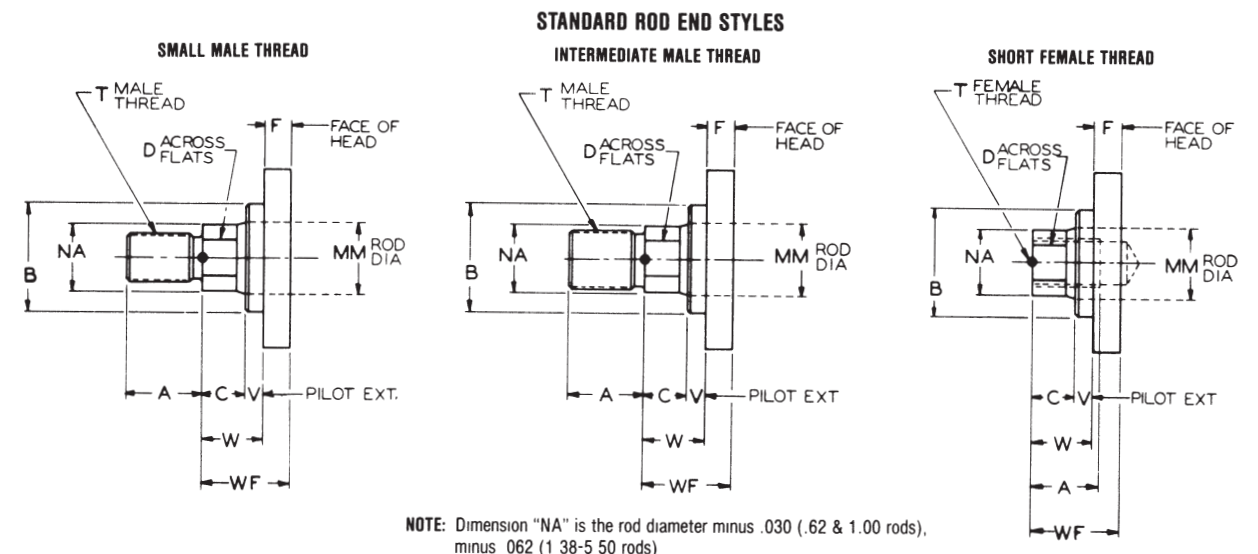
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XC	XD	Y	ZC	ZD	PSI RATING†
	ROD DIA.	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF								
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	44-20	.25	.62	5.38	5.75	1.88	5.88	6.25	1800
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	.50	1.00	5.75	6.12	2.25	6.25	6.62	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	.25	.62	5.38	5.75	1.88	5.88	6.25	1800
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	.50	1.00	5.75	6.12	2.25	6.25	6.62	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	.25	.62	5.50	5.88	1.88	6.00	6.38	1000
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	.50	1.00	5.88	6.25	2.25	6.38	6.75	1400
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	75-16	.25	.75	6.88	7.50	2.38	7.62	8.25	1300
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	7.12	7.75	2.62	7.88	8.50	1300
4.00	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.38	8.00	2.88	8.12	8.75	1300
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	7.50	8.12	3.00	8.25	8.88	1300
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	88-14	75-16	.25	.75	7.12	7.75	2.38	7.88	8.50	750
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	7.38	8.00	2.62	8.12	8.75	1000
6.00	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	7.62	8.25	2.88	8.38	9.00	1000
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	7.75	8.38	3.00	8.50	9.12	1000
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	1000
6.00	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	1000
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	1000

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



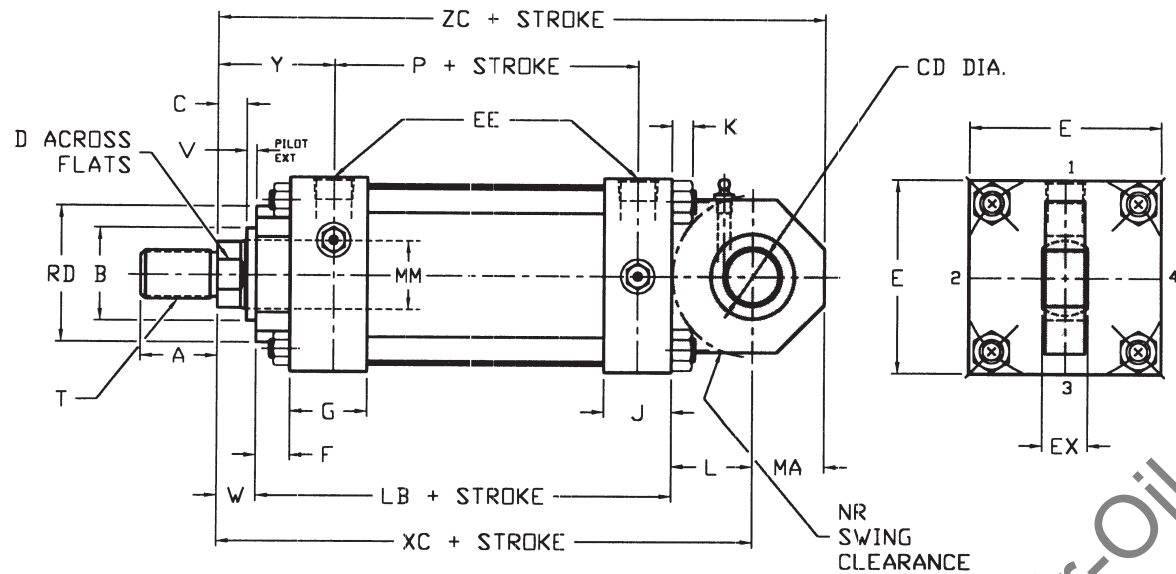
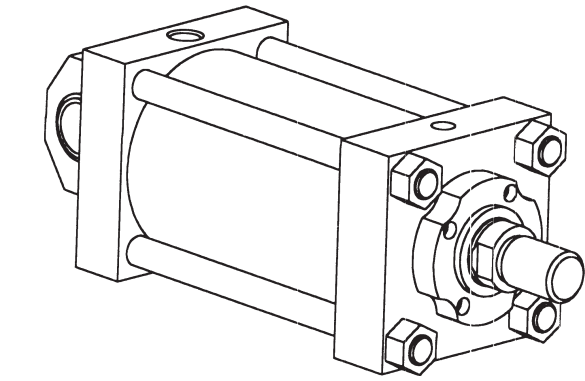
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MPU3 Spherical Bearing Mount

MPU3

Dimensions Are Affected by Rod Diameter

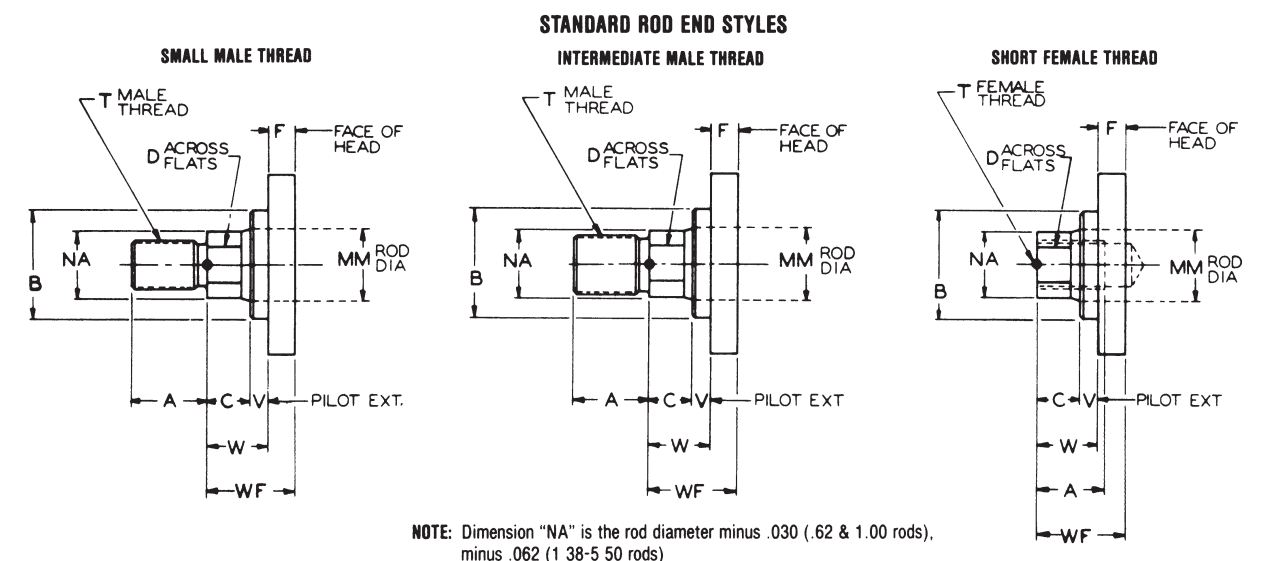
BORE	ROD DIA CODE	ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	XC	Y	ZC	PSI RATING†
								SMALL MALE SM	INTER-MEDIATE MALE	SHORT FEMALE SF IM						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	.50-20	44-20	25	.62	5.38	1.88	6.13	1750
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	.50	1.00	5.75	2.25	6.50	1750
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	25	.62	5.38	1.88	6.13	980
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	.50	1.00	5.75	2.25	6.50	980
	G	1.38	.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	6.00	2.50	6.75	980
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	25	.62	5.50	1.88	6.25	630
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	.88-14	.75-16	50	1.00	5.88	2.25	6.62	630
	G	1.38	.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	62	1.25	6.12	2.50	6.88	630
	H	1.75	2.00	2.375	.75	1.50	-	1.50-12	1.50-12	1.50-12	75	1.50	6.38	2.75	7.13	630
3.25	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	25	.75	6.88	2.38	8.12	830
	G	1.38	.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	7.12	2.62	8.38	830
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	7.38	2.88	8.62	830
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	7.50	3.00	8.75	830
4.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	.88-14	75-16	25	.75	6.88	2.38	8.12	550
	G	1.38	.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	7.12	2.62	8.38	550
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	7.38	2.88	8.62	550
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	7.50	3.00	8.75	550
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	62	1.62	7.75	3.25	9.00	550
5.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	.88-14	.75-16	25	.75	7.12	2.38	8.38	350
	G	1.38	.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	38	1.00	7.38	2.62	8.62	350
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	50	1.25	7.62	2.88	8.88	350
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	50	1.38	7.75	3.00	9.00	350
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	62	1.62	8.00	3.25	9.25	350
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	62	1.62	8.00	3.25	9.25	350
6.00	G	1.38	.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	25	.88	8.12	2.75	9.62	440
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	38	1.12	8.38	3.00	9.88	440
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	38	1.25	8.50	3.12	10.00	440
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	50	1.50	8.75	3.38	10.25	440
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	50	1.50	8.75	3.38	10.25	440
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	50	1.50	8.75	3.38	10.25	440
N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	8.75	3.38	10.25	440	



These Dimensions Are Constant Regardless of Rod Diameter

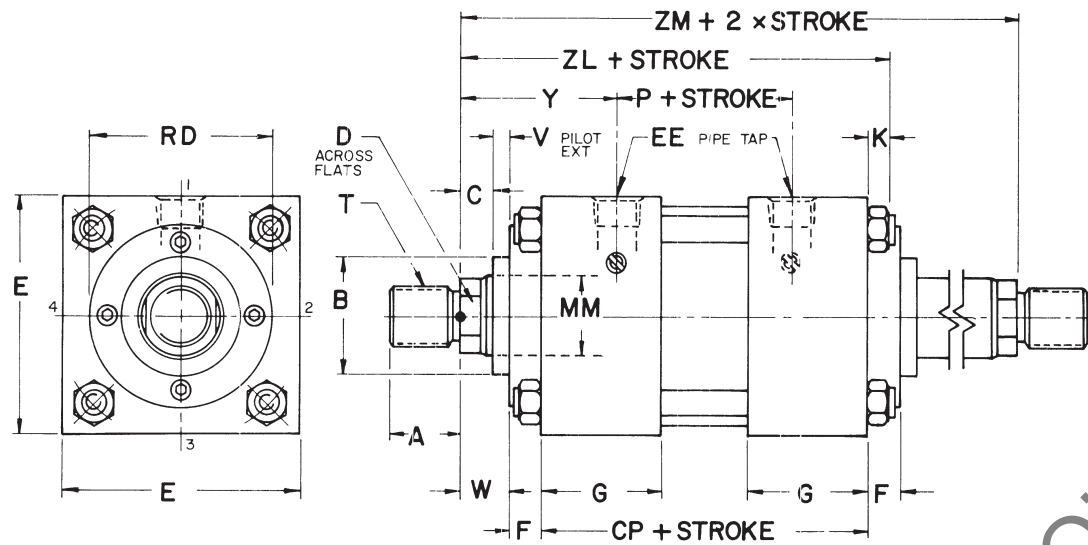
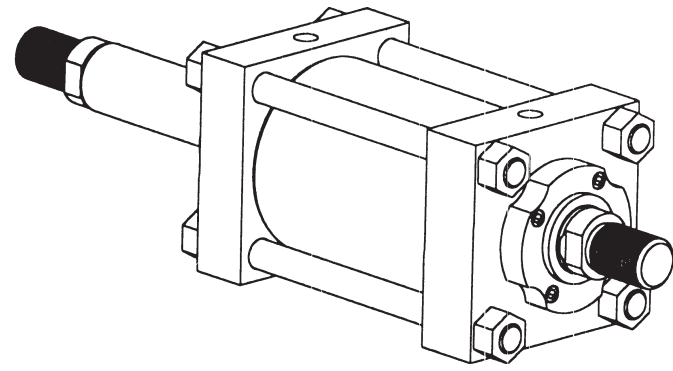
BORE	CD -0.0005	E	EE NPTF	EX	F	G	J	K	L	LB	MA	NR	P
1.50	0.5000	2.00	3/8	.44	.38	1.50	1.00	.25	.75	4.00	.75	.62	2.31
2.00	0.5000	2.50	3/8	.44	.38	1.50	1.00	.31	.75	4.00	.75	.62	2.31
2.50	0.5000	3.00	3/8	.44	.38	1.50	1.00	.31	.75	4.12	.75	.62	2.44
3.25	0.7500	3.75	1/2	.66	.62	1.75	1.25	.38	1.25	4.88	1.25	1.00	2.69
4.00	0.7500	4.50	1/2	.66	.62	1.75	1.25	.38	1.25	4.88	1.25	1.00	2.69
5.00	0.7500	5.50	1/2	.66	.62	1.75	1.25	.44	1.25	5.12	1.25	1.00	2.94
6.00	1.0000	6.50	3/4	.88	.75	2.00	1.50	.44	1.50	5.75	1.50	1.25	3.19

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.
 † CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.
 NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 3L 1.50"-6.00" Bores MXO-D Double Rod End*



These Dimensions are Constant Regardless of Rod Diameter

BORE	CP	E	EE NPTF	F	G	K	P
1.50	4 12	2 00	3/8	38	1 50	25	2 31
2.00	4 12	2 50	3/8	38	1 50	31	2 31
2.50	4 25	3 00	3/8	38	1 50	31	2 44
3.25	4 75	3 75	1/2	62	1 75	38	2 69
4.00	4 75	4 50	1/2	62	1 75	38	2 69
5.00	5 00	5 50	1/2	62	1 75	44	2 94
6.00	5 50	6 50	3/4	75	2 00	44	3 19

* Available in MS2, MS3, MS4, MS7, MF1, MF5, ME5, MT1, MT4, see single rod pages for mounting dimensions and appropriate P.S.I. Ratings

For Models MS2 and MS3 (1.50" thru 5.00" bores), add .50" to Dimension "SS."
For Models MS7 and MS4, consult factory for Dimensions "SE" and "SN"

MXO-D

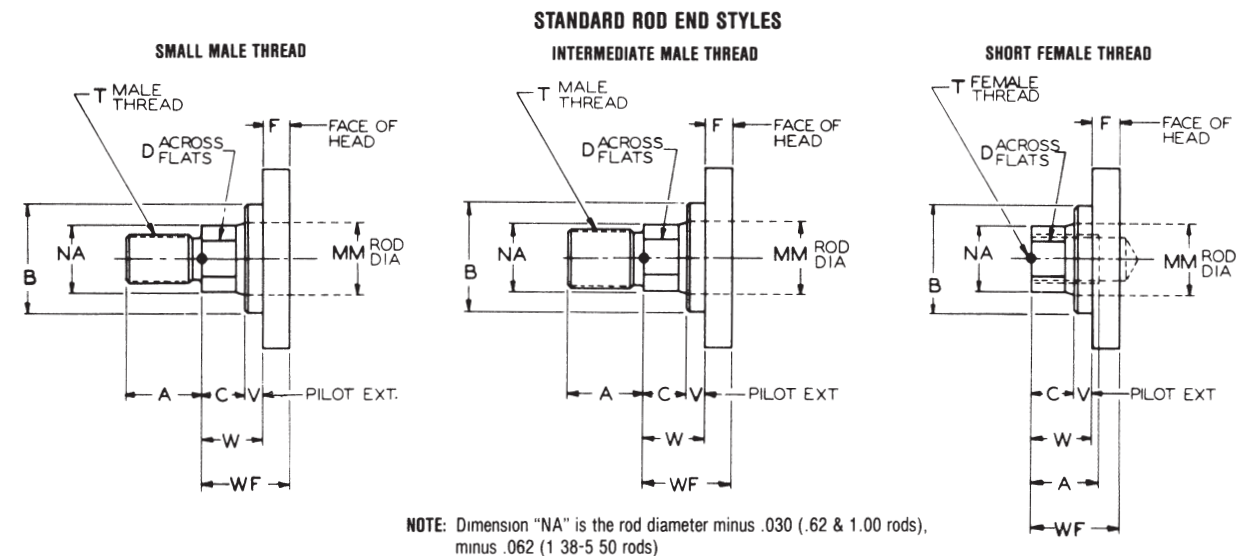
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	Y	ZL	ZM	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	44-20	25	.62	1.88	5.75	6.12	1800
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	75-16	50	1.00	2.25	6.12	6.88	1800
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	25	.62	1.88	5.44	6.12	1800
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	50	1.00	2.25	5.81	6.88	1800
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	44-20	25	.62	1.88	5.56	6.25	1000
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	75-16	50	1.00	2.25	5.94	7.00	1400
3.25	G	1.38	1.62	2.000	.62	1.12	-	1 00-14	1 25-12	1 00-14	62	1 25	2 50	6 56	7 50	1400
	H	1.75	2.00	2.375	.75	1.50	-	1 25-12	1 50-12	1 25-12	75	1 50	2 75	6 81	8 00	1400
4.00	F	1.00	1.12	1.500	.50	.88	3.00	75-16	88-14	75-16	25	.75	2.38	6.50	7.50	900
	G	1.38	1.62	2.000	.62	1.12	3.00	1 00-14	1 25-12	1 00-14	38	1 00	2 62	6 75	8 00	900
5.00	H	1.75	2.00	2.375	.75	1.50	-	1 25-12	1 50-12	1 25-12	50	1 25	2 88	7 62	8 50	900
	J	2.00	2.25	2.625	.88	1.69	-	1 50-12	1 75-12	1 50-12	50	1 38	3 00	7 75	8 75	900
6.00	K	2.50	3.00	3.125	1.00	2.06	-	1 88-12	2 25-12	1 88-12	62	1 62	3 25	8 31	9 50	1000
	L	3.00	3.50	3.750	1.00	2.62	-	2 25-12	2 75-12	2 25-12	62	1 62	3 25	8 31	9 50	1000
7.00	M	3.50	3.50	4.250	1.00	3.00	-	2 50-12	3 25-12	2 50-12	62	1 62	3 25	8 31	9 50	1000
	N	4.00	4.00	4.750	1.00	3.38	-	3 00-12	3 75-12	3 00-12	50	1 50	3 38	8 94	10 00	750

* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† CAUTION: PSI ratings shown are HANNA recommended maximum operating pressures. Check STROKE LIMITATION DATA in TECHNICAL INFORMATION section which may reduce maximum operating pressure. Check STOP TUBE DATA (TECHNICAL INFORMATION section) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

DESCRIPTION	PAGE
Port Size and Location.....	81
Stroke Limitation Data.....	82
Stop Tube Data.....	83
Hydraulic Force Data.....	84
Cylinder Cushion.....	86

PORT LOCATION

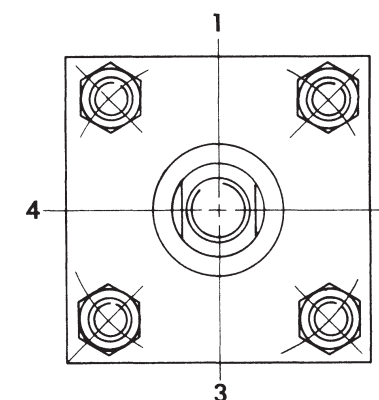
Numbers 1, 2, 3 and 4 around end view of cylinder drawings are for describing optional pipe port locations. Position 1 is standard. In many cases ports can be positioned at 2, 3 or 4 by rotating the heads at assembly. In other cases where it is undesirable to rotate the heads because of corresponding rotation of cylinder mountings, additional ports can usually be placed at positions 2, 3 or 4. Orders or inquiries should state port locations for rod and cap end heads, if other than standard. When changing port locations, careful attention should be paid to clearance between pipes, cylinder mountings, and the heads of any mounting screws.

Standard ports will be supplied at Position 1. Orders should specify pipe port locations if other than standard. Optional ports and bossed ports are available. Refer to the charts below to select the appropriate port.

CAUTION:

Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. **Fluid velocities in the supply line in excess of 15 feet per second are not recommended.**

PORT NUMBERING AND POSITIONING



Position location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End.

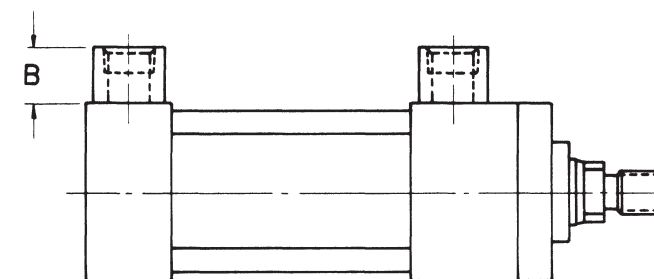
PORT SIZE

SERIES 2H OPTIONAL PORTING

BORE	STANDARD SAE PORT	OVERSIZED BOSSED SAE	DIM. B	STANDARD NPT PORT	OVERSIZE BOSSED PORT
1.50	#8 (.750-16)	#12 (1.062-12)	15/16	1/2	3/4
2.00	#8 (.750-16)	#12 (1.062-12)	15/16	1/2	3/4
2.50	#8 (.750-16)	#12 (1.062-12)	15/16	1/2	3/4
3.25	#12 (1.062-12)	#16 (1.312-12)	1-1/8	3/4	1
4.00	#12 (1.062-12)	#16 (1.312-12)	1-1/8	3/4	1
5.00	#12 (1.062-12)	#16 (1.312-12)	1-1/8	3/4	1
6.00	#16 (1.312-12)	#20 (1.625-12)	1-1/4	1	1-1/4
7.00	#20 (1.625-12)	#24 (1.875-12)	1-1/2	1-1/4	1-1/2
8.00	#24 (1.875-12)	#32 (2.50-12)	1-19/32	1-1/2	2
10.00			1-19/32	2	2-1/2
12.00				2-1/2	3
14.00				2-1/2	3

SERIES 3L OPTIONAL PORTING

BORE	STANDARD NPT PORT	OVERSIZED BOSSED NPT	DIM. B	OPTIONAL SAE PORT	OVERSIZE BOSSED SAE
1.50	3/8	1/2	15/16	#6 (.562-18)	#10 (.875-14)
2.00	3/8	1/2	15/16	#6 (.562-18)	#10 (.875-14)
2.50	3/8	1/2	15/16	#6 (.562-18)	#10 (.875-14)
3.25	1/2	3/4	15/16	#10 (.875-14)	#12 (1.062-12)
4.00	1/2	3/4	15/16	#10 (.875-14)	#12 (1.062-12)
5.00	1/2	3/4	15/16	#10 (.875-14)	#12 (1.062-12)
6.00	3/4	1	1-1/8	#12 (1.062-14)	#16 (1.312-12)



STROKE LIMITATION DATA

The rod diameter has to be capable of withstanding any compressive force developed by the cylinder working against the load. A piston rod diameter with adequate column strength to handle the compressive force of the application can be selected from the convenient pre-calculated chart below.

To use this chart find the force value, developed by the application, in the left column. Next, select the figure which resembles your application and then multiply "D" times the factor given in that figure. Finally, opposite the corresponding force value, find the value of "L" which is equal to, or greater than, the figure derived from factoring "D". Directly above is the rod diameter which is capable of withstanding the forces developed in the application.

EXAMPLE: Cylinder Bore = 4.00" Operating PSI = 750
 Force Value 9428 lbs.
 Application - Resembles Fig. 2 - Foot Lug Mtg. Stroke = 40"
 "L" = 0.7 x 40; L = 28"
 Correct Rod Diameter = 1.38"

NOTE: SEE APPLICATION FIGURES ON NEXT PAGE.

The total force is 9428 lbs., and the value of "L" is 28 inches in this application. The smallest diameter rod capable of handling this situation is 1.38 inches.

If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D".

FORCE VALUE	VALUE OF "L" IN INCHES												
	PISTON ROD DIAMETER												
in pounds	.62	1.00	1.38	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	7.00
100	66												
200	47												
400	33	85											
600	27	70	132										
800	24	60	114	184									
1000	21	54	102	165	215								
1300	18	47	90	145	188								
1700	16	41	78	127	165	258							
2100	14	37	71	114	149	232							
2500	13	34	65	104	136	213	304						
3000	12	31	58	95	124	192	280	381					
4000	10	27	51	83	108	162	242	330	430				
5000	9	24	46	74	96	150	217	295	385				
6000	8	22	42	67	89	137	198	269	352	443			
8000	7	19	36	58	76	119	172	233	305	384	475		
10000	7	17	32	52	68	106	153	209	273	344	426	514	
12000	15	29	48	62	97	139	190	249	314	328	468	761	
16000	13	26	42	54	84	121	165	215	272	316	407	659	
20000	23	38	48	75	109	148	193	243	301	365	590		
30000	18	31	39	61	89	120	153	198	245	297	484		
40000		27	34	53	77	104	136	172	213	257	417		
50000		23	31	48	69	93	122	153	190	230	373		
60000		21	28	44	63	85	111	140	174	210	340		
80000		24	38	54	74	96	122	143	192	295			
100000			34	48	66	86	109	132	163	264			
120000			31	44	60	79	100	121	142	240			
140000			41	56	73	92	112	135	223				
160000			38	52	63	86	105	129	209				
200000				47	61	77	93	115	187				
250000				42	54	69	84	103	167				
300000									152				
350000									141				
400000									131				
500000									118				

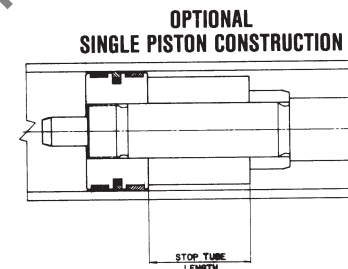
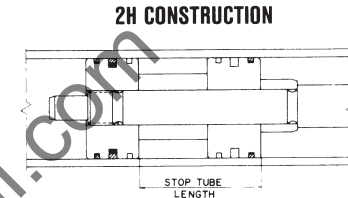
If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D".

STOP TUBE DATA

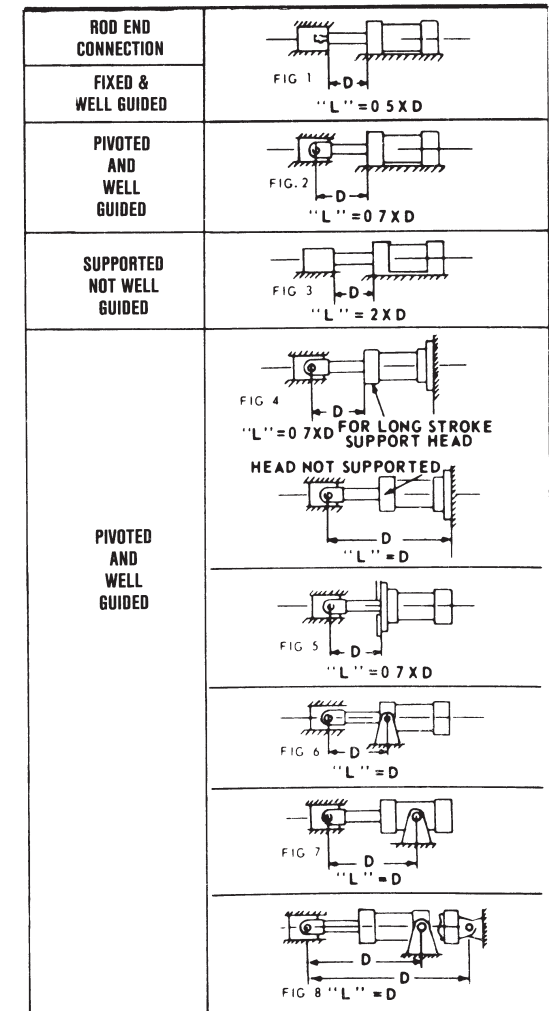
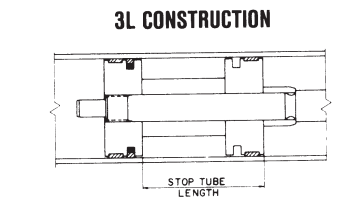
Long stroke cylinders can be subjected to a buckling action and excessive bearing wear due to the weight of the exposed rod. To reduce wear a stop tube is recommended.

All cylinders cushioned and non-cushioned are supplied with the double piston construction. General construction of cylinder stop tube is illustrated below.

SERIES 2H	
DUAL PISTON CONSTRUCTION	
MINIMUM STOP TUBE LENGTHS	
1.50 BORE	1.38 LG.
2.00 BORE	1.38 LG.
2.50 BORE	1.50 LG.
3.25 BORE	1.75 LG.
4.00 BORE	2.00 LG.
5.00 BORE	2.50 LG.
6.00 BORE	2.88 LG.
7.00 BORE	3.00 LG.
8.00 BORE	3.50 LG.



SERIES 3L	
DUAL PISTON CONSTRUCTION	
MINIMUM STOP TUBE LENGTHS	
1.50 BORE	1.12 LG.
2.00 BORE	1.12 LG.
2.50 BORE	1.25 LG.
3.25 BORE	1.25 LG.
4.00 BORE	1.25 LG.
5.00 BORE	1.50 LG.
6.00 BORE	1.50 LG.



To determine if a stop tube is required, find the total value of "L" using the stroke limitation chart. Compare this value with the stop tube chart. If the value of "L" exceeds 40 inches, you can find the recommendation for stop tube length at the bottom of the chart.

EXAMPLE PROBLEM:
 Cylinder Model MP1-3L-NC-4-27-KSM-1A
 Accessory - V-6 Clevis
 Pressure - 1500 PSI
 Clevis Mount - Horizontal

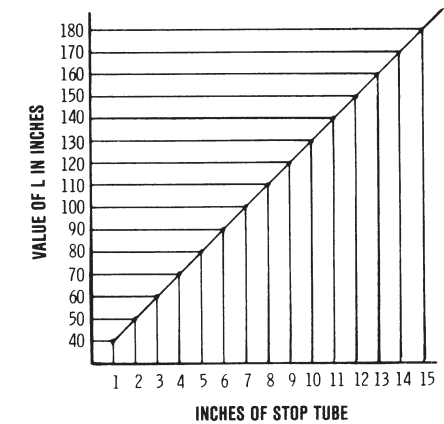
From the description, the cylinder falls into Fig. 8. To determine the value of "L":

ADD: MP1 "XC" Dimension 7-3/4"
 V-6 "CE" Dimension 5-1/2"
 Two times stroke (2 x 27) 54"
 Total Value of "L" 67-1/4"

Looking this up on the chart, you'll find a recommended stop tube length of 4 inches.

The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and recheck column strength on stroke limitation chart.

STOP TUBE CHART



HYDRAULIC FORCE DATA

WHAT BORE SIZE DO YOU NEED?

The force formula for determining the force produced by a cylinder is

$$F = A \times \text{PSI}$$

$$\text{Force (lbs.)} = \text{Cylinder Piston Area (sq. in.)} \times \text{Line Pressure (lbs./sq. in.)}$$

Chart C1 shows the force produced by specific cylinder bore sizes at various pressures. Forces not listed on the chart can be calculated by using the formula $F = A \times \text{PSI}$. An example of this formula follows:

EXAMPLE: Determine the thrust of a 14.00" bore cylinder operating at 1250 p.s.i. hydraulic line pressure.
 $F = 153.94 \times 1250 \quad F = 192,425$

To select the proper bore size, first determine the force required for your particular application, then add a factor of five percent to allow for internal frictional losses.

Locate the total required force in Chart C1 in the column that matches your system's operating pressure. The bore size that produces the necessary total force at the desired operating pressure is the proper size for your application.

Chart C1 HYDRAULIC CYLINDER FORCE CHART*

Bore	Piston Area Sq. In.	PUSH STROKE Values are Pounds of Force								Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	
1.50	1.77	442	884	1325	1767	2651	3534	4420	5304	.00765
2.00	3.14	786	1571	2357	3142	4713	6285	7850	9420	.0136
2.50	4.91	1227	2455	3682	4909	7364	9815	12270	14730	.0212
3.25	8.29	2074	4148	6222	8296	12440	16590	20740	24890	.0359
4.00	12.56	3143	6285	9428	12560	18860	25140	31415	37700	.0544
5.00	19.63	4910	9820	14730	19640	29460	39280	49085	58900	.0860
6.00	28.27	7068	14140	21200	28270	42400	56540	70685	84820	.1224
7.00	38.48	9623	19240	28870	38490	57740	76980	96210	115450	.1666
8.00	50.26	12570	25140	37700	50270	75400	100500	125660	150800	.2176
10.00	78.54	19640	39270	58900	78540	117800	157100	196350	235620	.3393
12.00	113.10	28280	56550	84820	113100	169600	226200	282750	339300	.4886
14.00	153.94	38480	76970	115455	153940	230910	307880	384850	461820	.6664

$$\text{Force (pounds)} = \text{Cylinder Piston Area (in square inches)} \times \text{Line Pressure (in pounds per sq. in.)}$$

EXAMPLE:

Determine the thrust of a 4.00 inch bore cylinder operating at 1000 psi hydraulic line pressure

$$F = 12.56 \times 1000$$

$$F = 12,560 \text{ lbs.}$$

Chart C1A

Rod Dia.	Rod Area Sq. In.	PULL STROKE <small>To determine pull stroke thrust or consumption, deduct the value for the rod diameter from the corresponding cylinder bore in Chart C1.</small>								Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	
62	307	77	154	230	307	461	615	767	920	.00133
1.00	78	196	393	590	785	1175	1570	1950	2355	.0034
1.37	1.48	371	742	1113	1485	2230	2970	3500	4455	.0067
1.75	2.40	601	1202	1803	2405	3610	4810	6010	7510	.0104
2.00	3.14	786	1572	2357	3142	4715	6285	7850	9420	.0136
2.50	4.91	1225	2450	3682	4909	7350	9815	12270	14730	.0212
3.00	7.07	1767	3535	5302	7070	10605	14140	17680	21200	.0306
3.50	9.62	2405	4810	7216	9620	14435	19240	24005	28810	.0417
4.00	12.56	3142	6284	9426	12570	18850	25140	31415	37700	.0544
4.50	15.90	3976	7952	11930	15900	23860	31810	38200	47750	.0688
5.00	19.63	4909	9820	14730	19640	29450	39270	49085	58900	.0860
5.50	23.76	5940	11880	17820	23760	35640	47575	59250	71250	.1028
6.00	28.27	7068	14140	21200	28270	42400	56540	70685	84820	.1224
7.00	38.49	9623	19240	28870	38490	57740	76980	96210	115450	.1666
8.00	50.26	12570	25140	37700	50270	75400	100500	125660	150800	.2176
10.00	78.54	19635	39270	58905	78540	117810	157080	196350	235620	.3400

To obtain forces not given, multiply piston area times operating pressure
 * Forces given do not allow for frictional or other power losses.
 1 U.S. Gallon = 231 Cubic Inches

COMPARE PRESSURE RATINGS

Chart C2 shows the pressure ratings for HANNA Hydraulic Cylinders and may help you in determining the most economical cylinder for your application. The 3L Series

is designed for medium duty service (under 2000 PSI). The 2H Series is a heavy-duty high pressure cylinder line (3000 PSI).

Chart C2 HYDRAULIC CYLINDER RATING* (P.S.I.)

Bore	SERIES 2H	
	3:1 Factor of Safety	4:1 Factor of Safety
1.50	2900	2180
2.00	3730	2800
2.50	3140	2360
3.25	3040	2280
4.00	2960	2220
5.00	2785	2090
6.00	2540	1905
7.00	2740	2053
8.00	2540	1905
10.00	2400	1800
12.00	2600	1950
14.00	2570	1930

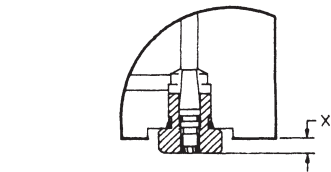
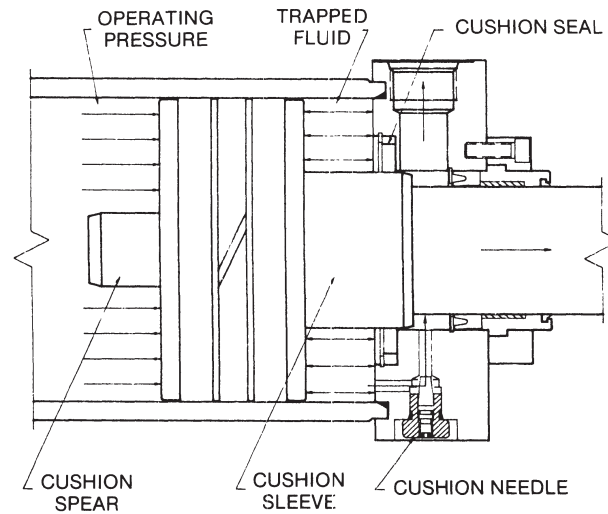
Bore	SERIES 3L	
	3:1 Factor of Safety	4:1 Factor of Safety
1.50	1915	1435
2.00	1200	900
2.50	750	560
3.25	1180	885
4.00	790	595
5.00	600	460
6.00	650	490

Models MF1, MF2, MF5 and MF6 may carry lower Pressure Ratings in some cases. Refer to the appropriate catalog pages for exact ratings on these Models.

* Ratings are based on the yield point of the weakest component and smallest rod size. See mounting pages for maximum recommended operating pressures.

Hydraulic Cylinders equipped with stainless steel piston rods have reduced Pressure Ratings due to the lower strength properties of stainless steel. Consult Factory for specific Ratings.

CYLINDER CUSHION



NOTE: Cushion needle extends beyond the edge of head on the following:

2H-LINE (both heads)

Bore	X
1.50	.148
2.00	.195

3L-LINE

Bore	F.H. B.H.	
	X	X
1.50	.235	.195
2.00	.235	.195
2.50	.235	.195
3.25	.125	.085

DETERMINING ENERGY OF THE APPLICATION

Cushions in cylinders are primarily intended to protect the cylinder from damaging impacts at the ends of the stroke. Properly selected and adjusted cushions may also reduce noise, reduce loading damage, may increase machine output.

As a general guide line, the use of hydraulic cushions should be considered whenever the velocity of the piston approaches 20 to 25 feet per minute. When piston velocity exceeds 35 to 40 feet per minute, the amount of energy being generated will usually demand the use of cushions to decelerate the piston. Cushions should also be seriously considered when a large mass imparts inertia loading to the cylinder.

Cushions work by trapping a volume of fluid at the end of the stroke to create a back pressure which resists the force being exerted on the working side of the piston. As shown above, this back pressure is developed when the cushion sleeve or spear enters into the cushion seal and the fluid is bled down through the orifice at the cushion seal and past the cushion adjustment needle. The back pressure developed must be sufficient to resist the force developed by the application. To determine if a suitable cushion can be provided in the cylinder selected for the application calculate the total energy which must be absorbed, as outlined below, and compare with the cushion capacity listed in the cushion capacity table.

Things to consider:

- Kinetic energy.
 - Propelling energy (including gravity).
- I. To solve for kinetic energy:
 $0.1865 \times W \times V^2 = K.E.$
 W = Weight of the entire moving mass (pounds) (include cylinder piston rod in the mass figure)
 V = Velocity at entering the cushion (feet/sec.)
 K.E. = Kinetic Energy (inch pounds).
- II. To solve for propelling energy:
 $F \times S = P_1$
 F = Force exerted by the cylinder (Piston Area x PSI at relief valve setting).
 S = Cushion length (inches)
 P_1 = Propelling Energy (inch pounds).
- III. Gravity effects must also be considered if the cylinder is mounted in a vertical plane. If the mass is moving down into the cylinder cushion, the energy due to gravity must be added to the propelling energy, P_1 . If the mass is moving up into the cushion, the gravity is negative and this energy may be subtracted from the propelling energy, P_1 .

To solve for propelling energy due to gravity:
 $W \times S = P_2$
 W = Weight of moving mass
 S = Length of cushion
 P_2 = Propelling energy due to gravity (inch pounds).

If the load is horizontal, the effect of gravity is zero and will not affect the total propelling energy.

TOTAL ENERGY IS:
 $K.E. + P_1 \pm P_2$
 K.E. = Total Kinetic Energy Formula I.
 P_1 = Total Propelling Energy Formula II.
 P_2 = Total Propelling Energy Formula III.

* Add if gravity is positive —
 Subtract if gravity is negative —
 Disregard if cylinder travel is horizontal.

NOTE: On Series 2H, the Head End Cushion on 1.50" Bore with (F) Rod is not adjustable.

On Series 3L, Cushions are not available on the Head End of 1.50" Bore (F) Rod, 2.00" Bore (G) Rod and 2.50" Bore (H) Rod.

CUSHION CAPACITY CHART

SERIES 2H

BORE	ROD DIA.	HEAD END		CAP END	
		CUSHION LENGTH	CAPACITY (IN.-LBS.)	CUSHION LENGTH	CAPACITY (IN.-LBS.)
1.50	.62	.73	4,840	.74	6,310
	1.00	.84	3,250		
2.00	1.00	.73	7,845	.74	10,900
	1.38	.73	5,545		
2.50	1.00	.73	11,990	.74	17,430
	1.38	.73	8,510		
3.25	1.75	.73	8,510		
	1.38	.77	17,470		
4.00	1.75	.77	17,470	.83	32,280
	2.00	.77	13,970		
5.00	2.50	.77	33,910		
	2.00	.77	28,525	.83	50,190
6.00	2.50	.77	28,525		
	2.00	.77	47,230	.77	71,760
7.00	2.50	.77	47,230		
	3.00	.77	25,690		
8.00	3.50	.77	25,690		
	2.50	.88	91,995		
10.00	3.00	.88	48,475	.96	127,930
	3.50	.88	48,475		
12.00	4.00	.88	47,475		
	3.00	1.25	132,670		
14.00	3.50	1.25	132,670		
	4.00	1.25	132,670	1.39	249,570
16.00	4.50	1.22	79,780		
	5.00	1.22	79,780		
18.00	5.00	1.38	227,750		
	4.00	1.38	227,750	1.46	339,515
20.00	4.50	1.35	136,320		
	5.00	1.35	136,320		
22.00	5.00	1.35	136,320		
	5.50	1.35	136,320		
24.00	4.50	1.83	438,100		
	5.00	1.83	438,100	1.84	677,440
26.00	5.50	1.83	438,100		
	7.00	1.83	341,110		
28.00	5.50	2.58	1,063,430		
	7.00	2.58	926,710	2.09	1,130,050
30.00	8.00	2.58	769,700		
	7.00	2.58	1,453,540		
32.00	8.00	2.58	1,296,550		
	10.00	2.58	921,750	2.34	1,743,680

SERIES 3L

BORE	ROD DIA.	HEAD END		CAP END	
		CUSHION LENGTH	CAPACITY (IN.-LBS.)	CUSHION LENGTH	CAPACITY (IN.-LBS.)
1.50	.62	.62	2,050	.50	2,130
	1.00	N/A	N/A		
2.00	.62	.62	3,495		
	1.00	.62	3,495	.50	3,850
2.50	1.38	N/A	N/A		
	.62	.62	3,740		
3.25	1.00	.62	3,740	.50	3,635
	1.38	.62	3,050		
4.00	1.75	N/A	N/A		
	1.00	.81	10,810		
5.00	1.38	.81	10,810	.61	9,730
	1.75	.81	7,350		
6.00	2.00	.81	7,350		
	1.00	.81	8,865		
7.00	1.38	.81	8,865		
	1.75	.81	7,140	.61	7,470
8.00	2.00	.81	7,140		
	2.50	.81	5,800		
9.00	1.00	.81	11,670		
	1.38	.81	11,670		
10.00	1.75	.81	10,290		
	2.00	.81	10,290	.61	9,425
11.00	2.50	.81	9,216		
	3.00	.81	6,035		
12.00	3.50	.81	6,035		
	1.38	.81	19,430		
13.00	1.75	.81	17,875		
	2.00	.81	17,875		
14.00	2.50	.81	16,670		
	3.00	.81	13,350	.73	18,180
15.00	3.50	.81	13,350		
	4.00	.81	11,164		

TYPICAL APPLICATION PROBLEM

You have tentatively chosen a 2H Series cylinder with a 3-1/4" bore to move a 4000 pound mass horizontally at 3 feet per second. The system relief valve setting is 1000 psi. The cylinder is equipped with the standard 1-3/8" diameter piston rod and the effective cushion stroke or length is .77 inch.

Kinetic Energy:
 $0.1865 \times 4000 \text{ lbs.} \times (3)^2$
 $746 \times 9 = 6714 \text{ in. lbs.}$
 Propelling Energy:
 $8.29 \times 1000 \times .77 = 6383$
 Total Application Energy:
 $6714 + 6383 = 13097 \text{ in. lbs.}$

The total energy seen by the cushion in this application is 13097 inch pounds. By referring to the cushion capacity chart shown above, we find the standard 3-1/4" bore 2H Series cushion can adequately handle the energy. If the energy developed exceeds the capacity of the standard cushion consider use of supercushions or changes in the hydraulic circuit which will reduce the amount of energy the cushions must absorb. (Supercushions have the same physical appearance as the standard cushion described above, except that the effective cushion length is doubled. An additional head or cap on both are added to accommodate the longer cushion sleeve or spear. The overall length of the cylinder body changes accordingly. Capacities of supercushions are double those shown in the cushion capacity chart.)

If in doubt about selecting a cushion, consult the factory with detailed application information and a recommendation will be made.

Caution: Cushion adjustment needles require only about one to one-half turn adjustment. Do not unscrew beyond the point at which the head of the screw is flushed with the surface of the head or cap.

DESCRIPTION	PAGE
Seal Kits.....	89
Parts List.....	90
Retainer Plate Construction.....	92
Fastener Torques and Cylinder Weights.....	93

STORAGE:

If cylinders are to be stored before use, they should be stored in the vertical position, rod end up. Cylinders in storage should always be fully protected against the elements or other adverse conditions.

INSTALLATION:

The pipe ports of cylinders are sealed with plastic plugs. The plugs protect the precision internal parts by sealing out damaging dirt and grit. Do not remove port seals until ready to connect piping. To protect cylinders, clean all pipes and pipe fittings of dirt, scale, and thread chips. A filter is recommended to keep the operating fluid free of foreign matter.

Accurate mounting and alignment are essential to proper cylinder performance. By eliminating side loading, packing and bearing life will be increased. Mounting surfaces should be straight, bearings for pin and trunnion mounting must be in line.

Dirt or abrasive matter adhering to the piston rod may cause excessive wear to the piston rod and gland. For best results, protect the cylinder from such dirt. A piston rod protective shield is ideal for this purpose.

OPERATION:

Needle valves in cylinder head and cap of adjustable cushioned cylinders permit regulation of cushioning effect. Adjust needle valve using an Allen wrench, rotating clockwise to increase cushioning and counterclockwise to decrease cushioning effect. Speed control valves are essential for obtaining the best cushioning operation. A proper balance of cushion needle and flow control valve adjustment should result in a smooth stop with no bouncing.

MAINTENANCE:

Parts which may need replacement in the course of normal use are the rod wiper, rod seal and piston seals.

The need for replacement of the rod seal will become evident through the escaping of fluid around the gland.

To replace rod wiper or rod seal, remove the gland from the cylinder. Remove worn rod wiper and rod seal. To reassemble, slip new rod wiper and rod seal into grooves. Care should be exercised not to nick the lips of the seals. Be sure to retorque gland screws to the specified torque for the cylinder.

To replace piston seal, cut the old piston seal, and remove it and the old O-ring from the groove. Install new O-ring. Next, slightly stretch the Teflon piston seal and work it into the groove. Replace wear strip(s). Carefully insert the ram assembly into the tube—this will assure the Teflon seal is reshaped equally.

It is recommended that new "O" rings be installed each time the cylinder is disassembled for maintenance. This applies to tube and gland "O" rings. The cushion needle valve "O" rings should also be replaced if these parts are disassembled. When reassembling, be sure to apply proper tie rod torque.

If the cushion action of the cylinder fails, check the cushion float sealing. Check to determine if the bronze ring has been worn on its internal diameter, and if foreign particles have become lodged between the face of the ring and the cylinder head recess face. A free play of the ring, both radially and axially, is normal to allow for centering and cushion float action.

If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned correctly with the load it is pushing or pulling. 4. That the piston seal or the rod seal is not worn, allowing pressure to escape.

Replacement parts can be furnished quickly if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number.

The cylinder illustrated is for reference purposes only, and does not represent any particular model.

SEAL KITS

All cylinders are fully field identifiable, including packing option codes.

NAMEPLATE CODE EXAMPLE

Bore Size
Cylinder Series
Rod Diameter Code

MF1-2H-CC-2.00"-9.00"-FSM1G

PISTON ROD KITS

Ordering Example:

SEAL KIT F-1 For Series 2H

From piston rod code | From rod packing code | From Series Code

Order by Piston Rod Packing Code, Rod Diameter Code, and Cylinder Series Code from nameplate as outlined.

- 1 (STANDARD)
Temperature Range -20°F to +200°F
Buna-N O-Rings, Polyurethane Rod Packing and Rod Wiper.
- 2 (OPTIONAL)
Temperature Range -20°F to +200°F
Buna-N O-Rings, Buna-N Multiple Lip Rod Packing, Polyurethane Rod Wiper.
- 3 (OPTIONAL)
Temperature Range -20°F to +400°F
Viton O-Rings, Viton Rod Packing, Teflon Rod Wiper.

PISTON PACKING KITS

Ordering Example:

SEAL KIT G-2.00 For Series 2H

From piston packing code | Bore size | From Series Code

Order by Piston Packing Code, Bore Size and Cylinder Series Code from nameplate as outlined.

- A Temperature Range -20°F to +200°F
Buna-N U-Cups, Teflon Back-Up Washers, Buna-N Tube Seals. **(Series 3L only)**.
- A Temperature Range -20°F to +200°F
Polyurethane U-Cup Seal, Buna Tube Seals. **(Series 2H only)**.
- B Temperature Range -20°F to +400°F
Viton U-Cups, Teflon Back-Up Washers, Viton Tube Seals. **(Series 3L only)**.
- B Temperature Range -20°F to +400°F
Viton U-Cup Seal, Viton Tube Seals. **(Series 2H only)**.
- E Temperature Range -20°F to +200°F
Cast Iron Rings, Filled Teflon Seal w/Buna-N Expander, Buna-N Tube Seals. **(Series 2H only)**.
- F Temperature Range -20°F to +400°F
Cast Iron Rings, Filled Teflon Seal w/Viton Expander, Viton Tube Seals. **(Series 2H only)**.
- G Temperature Range -20°F to +200°F
Piston Wear Strip(s), Filled Teflon Seal w/Buna-N Expander, Buna-N Tube Seals.
- H Temperature Range -20°F to +400°F
Piston Wear Strip(s), Filled Teflon Seal w/Viton Expander, Viton Tube Seals.

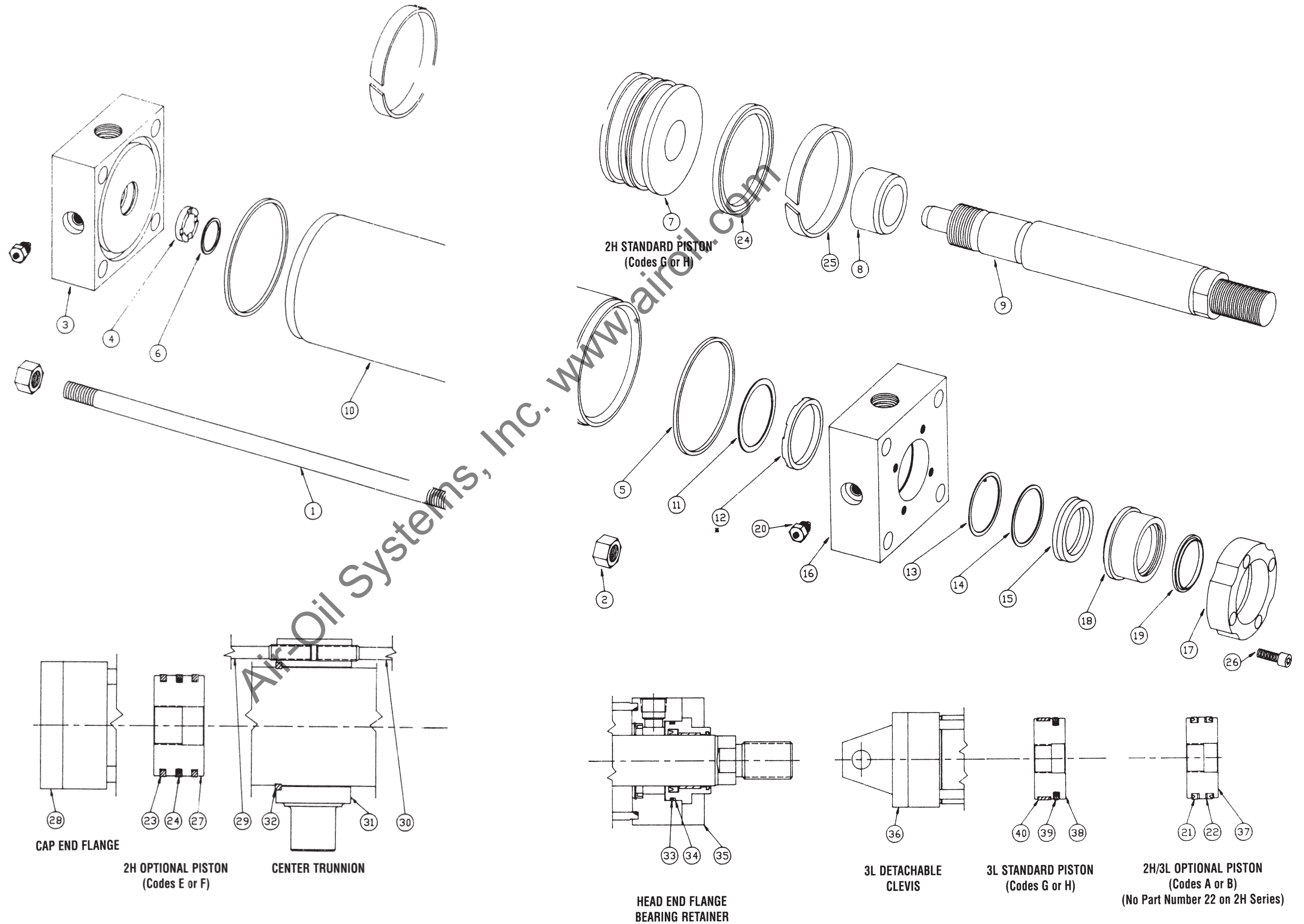
The correct Rod Piston Kits and Piston Packing Kits can be furnished quickly if you will indicate the serial number of the cylinder as shown on the nameplate, and/or by accurately following the ordering examples shown above.

PARTS LIST

When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

PART NO.	NO. REQ'D.	DESCRIPTION
1	**	Tie Rod
2	**	Tie Rod Nut
3	1	Cap
4	1	Cap Cushion Float
5	2	O-Ring (Tube)
6	1	Cap Retaining Ring
7	1	2H Standard Piston
8	1	Cushion Sleeve
9	1	Piston Rod
10	1	Tube
11*	1	Head Cushion Retaining Ring
12*	1	Head Cushion Float
13	1	Packing Retaining Ring
14	1	Rod Washer
15	1	Rod Packing
16	1	Front Head
17	1	Retainer Plate
18	1	Gland Assembly
19	1	Rod Wiper
20	2	Cushion Needle
21	2	Piston U-Cup
22	2	Back Up (3L Only)
23	2	Cast Iron Ring (2H Only)
24	1	Filled Teflon Seal with Buna Expander
25	2	Wear Strip
26	4/8	Gland Screw
27	1	Optional Piston (2H Only)
28	1	Cap End Flange
29	**	Cap End Tie Rod
30	**	Head End Tie Rod
31	1	Center Trunnion Band
32	4	Trunnion Locator Key (2H Only)
33	1	O-Ring (Gland)
34	1	Back-Up (2H Only)
35	1	Front Flange
36	1	Detachable Clevis (3L Only)
37	1	Optional Piston (2H or 3L)
38	1	3L Standard Piston
39	1	Filled Teflon Seal with Buna Expander
40	1	Wear Strip

* 1.50 through 8.00" Bores only.



RETAINER PLATE CONSTRUCTION

SQUARE RETAINER CONSTRUCTION SERIES 2H

BORE	ROD	TT	RT
1.50	D	1.50	2.13
2.00	F	2.00	2.84
2.50	F	2.00	2.84

For all mounts except ME5.

BORE	ROD
1.50	F
2.00	G
2.50	G,H

SQUARE RETAINER CONSTRUCTION SERIES 3L

BORE	RODS
1.50	D, F
2.00	G
2.50	G, H
3.25	H, J
4.00	H, J, K
5.00	H, J, K, L, M
6.00	K, L, M, N

ME5 RETAINER CONSTRUCTION SERIES 3L

BORE	ROD DIA.
1.50	D (.62) & F (.00)
2.00	G (1.38)
2.50	H (1.75)
3.25	J (2.00)

FASTENER TORQUES AND CYLINDER WEIGHTS

2H SERIES TIE ROD TORQUE			
BORE	SIZE	TORQUE	TORQUE MX1, 2, 3, 4
1.5	38-24	25 ft-lbs	30 ft-lbs
2.0	50-20	55	70
2.5	50-20	55	70
3.25	62-18	100	140
4.00	62-18	110	160
5.00	88-14	230	375
6.00	1 00-14	300	600
7.00	1 1/2-12	600	800
8.00	1 25-12	850	1,000
10.00	1 25-12	850	1,000
12.00	1 25-12	850	1,000
14.00	1 25-12	850	1,000

3L SERIES TIE ROD TORQUE			
BORE	SIZE	TORQUE	TORQUE MX1, 2, 3, 4
1.5	25-28	8 ft-lbs.	8 ft-lbs
2.0	31-24	14	14
2.5	.31-24	14	14
3.25	38-24	25	28
4.00	38-24	25	28
5.00	.50-20	35	48
6.00	.50-20	35	48

2H SERIES GLAND SCREW TORQUES			
BORE	ROD	SCREW SIZE	TORQUE
1.5	ALL	#10-32	4 ft-lbs.
2.0	ALL	#10-32	4
2.5	ALL	#10-32	4
3.25	ALL	312-24	18
4.00	ALL	312-24	18
5.00	J, K	.312-24	18
5.00	L, M	.375-24	42
6.00	K	312-24	18
6.00	L, M, N	.438-20	50
7.00	L, M, N	438-20	50
7.00	P, R	.500-20	75
8.00	M, N	438-20	50
8.00	P, R, S	500-20	75
10.00	P, R, S	500-20	75
10.00	T	438-20	50
12.00	S, U	500-20	75
12.00	T	438-20	50
14.00	T	438-20	50
14.00	U, V	.500-20	75

3L SERIES GLAND SCREW TORQUES		
BORE	SCREW SIZE	TORQUE
1.5	—	—
2.0	#10-32	4 ft-lbs
2.5	#10-32	4
3.25	#10-32	4
4.00	#10-32	4
5.00	#10-32	4
6.00	25-28	10

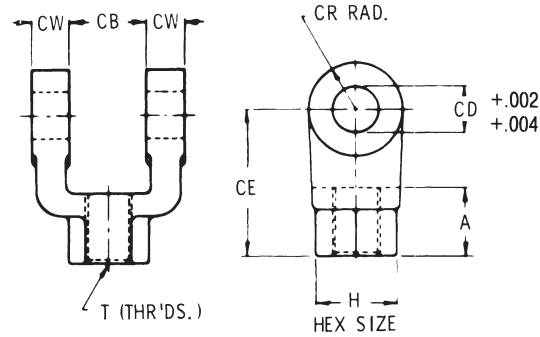
2H SERIES		
CYLINDER BORE	BASE WEIGHT AT ZERO STROKE	WEIGHT PER INCH OF STROKE
1.50	8 lbs	.4 lbs
2.00	14	.8
2.50	19	1.0
3.25	37	1.5
4.00	51	2.3
5.00	90	4.0
6.00	140	5.1
7.00	210	6.5
8.00	294	8.2
10.00	660	16.0
12.00	1,110	23.0
14.00	1,541	44.0

3L SERIES		
CYLINDER BORE	BASE WEIGHT AT ZERO STROKE	WEIGHT PER INCH OF STROKE
1.50	5 lbs	.4 lbs
2.00	6.5	.5
2.50	10	.6
3.25	20	.9
4.00	27	1.0
5.00	40	1.2
6.00	68	1.6

These are standard accessories matched to bore size and piston rod code. The Mounting Bracket fits the cap end of Model MP1. The Bracket also fits the piston Rod Clevis with the same number (i.e. B-7 Bracket fits V-7 Rod Clevis). The pin is furnished with Model MP1 and fits the bracket, however, specify if additional pins are required. Pins also fit rod clevis and rod eyes. If you require accessories other than standard for that bore size or piston rod, specify the item number on your order.

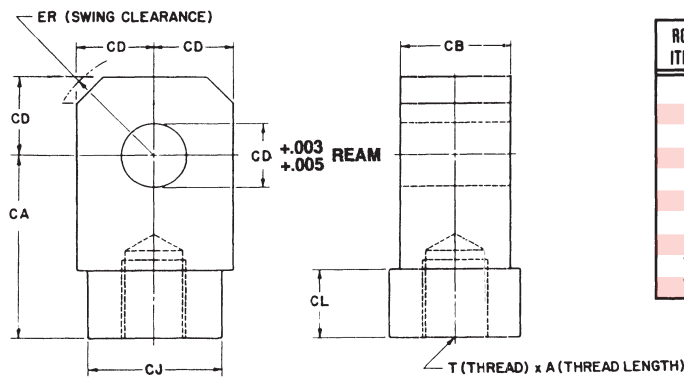
***CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

Rod Clevis



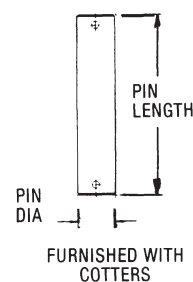
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-1	D	.75	.75	.50	1.50	.62	.50	1.00	.44-20	5,360
V-2	F	1.12	1.25	.75	2.38	.88	.62	1.25	.75-16	14,000
V-3	G	1.62	1.50	1.00	3.12	1.12	.75	1.75	1.00-14	22,500
V-4	H	2.00	2.00	1.37	4.12	1.62	1.00	2.00	1.25-12	41,250
V-5	J	2.25	2.50	1.75	4.50	2.00	1.25	2.75	1.50-12	57,000
V-6	K	3.00	2.50	2.00	5.50	2.25	1.25	3.00	1.88-12	75,000
V-7	L	3.50	3.00	2.50	6.50	2.88	1.50	3.50	2.25-12	112,500
V-8	M	3.50	3.00	3.00	6.75	3.12	1.50	3.88	2.50-12	135,000
V-10	P	4.50	4.00	3.50	8.50	3.88	2.00	5.00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4.38	2.25	6.19	4.00-12	270,000

Rod Eye



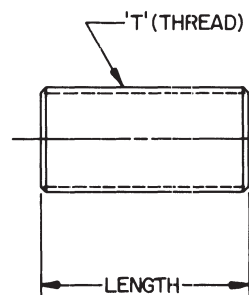
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-1	D	.75	1.50	.75	.50	-	-	.75	.44-20	5,060
Y-2	F	1.12	2.06	1.25	.75	-	-	1.12	.75-16	12,500
Y-3	G	1.62	2.81	1.50	1.00	-	-	1.44	1.00-14	20,250
Y-4	H	2.00	3.44	2.00	1.37	-	-	2.00	1.25-12	37,000
Y-5	J	2.25	4.00	2.50	1.75	-	-	2.50	1.50-12	59,000
Y-6	K	3.00	5.00	2.50	2.00	3.25	2.50	2.88	1.88-12	67,500
Y-7	L	3.50	5.81	3.00	2.50	4.00	2.81	3.56	2.25-12	101,250
Y-8	M	3.50	6.12	3.00	3.00	5.00	2.50	4.25	2.50-12	121,500
Y-10	P	4.50	7.62	4.00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5.50	9.12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

Pin



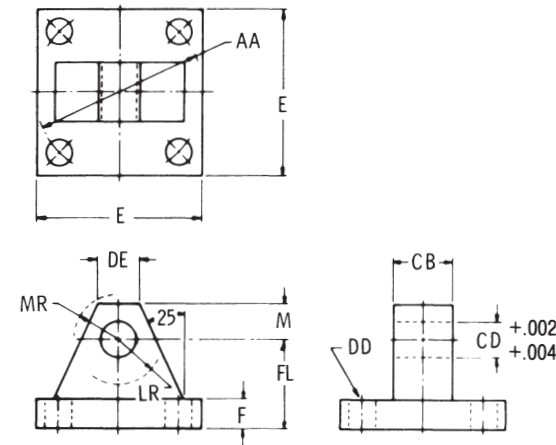
PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P1	2.28	.50	6,125
P2	3.09	.75	13,800
P3	3.60	1.00	24,500
P4	4.66	1.37	46,500
P5	5.66	1.75	75,150
P6	5.72	2.00	98,150
P7	6.94	2.50	153,400
P8	7.19	3.00	220,900
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

Piston Rod Stud



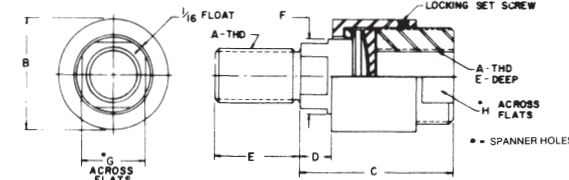
ITEM NO.	T	LENGTH
Stud 1	.44-20	1.50
Stud 2	.75-16	2.25
Stud 3	1.00-14	3.25
Stud 4	1.25-12	4.00
Stud 5	1.50-12	4.50

Brackets



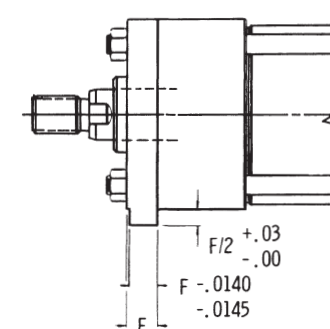
2H SERIES BORE DIA.	3L SERIES BORE DIA.	BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
1.50	1.50, 2.00, 2.50	B-1	2.30	.75	.500	44	.56	2.50	.38	1.12	.62	.50	.62	2,500
2.00, 2.50	3.25, 4.00, 5.00	B-2	3.60	1.25	.750	.56	.88	3.50	.62	1.88	.88	.75	.88	6,300
3.25	6.00	B-3	4.60	1.50	1.000	69	1.38	4.50	.75	2.25	1.25	1.00	1.25	10,000
4.00, 5.00, 6.00, 7.00, 8.00, 10.00, 12.00		B-4	5.40	2.00	1.375	.69	1.75	5.00	.88	3.00	1.75	1.38	1.75	19,250
		B-5	7.00	2.50	1.750	.94	2.25	6.50	.88	3.12	2.12	1.75	2.12	21,200
		B-6	8.10	2.50	2.000	1.06	2.56	7.50	1.00	3.50	2.38	2.00	2.38	24,500
		B-7	9.30	3.00	2.500	1.19	3.12	8.50	1.00	4.00	2.94	2.50	2.94	25,000
		B-8	10.60	3.00	3.000	1.31	3.25	9.50	1.00	4.25	3.19	2.75	3.19	22,500
		B-10	13.60	4.00	3.500	1.81		12.62	1.69	7.25	3.62	3.50	3.62	58,500
		B-12	16.19	4.50	4.000	2.06		14.88	1.94	7.75	4.12	4.00	4.12	73,250

Linear Alignment Coupler



PART NO.	A	B	C	D	E	F	G	H	MAX PULL LOAD
S-1	7/16 - 20	1-1/4	2	1/2	3/4	5/8	1/2	13/16	2,535
S-2	3/4 - 16	1-3/4	2-5/16	1/2	1-1/8	31/32	13/16	1-1/8	8,750
S-3	1 - 14	2-1/2	2-15/16	17/32	1-5/8	1-11/32	1-5/32	1-5/8	16,125
S-4	1-1/4 - 12	2-1/2	2-15/16	17/32	1-5/8	1-11/32	1-5/32	1-5/8	19,600
S-5	1-1/2 - 12	3-1/4	4-3/8	7/8	2-1/4	1-31/32	1-3/4	2-3/8	34,000
S-6	1-7/8 - 12	3-3/4	5-5/8	1	3	2-15/32	-	-	41,250

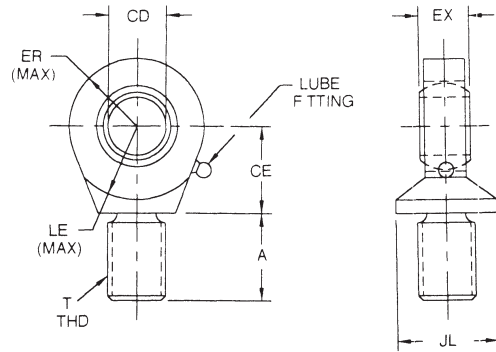
Thrust Key



Thrust keys are available on most side type mountings. Please refer to model dimension charts for F dimensions. A thrust key eliminates the need for fitted bolts or external keys. It adds extra rigidity to your cylinder mounting when the key is fitted to a keyway milled into your mounting surface.

Spherical Rod Eyes

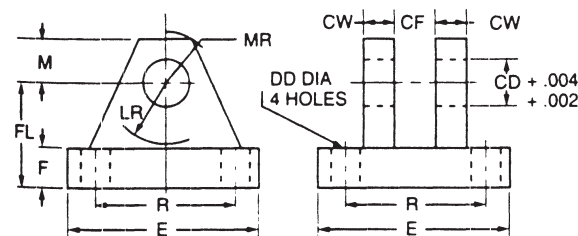
Order to fit Piston Rod thread size.



ROD EYE ITEM NO.	CD -0.0005	A	CE	EX	ER	LE	T	JL	*LBS. CAPACITY
SBY-1	0.5000	.69	.88	.44	.88	.75	.44-20	.88	2.644
SBY-2	0.7500	1.00	1.25	.66	1.25	1.06	.75-16	1.31	9.441
SBY-3	1.0000	1.50	1.88	.88	1.38	1.44	1.00-14	1.50	16.860
SBY-4	1.3750	2.00	2.13	1.19	1.81	1.88	1.25-12	2.00	28.562
SBY-5	1.7500	2.13	2.50	1.53	2.19	2.13	1.50-12	2.25	43.005
SBY-6	2.0000	2.88	2.75	1.75	2.63	2.50	1.88-12	2.75	70.193

Spherical Clevis Brackets

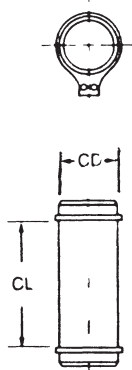
Order to fit Mounting Plate or Rod Eye.



BRACKET ITEM	E	F	M	R	CD	CF	CW	DD	FL	LR	MR	*LBS. CAPACITY
SBB-1	3.00	.50	.50	2.05	0.500	.44	.50	.41	1.50	.94	.62	5.770
SBB-2	3.75	.62	.88	2.76	0.750	.66	.62	.53	2.00	1.38	1.00	9.450
SBB-3	5.50	.75	1.00	4.10	1.000	.88	.75	.53	2.50	1.69	1.19	14.300
SBB-4	6.50	.88	1.38	4.95	1.375	1.19	1.00	.66	3.50	2.44	1.62	20.322
SBB-5	8.50	1.25	1.75	6.58	1.750	1.53	1.25	.91	4.50	2.88	2.06	37.800
SBB-6	10.62	1.50	2.00	7.92	2.000	1.75	1.50	.91	5.00	3.31	2.38	50.375

Pivot Pins

Pivot Pins are furnished with two retainer rings.



PIN ITEM NO.	CD	CL	*LBS. CAPACITY
SBP-1	.4997-.0004	1.56	8,600
SBP-2	.7497-.0005	2.03	19,300
SBP-3	.9997-.0005	2.50	34,300
SBP-4	1.3746-.0006	3.31	65,000
SBP-5	1.7496-.0006	4.22	105,200
SBP-6	1.9996-.0007	4.94	137,400

*CAUTION

Accessory load rating may be lower than maximum force available from cylinder. Accessory load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

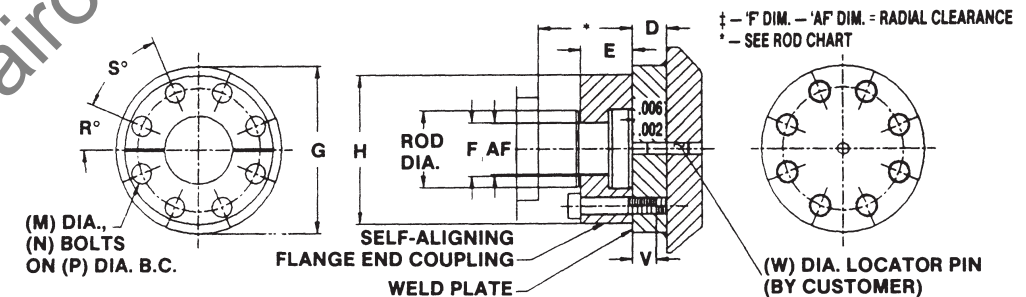
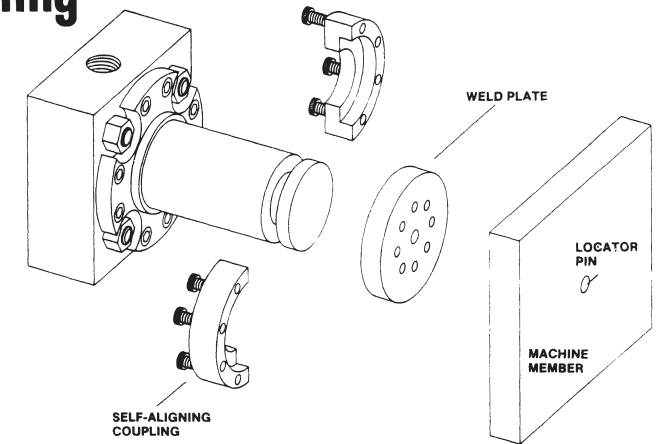
Self-Aligning Rod End Coupling

Hanna's Self-Aligning Rod End Coupling permits fast, easy assembly, disassembly, installation and servicing. Precision-machined, two-piece steel construction provides close radial alignment between piston rod end and machine member.

Allowing for radial movement increases a cylinder's seal and bearing life by eliminating much of the side load. High-tensile alloy steel, socket head cap screws and all-steel construction are designed to take full cylinder load with a factor of safety.

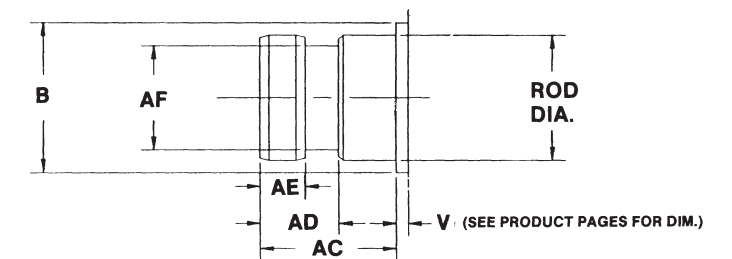
The Self-Aligning Rod End Coupling is used in conjunction with Hanna's RC rod end.

A Weld Plate is an accessory for use with the Self-Aligning Rod End Coupling. It eliminates lay-out, drilling and tapping each hole to match the coupling on your machine. The hole in the center of the Weld Plate is accurately drilled for a locating pin for fast, close positioning to the machine prior to welding.



COUPLING NO.	ROD DIA MM	AF †	E	F †	H	M	N	P	R	S	V	WELD PLATE NO.	D	G	W PIN DIA.	BOLT TORQUE FT./LB.
CP-062	.62	.38	.44	.41	1.50	10-24	4	1.12	45	90	44	WP-062	50	2.00	25	5
CP-100	1.00	.69	.62	.75	2.00	250-20	6	1.50	30	60	38	WP-100	50	2.50	25	13
CP-138	1.28	.88	.69	.94	2.50	312-18	6	2.00	30	60	56	WP-138	62	3.00	25	25
CP-175	1.75	1.12	.88	1.19	3.00	375-16	8	2.38	22.5	45	62	WP-175	75	3.50	25	45
CP-200	2.00	1.38	1.25	1.44	3.50	375-16	12	2.69	15	30	75	WP-200	88	4.00	38	45
CP-250	2.50	1.75	1.38	1.88	4.25	500-13	8	3.44	22.5	45	88	WP-250	1.00	5.00	38	80
CP-300	3.00	2.25	1.88	2.38	5.00	500-13	12	4.00	15	30	88	WP-300	1.00	5.50	38	80
CP-350	3.50	2.50	2.00	2.62	5.88	625-11	12	4.69	15	30	1.00	WP-350	1.12	6.50	38	200
CP-400	4.00	3.00	2.00	3.12	6.38	625-11	12	5.19	15	30	1.00	WP-400	1.12	7.00	38	200
CP-450	4.50	3.50	2.39	3.62	6.88	750-10	8	5.69	22.5	45	1.12	WP-450	1.25	7.50	38	350
CP-500	5.00	3.88	2.50	4.00	7.38	625-11	12	6.19	15	30	1.00	WP-500	1.38	8.00	38	200
CP-550	5.50	4.38	3.12	4.50	8.25	750-10	12	6.88	15	30	1.38	WP-550	1.50	9.00	38	350
CP-700	7.00	5.75	4.00	5.94	10.38	1000-8	12	8.75	15	30	1.50	WP-700	1.75	11.00	50	1090
CP-800	8.00	6.50	4.00	6.69	11.38	1000-8	16	9.75	11.25	22.5	1.50	WP-800	2.00	12.00	50	1090
CP-900	9.00	7.25	4.00	7.50	12.12	1.250-7	12	11.12	15	30	2.00	WP-900	2.25	14.00	50	2180
CP-1000	10.00	8.00	4.50	8.25	14.12	1.250-7	16	12.12	11.25	22.5	2.00	WP-1000	2.50	15.00	50	2180
CP-1200	12.00	10.00	5.12	10.25	16.25	1.250-7	20	14.62	18	16	2.00	WP-1200	2.50	18.00	50	2180

ROD STYLE	ROD CODE	ROD DIA. MM	AC	AD	AE	AF DIA.	B DIA. -0.001 -0.003
RC-062	D	.62	1.12	.62	.25	.38	1.12
RC-100	F	1.00	1.62	.94	.38	.69	1.50
RC-138	G	1.38	2.25	1.06	.38	.88	2.00
RC-175	H	1.75	2.75	1.31	.50	1.12	2.38
RC-200	J	2.00	3.12	1.69	.62	1.38	2.62
RC-250	K	2.50	4.00	1.94	.75	1.75	3.12
RC-300	L	3.00	4.50	2.44	.88	2.25	3.75
RC-350	M	3.50	4.50	2.69	1.00	2.50	4.25
RC-400	N	4.00	5.00	2.99	1.00	3.00	4.75
RC-450	P	4.50	5.50	3.19	1.50	3.50	5.25
RC-500	R	5.00	6.00	3.19	1.50	3.88	5.75
RC-550	S	5.50	6.50	3.94	1.88	4.38	6.25
RC-700	T	7.00	6.50	4.06	2.00	5.75	8.00
RC-800	U	8.00	6.50	4.06	2.00	6.50	9.00
RC-900	Z	9.00	6.75	4.12	2.00	7.25	10.00
RC-1000	V	10.00	7.25	4.62	2.38	8.00	11.00
RC-1200	W	12.00	7.75	5.12	2.88	10.00	13.00



Hanna offers a wide variety of modifications and options to our Standard 2H and 3L Product Lines.
Please contact your local authorized Distributor for more information.

SERIES 2H

- Stroke Adjustable Cylinders
- Drain Glands
- Metallic Rod Scrapers
- S.A.E. Flange Fitted Ports
- Super Cushions
- Spring Return Cylinders
- Heavy Duty Air Cylinders
- Stainless Steel Piston Rods
- Air Bleeds
- Epoxy Painting
- Rod Boots
- Heavy Chrome Plated Piston Rods
- Intermediate Center Supports
- Tightened Stroke Tolerance
- Full Face Retainer Plates
- MS1 Mount
- Tandem Mounted Cylinders

SERIES 3L

- Stroke Adjustable Cylinders
- Drain Glands
- Metallic Rod Scrapers
- S.A.E. Flange Fitted Ports
- Super Cushions
- Water Service Cylinders
- Spring Return Cylinders
- Stainless Steel Piston Rods
- Air Bleeds
- Epoxy Painting
- Rod Boots
- Heavy Chrome Plated Piston Rods
- Intermediate Center Supports
- Tightened Stroke Tolerance
- Full Face Retainer Plates
- MS1 Mount
- Tandem Mounted Cylinders

Contact factory for other special options.

MOUNTING STYLE

- Side Lugs..... **MS2**
- Centerline Lugs..... **MS3**
- Side Tapped..... **MS4**
- Head Square Flange..... **MF5**
- Cap Square Flange..... **MF6**
- Head Trunnion..... **MT1**
- Cap Trunnion..... **MT2**
- Intermediate Fixed Trunnion..... **MT4**
- Head Rectangular Flange..... **MF1**
- Cap Rectangular Flange..... **MF2**
- Tie-Rods..... **MX0, MX1, MX2, MX3, MX4**
- Head Flange..... **ME5**
- Cap Flange..... **ME6**
- Side End Lugs..... **MS7**
- Fixed Double-Ear Clevis..... **MP1**
- Fixed Single-Ear Clevis..... **MP3**
- Spherical Bearing..... **MPU3**
- Double Rod (Available in most mounting styles)..... **MX0-D**
- Double Rod End..... **D**
(Specify only if required)

SERIES

- Hydraulic (Heavy Duty) **2H**

CUSHION

- Non-Cushion **NC**
- Cushion, Both Ends* **CC**
- Cushion, Cap End Only **CB**
- Cushion, Head End Only* **CR**

*Head End Cushion on 1.5 Bore (F)
Rod is non-adjustable.

MF1 * - 2H-CC-2.00"-9.00"-FSM1G

BORE SIZE (Specify)

STROKE (Specify)

ROD END STYLE

- Small Male **SM**
- Intermediate Male **IM**
- Short Female **SF***
- Rod End Coupling **RC**
- Alternate Male (Specify) . . . **AL**
- Alternate Female (Specify) . **AF**
- Special (Specify) **SP**

*Specify rod stud if required—
up thru 2" diameter piston rod

PISTON ROD PACKING, GLAND O-RING, ROD WIPER

- STANDARD**—Polyurethane Packing, Buna O-Ring, Polyurethane Wiper . . . **1**
- OPTIONAL** —Buna Packing, O-Ring, Polyurethane Wiper . . . **2**
- OPTIONAL** —Viton Packing, Viton O-Ring, Teflon Wiper **3**

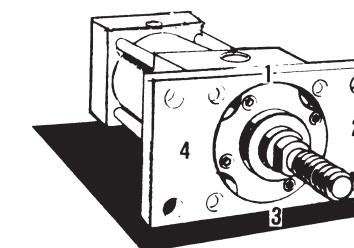
PISTON PACKING AND TUBE SEALS

- STANDARD**—Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals **G**
- OPTIONAL** —Cast Iron Rings, Filled Teflon Seal with Buna Expander, Buna Tube Seals **E**
- OPTIONAL** —Polyurethane U-Cup Seal with Buna Tube Seals **A**
- OPTIONAL** —Cast Iron Rings, Filled Teflon Seal with Viton Expander, Viton Tube Seals **F**
- OPTIONAL** —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals **H**
- OPTIONAL** —Viton U-Cup Seal with Viton Tube Seals **B**

NOTE: Cushion needles furnished with viton seals.

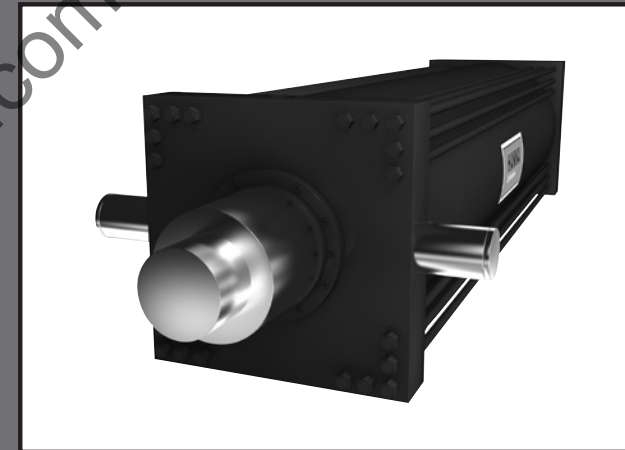
When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

NPTF ports will be furnished as standard unless SAE straight thread ports are specified.



Port location: if other than position 1, must be specified.
Mounting accessories must be specified if required.

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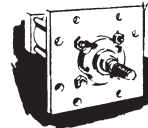
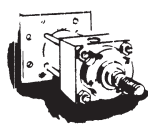
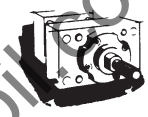
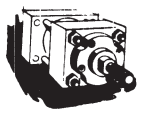

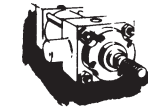



Series 3H for Heavy-Duty Service

- High-Tech Duralon® Rod Bearing
- State-of-the-Art Rod and Piston Sealing System
- Heavy-Duty Piston-to-Rod Connection
- 10.00" – 24.00" Bores
- Rod Diameters through 12.00"
- Pressure Ratings up to 3,000 PSI
- 7 Mounting Styles

SERIES 3H HYDRAULIC CYLINDERS

10.00" thru 24.00" Bores

		Description	Page No.	
Head Square Mount ME3 	Cap Square Mount ME4 	ME3 Head Square Mount	104	
		ME4 Cap Square Mount	104	
Head Rectangular Flange Mount ME5 	Cap Rectangular Flange Mount ME6 	ME5 Head Rectangular Flange Mount ...	106	
		ME6 Cap Rectangular Flange Mount	106	
		Cap Fixed Clevis Mount MP1 	MP1 Cap Fixed Clevis Mount	108
		Head Trunnion Mount MT1 	MT1 Head Trunnion Mount	108
		Side Lug Mount MS2 	MS2 Side Lug Mount	110

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HOW TO ORDER

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Air-Oil Systems, Inc. www.airoil.com

HANNA
cylinders

Series 3H Large Bore Hydraulic Cylinders for Heavy-Duty Service

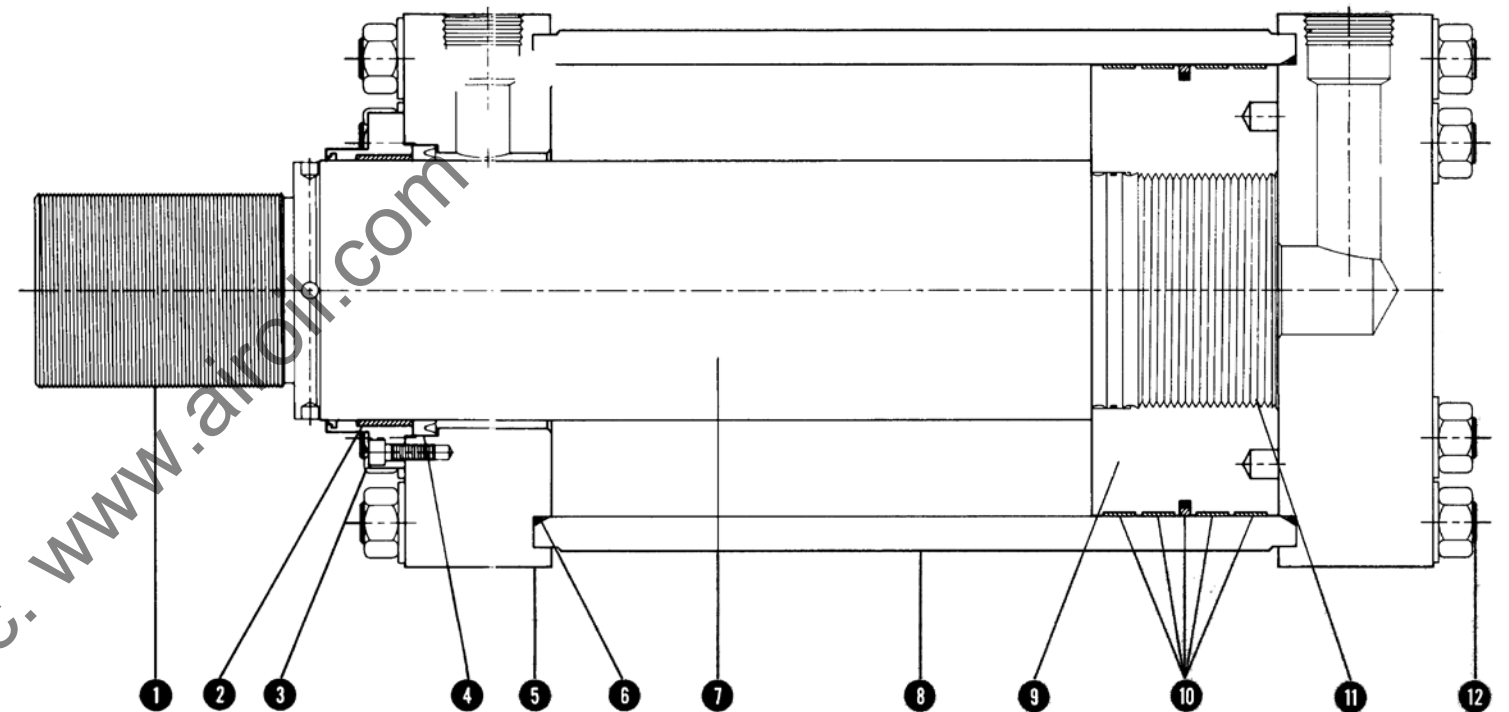
Hanna's Series 3H large bore, heavy-duty hydraulic cylinders have been designed for today's higher pressures and faster moving machinery applications.

Ruggedly built, 3H cylinders incorporate many field-proven design features that assure trouble-free performance for millions of cycles. Included are Hanna's unique non-metallic Duralon® rod bearing and our glass-filled Teflon® O-ring energized piston seal with four bronze-filled bearing strips, which combine to eliminate metal-to-metal contact at bearing surfaces. This assures long life and extremely low friction. In addition, it makes Series 3H cylinders the most suitable units available for applications that demand ruggedness, precision, zero leakage and day-in, day-out performance.

Very affordably priced, Series 3H cylinders offer outstanding value for many large bore (10.00" through 24.00") hydraulic cylinder applications. Developed for pressure ratings up to 3000 p.s.i., 3H cylinders are available in seven mounting styles. S.A.E. flange porting is available.

* Consult factory for special requirements.

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Teflon and Dacron are Trademarks of DuPont Company



Series 3H Features

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity.

2. Duralon Rod Bearing

Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings are capable of sustaining much higher compressive loads than other materials commonly used for bearings, have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

3. Rod Bearing Cartridge Construction

One-piece, bolted-on retainer design. Packings may be captive in the cartridge or located in the head.

4. Rod Seal

Series 3H cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance. Viton U-cup is available for use with non-petroleum based fluids or for higher temperature service.

5. Heads

Steel heads are precision-machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

6. Tube Seal

Buna-N O-ring seal. Viton available for use with non-petroleum based fluids, or for higher temperature service.

7. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failure. The rods provide 59,000 average yield strength. All sizes are hard chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish.

8. Tubing

Steel tubing is precision-honed to a 16-20 micro-inch finish for close tolerance between piston bearing and tube wall.

9. Piston

One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

10. Piston Sealing System

Hanna's glass-filled Teflon, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with other type seals. Bronze-filled bearing strips provide non-metallic bearing points on the piston, assuring long life and extremely low friction.

11. Piston-to-Rod Connection

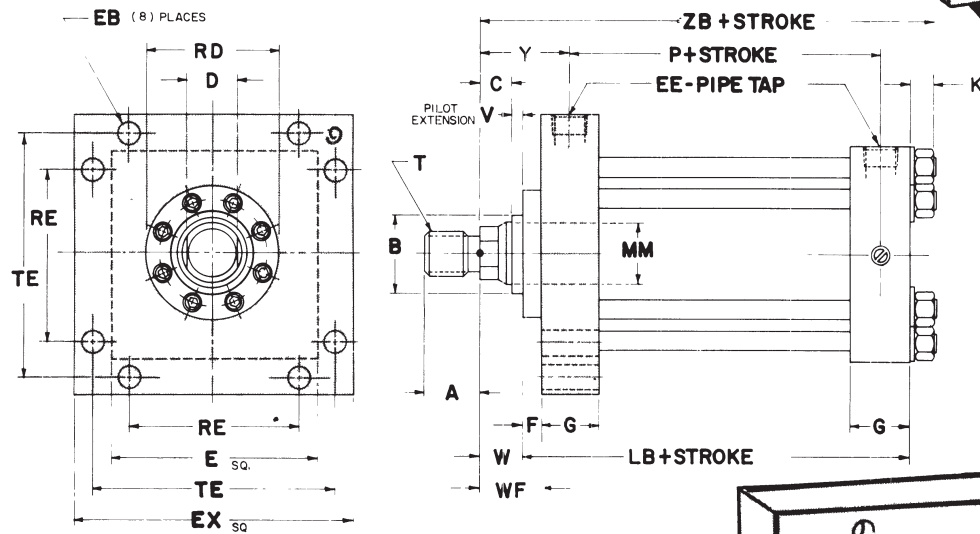
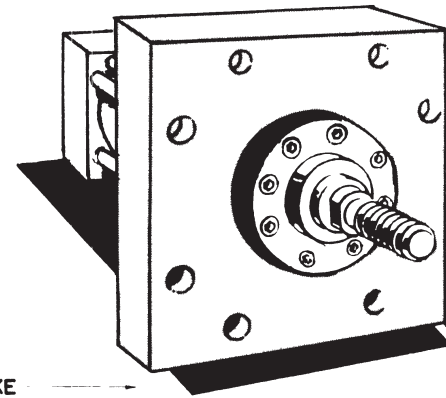
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

12. Tie Rods

Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.

SERIES 3H 10.00"-24.00" Bores

ME3 Head Square Mount



CAUTION:
Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. Fluid velocities in the supply line in excess of 15 feet per second are not recommended.

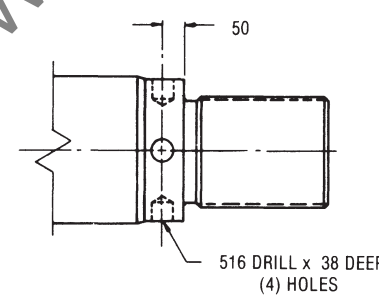
Dimensions are Constant Regardless of Rod Diameter

ME3, ME4

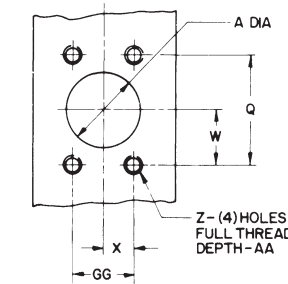
BORE	EE*	EE**	E	EB	EX	G	K	P	RE	TE
	N.P.T.F.	S.A.E. FLANGE PORT								
10.00	2	2	12.62	1.31	16.62	3.69	1.09	8.50	9.89	14.13
12.00	2½	2½	14.88	1.56	19.75	4.44	1.09	9.88	11.75	16.79
14.00	2½	2½	17.12	1.81	21.75	4.88	1.19	10.38	12.90	18.43
16.00	2½	2½	19.25	1.81	24.50	5.88	1.09	11.75	15.28	21.03
18.00	2½	2½	22.00	2.06	26.50	6.88	1.09	13.75	16.45	22.65
20.00	2½	2½	23.62	2.06	29.00	7.88	1.47	15.75	18.07	24.87
22.00	***	***	28.00	2.56	32.50	8.88	1.47	17.75	19.75	27.38
24.00	***	***	31.00	2.81	36.00	10.00	1.47	20.00	22.12	31.25

* N.P.T.F. Ports are furnished as standard
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer.
*** Specify port size when ordering

SPANNER HOLES
Furnished on 7" thru 12"
Rod Diameters

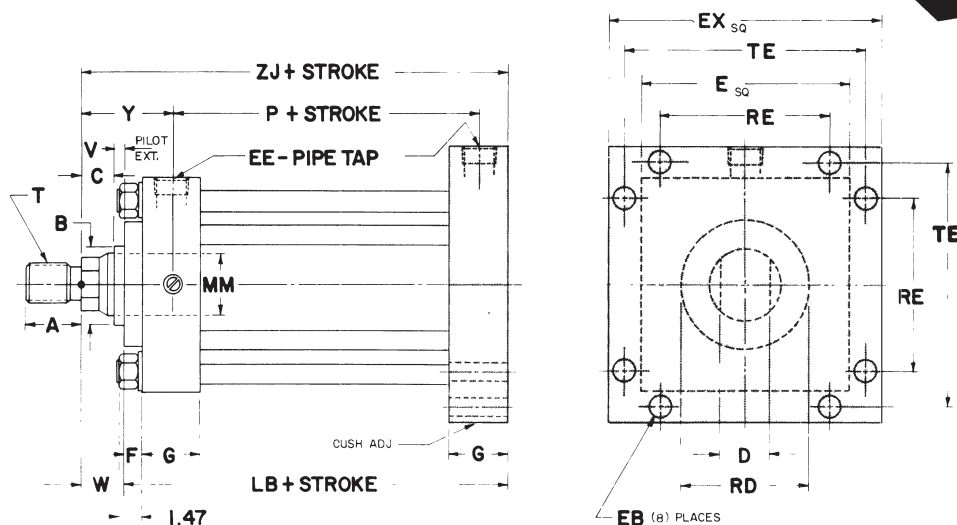
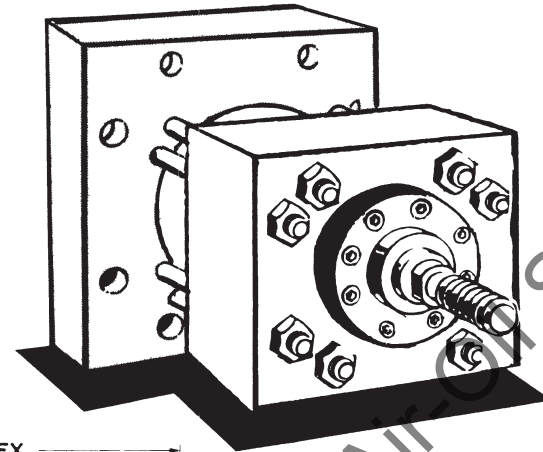


OPTIONAL SAE FLANGE PORT PATTERN
CODE 61 3000 P.S.I.



NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

ME4 Cap Square Mount



Dimensions are Affected by the Rod Diameter

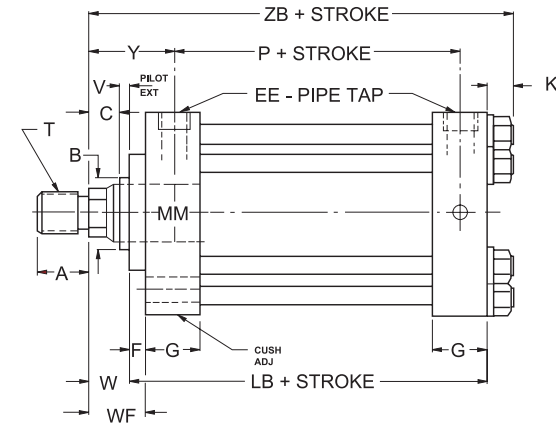
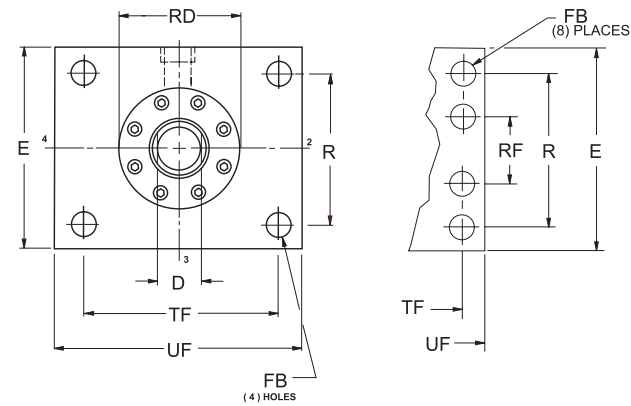
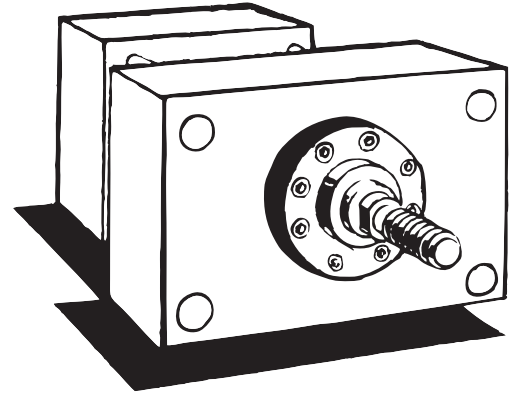
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	2.94	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	7.00	T	7.00	7.750	1.00	—	1.06	13.19	10.00	5.50-12	1.38	2.38	3.44	5.25	17.03	15.56	3000
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	.25	2.19	3.19	5.50	19.16	17.69	3000
12.00	7.00	T	7.00	7.750	1.00	—	1.06	15.56	10.00	5.50-12	1.38	2.38	3.44	5.75	19.41	17.94	3000
12.00	8.00	U	8.00	8.750	1.00	—	1.12	15.62	11.00	6.00-12	1.31	2.31	3.44	5.75	19.41	17.94	3000
14.00	7.00	T	7.00	7.750	1.00	—	1.06	16.69	10.00	5.50-12	1.38	2.38	3.44	6.06	20.53	19.06	3000
14.00	8.00	U	8.00	8.750	1.00	—	1.12	16.75	11.00	6.00-12	1.31	2.31	3.44	6.06	20.53	19.06	3000
14.00	10.00	V	10.00	10.750	1.00	—	1.12	16.75	13.00	7.50-12	1.31	2.31	3.44	6.06	20.53	19.06	3000
16.00	8.00	U	8.00	8.750	1.00	—	1.12	18.75	11.00	6.00-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
16.00	9.00	Z	9.00	9.750	1.00	—	1.12	18.75	12.00	6.50-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
16.00	10.00	V	10.00	10.750	1.00	—	1.12	18.75	13.00	7.50-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
18.00	9.00	Z	9.00	9.750	1.00	—	1.12	21.75	12.00	6.50-12	1.31	2.31	3.44	6.88	25.16	24.06	3000
18.00	10.00	V	10.00	10.750	1.00	—	1.12	21.75	13.00	7.50-12	1.31	2.31	3.44	6.88	25.16	24.06	3000
20.00	10.00	V	10.00	10.750	1.00	—	1.12	24.75	13.00	7.50-12	1.31	2.31	3.44	7.38	28.53	27.06	3000
20.00	12.00	W	12.00	13.000	.94	—	1.19	24.81	15.50	9.00-12	1.31	2.25	3.44	7.38	28.53	27.06	3000
22.00	10.00	V	10.00	10.750	1.00	—	1.12	27.75	13.00	7.50-12	1.31	2.31	3.44	7.88	31.53	30.06	3000
22.00	12.00	W	12.00	13.000	.94	—	1.19	27.81	15.50	9.00-12	1.31	2.25	3.44	7.88	31.53	30.06	3000
24.00	12.00	W	12.00	13.000	.94	—	1.19	31.19	15.50	9.00-12	1.31	2.25	3.44	8.44	34.91	33.44	3000

† CAUTION: PSI ratings shown are HANNA CYLINDERS recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression

SERIES 3H 10.00"-24.00" Bores

ME5 Head Rectangular Flange Mount



CAUTION:
Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. Fluid velocities in the supply line in excess of 15 feet per second are not recommended.

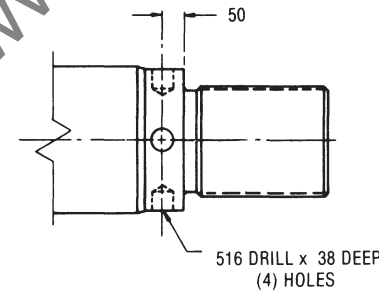
Dimensions are Constant Regardless of Rod Diameter

ME5, ME6

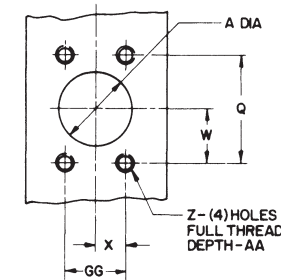
BORE	EE*	EE**	E	FB	G	K	P -.006	R	RF	TF	UF
	N.P.T.F.	S.A.E. FLANGE PORT									
10.00	2	2	12.62	1.81	3.69	1.09	8.50	9.62	—	15.88	19.00
12.00	2½	2½	14.88	2.06	4.44	1.09	9.88	11.45	—	18.50	22.00
14.00	2½	2½	17.12	2.31	4.88	1.19	10.38	13.25	—	21.00	25.00
16.00	2½	2½	19.25	1.81	5.88	1.09	11.75	15.62	5.21	22.88	26.50
18.00	2½	2½	22.00	2.06	6.88	1.09	13.75	17.88	5.96	26.12	30.25
20.00	2½	2½	23.62	2.06	7.88	1.47	15.75	19.50	6.50	27.75	31.88
22.00	***	***	28.00	2.56	8.88	1.47	17.75	22.88	7.62	33.12	38.25
24.00	***	***	31.00	2.81	10.00	1.47	20.00	25.38	8.46	36.62	42.25

* N.P.T.F. Ports are furnished as standard.
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer
*** Specify port size when ordering.

SPANNER HOLES
Furnished on 7" thru 12" Rod Diameters

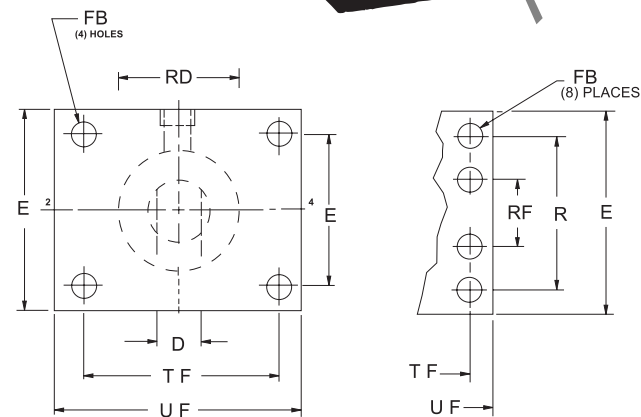
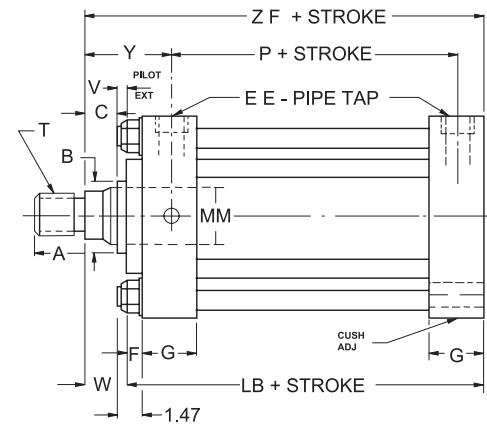
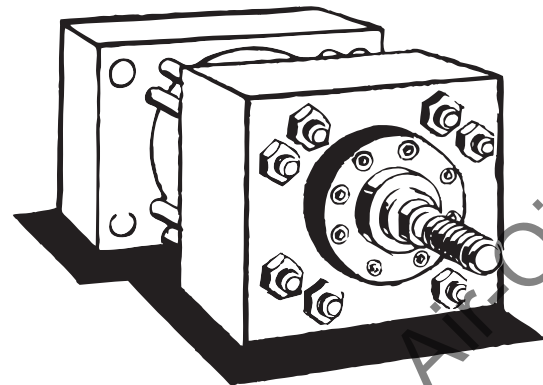


OPTIONAL SAE FLANGE PORT PATTERN
CODE 61 3000 P.S.I.



NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

ME6 Cap Rectangular Flange Mount



Dimensions are Affected by the Rod Diameter

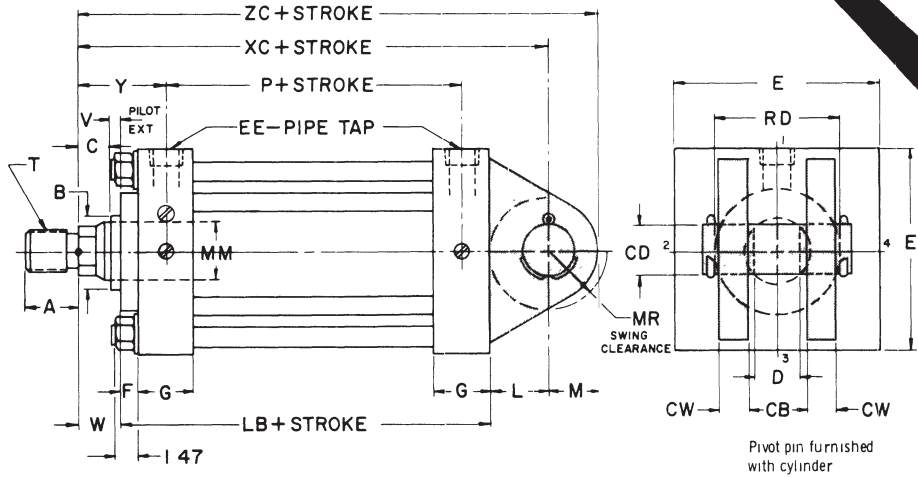
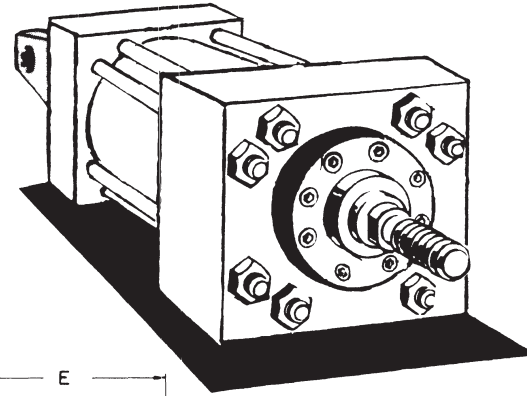
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	2.94	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	7.00	T	7.00	7.750	1.00	—	1.06	13.19	10.00	5.50-12	1.38	2.38	3.44	5.25	17.03	15.56	3000
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	.25	2.19	3.19	5.50	19.16	17.69	3000
12.00	7.00	T	7.00	7.750	1.00	—	1.06	15.56	10.00	5.50-12	1.38	2.38	3.44	5.75	19.41	17.94	3000
12.00	8.00	U	8.00	8.750	1.00	—	1.12	15.62	11.00	6.00-12	1.31	2.31	3.44	5.75	19.41	17.94	3000
14.00	7.00	T	7.00	7.750	1.00	—	1.06	16.69	10.00	5.50-12	1.38	2.38	3.44	6.06	20.53	19.06	3000
14.00	8.00	U	8.00	8.750	1.00	—	1.12	16.75	11.00	6.00-12	1.31	2.31	3.44	6.06	20.53	19.06	3000
14.00	10.00	V	10.00	10.750	1.00	—	1.12	16.75	13.00	7.50-12	1.31	2.31	3.44	6.06	20.53	19.06	3000
16.00	8.00	U	8.00	8.750	1.00	—	1.12	18.75	11.00	6.00-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
16.00	9.00	Z	9.00	9.750	1.00	—	1.12	18.75	12.00	6.50-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
16.00	10.00	V	10.00	10.750	1.00	—	1.12	18.75	13.00	7.50-12	1.31	2.31	3.44	6.38	22.16	21.06	3000
18.00	9.00	Z	9.00	9.750	1.00	—	1.12	21.75	12.00	6.50-12	1.31	2.31	3.44	6.88	25.16	24.06	3000
18.00	10.00	V	10.00	10.750	1.00	—	1.12	21.75	13.00	7.50-12	1.31	2.31	3.44	6.88	25.16	24.06	3000
20.00	10.00	V	10.00	10.750	1.00	—	1.12	24.75	13.00	7.50-12	1.31	2.31	3.44	7.38	28.53	27.06	3000
20.00	12.00	W	12.00	13.000	.94	—	1.19	24.81	15.50	9.00-12	1.31	2.25	3.44	7.38	28.53	27.06	3000
22.00	10.00	V	10.00	10.750	1.00	—	1.12	27.75	13.00	7.50-12	1.31	2.31	3.44	7.88	31.53	30.06	3000
22.00	12.00	W	12.00	13.000	.94	—	1.19	27.81	15.50	9.00-12	1.31	2.25	3.44	7.88	31.53	30.06	3000
24.00	12.00	W	12.00	13.000	.94	—	1.19	31.19	15.50	9.00-12	1.31	2.25	3.44	8.44	34.91	33.44	3000

† CAUTION: PSI ratings shown are HANNA CYLINDERS recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

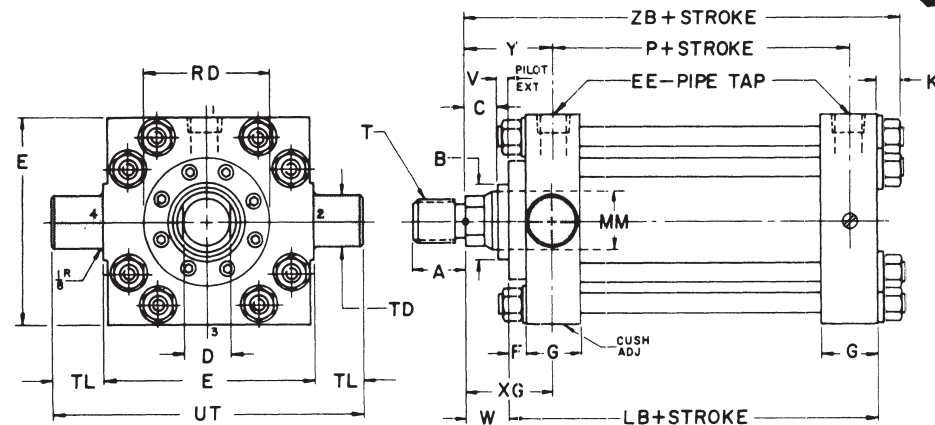
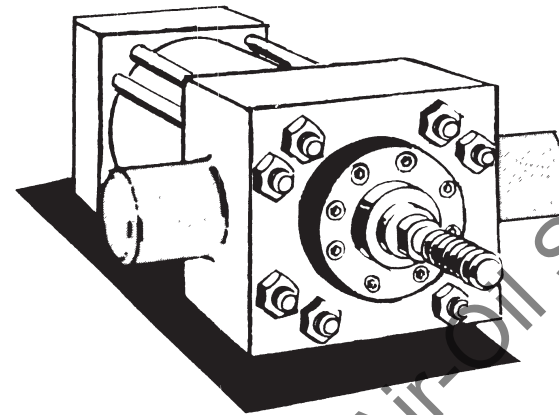
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

SERIES 3H 10.00"-24.00" Bores

MP1 Fixed Clevis Mount



MT1 Head Trunnion Mount



MP1, MT1

Dimensions are Constant Regardless of Rod Diameter

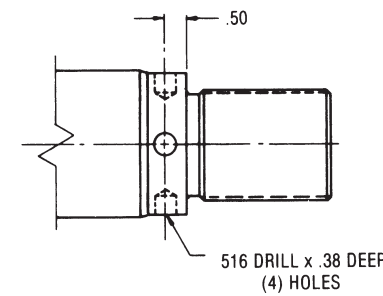
BORE	CB +.016 +.047	CD	CW	E	EE*	EE**	G	K	L	M	MR	P	TD +.000 -.002	TL	UT
					N.P.T.F.	S.A.E. FLANGE PORT									
10.00	4.00	3.50	2.00	12.62	2	2	3.69	1.09	4.00	3.50	3.62	8.50	3.50	3.50	19.62
12.00	4.50	4.00	2.25	14.88	2 1/2	2 1/2	4.44	1.09	4.50	4.00	4.12	9.88	4.00	4.00	22.88
14.00	6.00	5.00	3.00	17.12	2 1/2	2 1/2	4.88	1.19	5.75	5.00	5.12	10.38	5.00	5.00	26.12
16.00	7.00	6.00	3.50	19.25	2 1/2	2 1/2	5.88	1.09	7.00	6.00	6.25	11.75	5.00	5.00	29.25
18.00	8.00	6.50	4.00	22.00	2 1/2	2 1/2	6.88	1.09	7.62	6.50	6.75	13.75	6.00	6.00	33.50
20.00	9.00	7.50	4.50	23.62	2 1/2	2 1/2	7.88	1.47	8.75	7.50	7.75	15.75	7.00	7.00	36.12
22.00	9.50	8.25	4.75	28.00	***	***	8.88	1.47	10.00	8.00	8.25	17.75	8.00	8.00	43.00
24.00	10.00	9.00	5.00	31.00	***	***	10.00	1.47	11.00	9.00	9.25	20.00	9.00	9.00	49.00

CAUTION: Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. Fluid velocities in the supply line in excess of 15 feet per second are not recommended.

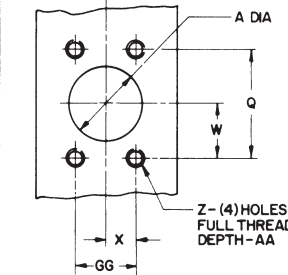
- * N.P.T.F. Ports are furnished as standard.
- ** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer.
- *** Specify port size when ordering.

SPANNER HOLES

Furnished on 7" thru 12" Rod Diameters



OPTIONAL SAE FLANGE PORT PATTERN
CODE 61 3000 P.S.I.



NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

Dimensions are Affected by the Rod Diameter

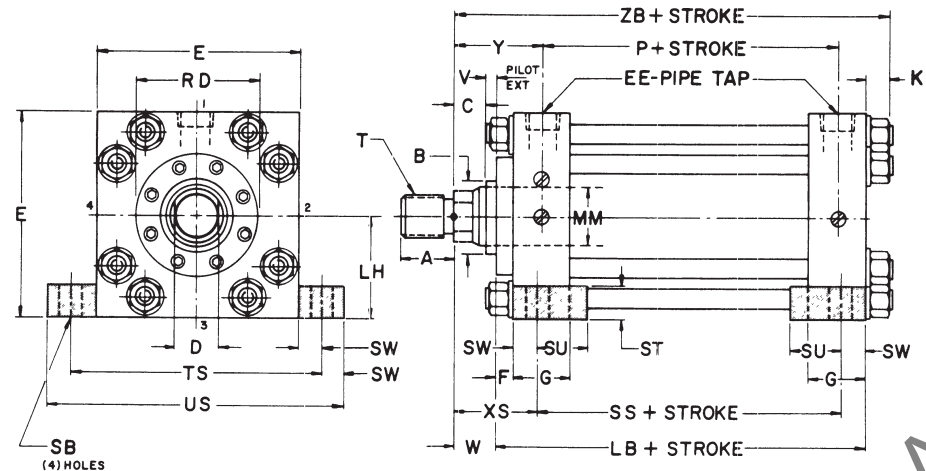
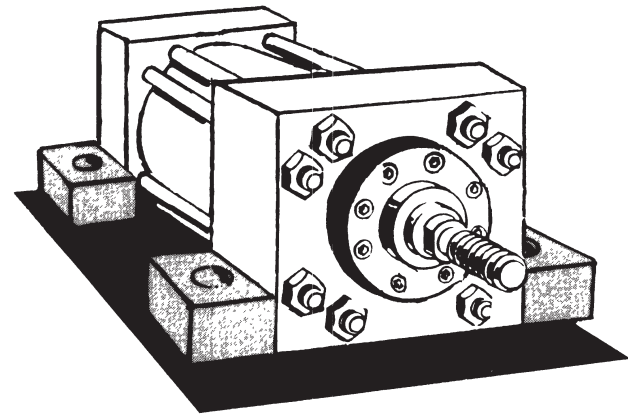
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	XC	XG	Y	ZB	ZC	PSI RATING†	
																		MP1	MT1
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	25	1.94	19.06	4.75	4.75	16.53	22.56	3000	1365
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	25	2.19	19.31	5.00	5.00	16.78	22.81	3000	1365
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	25	2.19	19.31	5.00	5.00	16.78	22.81	3000	1365
10.00	7.00	T	7.00	7.750	1.00	—	1.06	13.19	10.00	5.50-12	1.38	2.38	19.56	5.25	5.25	17.03	23.06	3000	1365
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	25	2.19	22.19	5.38	5.50	19.16	26.19	3000	1250
12.00	7.00	T	7.00	7.750	1.00	—	1.06	15.56	10.00	5.50-12	1.38	2.38	22.44	5.62	5.75	19.41	26.44	3000	1250
12.00	8.00	U	8.00	8.750	1.00	—	1.12	15.62	11.00	6.00-12	1.31	2.31	22.44	5.62	5.75	19.41	26.44	3000	1250
14.00	7.00	T	7.00	7.750	1.00	—	1.06	16.69	10.00	5.50-12	1.38	2.38	24.81	5.81	6.06	20.53	29.81	3000	1150
14.00	8.00	U	8.00	8.750	1.00	—	1.12	16.75	11.00	6.00-12	1.31	2.31	24.81	5.81	6.06	20.53	29.81	3000	1150
14.00	10.00	V	10.00	10.750	1.00	—	1.12	16.75	13.00	7.50-12	1.31	2.31	24.81	5.81	6.06	20.53	29.81	3000	1150
16.00	8.00	U	8.00	8.750	1.00	—	1.12	18.75	11.00	6.00-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
16.00	9.00	Z	9.00	9.750	1.00	—	1.12	18.75	12.00	6.50-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
16.00	10.00	V	10.00	10.750	1.00	—	1.12	18.75	13.00	7.50-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
18.00	9.00	Z	9.00	9.750	1.00	—	1.12	21.75	12.00	6.50-12	1.31	2.31	31.69	6.88	6.88	25.16	38.19	3000	1250
18.00	10.00	V	10.00	10.750	1.00	—	1.12	21.75	13.00	7.50-12	1.31	2.31	31.69	6.88	6.88	25.16	38.19	3000	1250
20.00	10.00	V	10.00	10.750	1.00	—	1.12	24.75	13.00	7.50-12	1.31	2.31	35.81	7.38	7.38	28.53	43.31	3000	1365
20.00	12.00	W	12.00	13.000	.94	—	1.19	24.81	15.50	9.00-12	1.31	2.25	35.81	7.38	7.38	28.53	43.31	3000	1365
22.00	10.00	V	10.00	10.750	1.00	—	1.12	27.75	13.00	7.50-12	1.31	2.31	40.06	7.88	7.88	31.53	48.06	3000	1475
22.00	12.00	W	12.00	13.000	.94	—	1.19	27.81	15.50	9.00-12	1.31	2.25	40.06	7.88	7.88	31.53	48.06	3000	1475
24.00	12.00	W	12.00	13.000	.94	—	1.19	31.19	15.50	9.00-12	1.31	2.25	44.44	8.44	8.44	34.91	53.44	3000	1575

† CAUTION: PSI ratings shown are HANNA CYLINDERS recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

SERIES 3H 10.00"-24.00" Bores

MS2 Side Lug Mount



NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

Dimensions are Constant Regardless of Rod Diameter

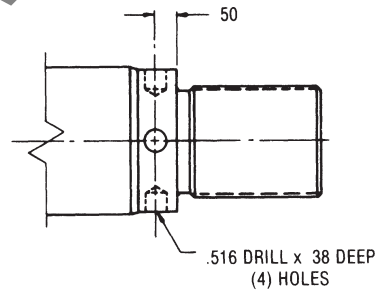
MS2

BORE	E	EE*	EE**	G	K	LH -.000 -.006	P	SB	SS	ST	SU	SW	TS	US
		N.P.T.F.	S.A.E. FLANGE PORT											
10.00	12.62	2	2	3.69	1.09	6.312	8.50	1.56	8.88	2.19	3.50	1.62	15.88	19.12
12.00	14.88	2½	2½	4.44	1.09	7.437	9.88	1.56	10.50	2.94	4.25	2.00	18.88	22.88
14.00	17.12	2½	2½	4.88	1.19	8.562	10.38	2.31	11.12	3.94	4.75	2.25	21.62	26.12
16.00	19.25	2½	2½	5.88	1.09	9.625	11.75	2.56	12.12	4.50	3.12	2.25	24.75	30.25
18.00	22.00	2½	2½	6.88	1.09	11.000	13.75	2.81	14.12	5.25	3.62	3.75	28.50	35.00
20.00	23.62	2½	2½	7.88	1.47	11.812	15.75	3.06	15.88	6.50	4.00	3.88	31.38	39.12
22.00	28.00	***	***	8.88	1.47	14.000	17.75	3.31	18.12	7.25	4.62	4.25	36.50	45.00
24.00	31.00	***	***	10.00	1.47	15.500	20.00	3.56	19.75	8.00	4.88	5.12	41.25	51.50

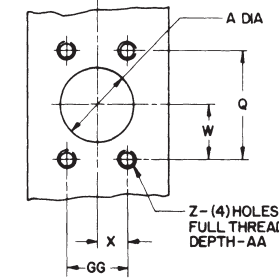
CAUTION:
Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. Fluid velocities in the supply line in excess of 15 feet per second are not recommended.

* N.P.T.F. Ports are furnished as standard
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer.
*** Specify port size when ordering.

SPANNER HOLES
Furnished 7" thru 12"
Rod Diameters



OPTIONAL SAE FLANGE PORT PATTERN
CODE 61 3000 P.S.I.



NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1.50	2.750	1.406	1.38	0.70	1/2-13	1.06
2	2.00	3.062	1.688	1.53	0.84	1/2-13	1.06
2-1/2	2.50	3.500	2.000	1.75	1.00	1/2-13	1.19

Dimensions are Affected by the Rod Diameter

BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	XS	Y	ZB	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	4.56	4.75	16.53	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	4.81	5.00	16.78	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	.25	2.19	4.81	5.00	16.78	3000
10.00	7.00	T	7.00	7.750	1.00	—	1.06	13.19	10.00	5.50-12	1.38	2.38	5.06	5.25	17.03	3000
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	.25	2.19	5.19	5.50	19.16	3000
12.00	7.00	T	7.00	7.750	1.00	—	1.06	15.56	10.00	5.50-12	1.38	2.38	5.44	5.75	19.41	3000
12.00	8.00	U	8.00	8.750	1.00	—	1.12	15.62	11.00	6.00-12	1.31	2.31	5.44	5.75	19.41	3000
14.00	7.00	T	7.00	7.750	1.00	—	1.06	16.69	10.00	5.50-12	1.38	2.38	5.69	6.06	20.53	3000
14.00	8.00	U	8.00	8.750	1.00	—	1.12	16.75	11.00	6.00-12	1.31	2.31	5.69	6.06	20.53	3000
14.00	10.00	V	10.00	10.750	1.00	—	1.12	16.75	13.00	7.50-12	1.31	2.31	5.69	6.06	20.53	3000
16.00	8.00	U	8.00	8.750	1.00	—	1.12	18.75	11.00	6.00-12	1.31	2.31	6.19	6.38	22.16	3000
16.00	9.00	Z	9.00	9.750	1.00	—	1.12	18.75	12.00	6.50-12	1.31	2.31	6.19	6.38	22.16	3000
16.00	10.00	V	10.00	10.750	1.00	—	1.12	18.75	13.00	7.50-12	1.31	2.31	6.19	6.38	22.16	3000
18.00	9.00	Z	9.00	9.750	1.00	—	1.12	21.75	12.00	6.50-12	1.31	2.31	6.69	6.88	25.16	3000
18.00	10.00	V	10.00	10.750	1.00	—	1.12	21.75	13.00	7.50-12	1.31	2.31	6.69	6.88	25.16	3000
20.00	10.00	V	10.00	10.750	1.00	—	1.12	24.75	13.00	7.50-12	1.31	2.31	7.31	7.38	28.53	3000
20.00	12.00	W	12.00	13.000	.94	—	1.19	24.81	15.50	9.00-12	1.31	2.25	7.31	7.38	28.53	3000
22.00	10.00	V	10.00	10.750	1.00	—	1.12	27.75	13.00	7.50-12	1.31	2.31	7.69	7.88	31.53	3000
22.00	12.00	W	12.00	13.000	.94	—	1.19	27.81	15.50	9.00-12	1.31	2.25	7.69	7.88	31.53	3000
24.00	12.00	W	12.00	13.000	.94	—	1.19	31.19	15.50	9.00-12	1.31	2.25	8.56	8.44	34.91	3000

† CAUTION: PSI ratings shown are HANNA CYLINDERS recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STROKE LIMITATION DATA

The rod diameter has to be capable of withstanding any compressive force developed by the cylinder working against the load. A piston rod diameter with adequate column strength to handle the compressive force of the application can be selected from the convenient pre-calculated chart below.

To use this chart find the force value, developed by the application, in the left column. Next, select the figure which resembles your application and then multiply "D" times the factor given in that figure. Finally, opposite the corresponding force value, find the value of "L" which is equal to, or greater than, the figure derived from factoring "D". Directly above is the rod diameter which is capable of withstanding the forces developed in the application.

EXAMPLE: Cylinder Bore = 10.00" Operating PSI = 3000
 Force Value 235,620 lbs.
 Application - Resembles Fig. 2 - Foot Lug Mtg.
 Stroke = 98"
 "L" = 0.7 x 98; L = 69"
 Correct Rod Diameter = 4.50"

The total force is 235,620 lbs., and the value of "L" is 69 inches in this application. The smallest diameter rod capable of handling this situation is 4.50 inches.

If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D".

FORCE VALUE in pounds	VALUE OF "L" IN INCHES PISTON ROD DIAMETER							
	4.50	5.00	5.50	7.00	8.00	9.00	10.00	12.00
20000	244	301	364					
40000	172	213	253	417				
60000	141	174	210	341	445			
80000	122	151	182	295	385	488		
100000	109	135	163	264	345	436		
120000	100	123	149	241	315	398	492	
140000	92	114	138	223	291	369	455	
160000	86	106	129	209	272	345	426	
200000	77	95	115	187	244	309	381	
250000	69	85	103	167	218	276	341	490
300000				152	199	252	311	448
350000				141	184	233	288	415
400000				132	172	218	269	388
500000					154	195	241	347
600000					141	173	220	317
700000						165	204	293
800000						154	190	274
900000							180	258
1000000							170	245
1100000							162	234
1200000							155	224
1300000								215
1400000								207

NOTE: SEE APPLICATION FIGURES ON NEXT PAGE.

STOP TUBE DATA

Long stroke cylinders can be subjected to a buckling action and excessive bearing wear due to the weight of the exposed rod. To reduce wear a stop tube is recommended.

To determine if a stop tube is required, find the total value of "L" using the stroke limitation chart. Compare this value with the stop tube chart. If the value of "L" exceeds 40 inches, you can find the recommendation for stop tube length at the bottom of the chart.

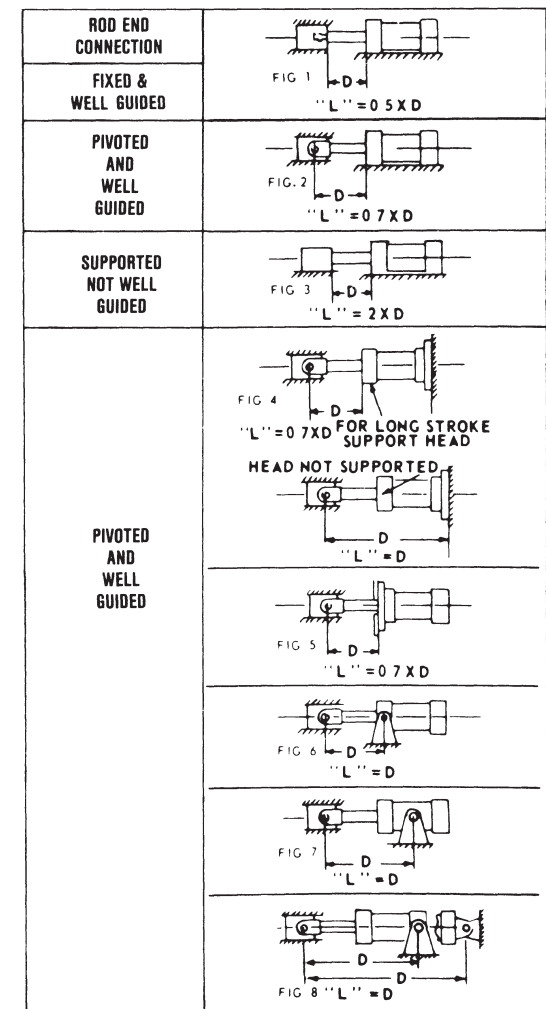
EXAMPLE PROBLEM:
 Cylinder Model MP1-3H-NC=10.00 x 27.00 - PSM-1G
 Accessory - V-10 Clevis
 Pressure - 2000 PSI
 Clevis Mount - Horizontal

From the description, the cylinder falls into Fig. 8. To determine the value of "L":

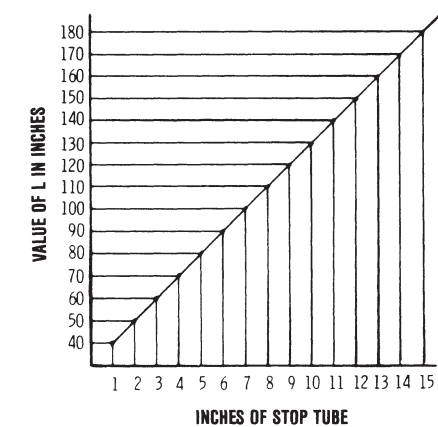
ADD:	MP1	"XC" Dimension	19.06"
	V-10	"CE" Dimension	8.50"
		Two times stroke (2 x 27)	54"
		Total Value of "L"	81.56"

Looking this up on the chart, you'll find a recommended stop tube length of 6 inches.

The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and recheck column strength on stroke limitation chart.



STOP TUBE CHART



HYDRAULIC FORCE DATA

WHAT BORE SIZE DO YOU NEED?

The force required for the application will be known in most cases. You can make your cylinder bore selection in either of two ways:

- Arbitrarily select a cylinder bore diameter which you feel would be economical for the application and then determine the pump required to produce the flow rate and pressure rating to mate with the cylinder.
- Select the pump and other system components and then determine the cylinder bore which will mate them to accomplish the work. The latter method seems to be the most widely used.

Regardless of the method chosen, the formula for determining the force produced by a cylinder is:

$$F = A \times \text{PSI}$$

$$\text{Force (lbs)} = \text{Cylinder Piston Area (sq in)} \times \text{Line Pressure (lbs/sq in)}$$

Chart C1 shows the force produced by specific cylinder bore sizes at various pressures. Forces not listed on the chart can be calculated by using the formula given (F = A X PSI). An example of this formula is provided.

COMPARE PRESSURE RATINGS

Chart C2 shows the pressure ratings for Hanna Series 3H Hydraulic Cylinders, and may help you determine the most economical model for your application.

Hydraulic Cylinders equipped with stainless steel piston rods have reduced Pressure Ratings due to the lower strength properties of stainless steel. Consult Factory for specific Ratings.

* Ratings are based on the yield point of the weakest component and smallest rod size. See mounting pages for maximum recommended operating pressures.

Chart C2

3H HYDRAULIC CYLINDER RATING* (P.S.I.)

Bore	3:1 Factor of Safety	4:1 Factor of Safety
10.00	2400	1800
12.00	2600	1950
14.00	2570	1930
16.00	2420	1815
18.00	2420	1815
20.00	2200	1650
22.00	2680	2010
24.00	3060	2300

Chart C1 HYDRAULIC CYLINDER FORCE CHART*

Cyl. Bore	Piston Area Sq. In.	PUSH STROKE Values are Pounds of Force								Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	
10.00	78.54	19640	39270	58900	78540	117800	157100	196350	235620	.3393
12.00	113.10	28280	56550	84820	113100	169600	226200	282750	339300	.4886
14.00	153.94	38480	76970	115455	153940	230910	307880	384850	461820	.6664
16.00	201.06	50270	100530	150800	201060	301590	402120	502650	603180	.8686
18.00	254.47	63620	127240	190850	254470	381710	508940	636180	763410	1.0993
20.00	314.16	78540	157080	235620	314160	471240	628320	785400	942480	1.3572
22.00	380.13	95030	190070	285100	380130	570200	760260	950330	1140390	1.6422
24.00	452.39	113100	226200	339290	452390	678590	904780	1130980	1357170	1.9543

$$\text{Force (pounds)} = \text{Cylinder Piston Area (in square inches)} \times \text{Line Pressure (in pounds per sq. in.)}$$

EXAMPLE: Determine the thrust of a 14.00 inch bore cylinder operating at 1000 psi hydraulic line pressure
 $F = 153.94 \times 1000$ $F = 153940$

FASTENER TORQUES

3H SERIES TIE ROD TORQUES		
BORE	SIZE	TORQUE
10.00	1 12-12	600 ft-lbs
12.00	1 12-12	600 ft-lbs
14.00	1 25-12	850 ft-lbs
16.00	1 12-12	600 ft-lbs
18.00	1 12-12	600 ft-lbs
20.00	1 50-12	1500 ft-lbs
22.00	1 50-12	1500 ft-lbs
24.00	1 50-12	1500 ft-lbs

3H SERIES BEARING ASSEMBLY SCREW TORQUES			
BORE	ROD	SCREW SIZE	TORQUE
10.00	P, R, S	500-20	75 ft-lbs
10.00	T	438-20	50 ft-lbs
12.00	S, U	500-20	75 ft-lbs
12.00	T	438-20	50 ft-lbs
14.00	T	438-20	50 ft-lbs
14.00	U, V	500-20	75 ft-lbs
16.00	U	500-20	75 ft-lbs
16.00	Z, V	500-20	75 ft-lbs
18.00	Z	500-20	75 ft-lbs
18.00	V	625-18	100 ft-lbs
20.00	V	500-20	75 ft-lbs
20.00	W	625-18	100 ft-lbs
22.00	V	500-20	75 ft-lbs
22.00	W	625-18	100 ft-lbs
24.00	V	625-18	100 ft-lbs

Chart C1A

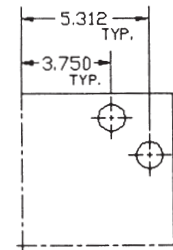
Rod Dia.	Rod Area Sq. In.	PULL STROKE To determine pull stroke thrust or consumption, deduct the value for the rod diameter from the corresponding cylinder bore in Chart C1.								Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	
4.50	15.90	3976	7952	11930	15900	23860	31810	38200	47750	.0688
5.00	19.63	4909	9820	14730	19640	29450	39270	49085	58900	.0860
5.50	23.76	5940	11880	17820	23760	35640	47575	59250	71250	.1028
6.00	28.27	7068	14140	21200	28270	42400	56540	70685	84820	.1224
7.00	38.49	9623	19240	28870	38490	57740	76980	96210	115450	.1666
8.00	50.26	12570	25140	37700	50270	75400	100500	125660	150800	.2176
9.00	63.62	15905	31810	47715	63620	95430	127240	159050	190860	.2754
10.00	78.54	19635	39270	58905	78540	117810	157080	196350	235620	.3400
12.00	113.10	28275	56550	84825	113100	169650	226200	282750	339300	.4897

To obtain forces not given, multiply piston area times operating pressure
 * Forces given do not allow for frictional or other power losses
 1 U.S. Gallon = 231 Cubic Inches

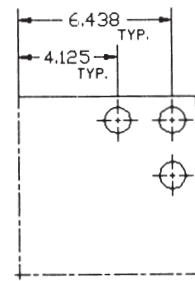
CYLINDER WEIGHTS

3H SERIES		
CYLINDER BORE	BASE WEIGHT AT ZERO STROKE	WEIGHT PER INCH OF STROKE
10.00	510 lbs	16.0 lbs.
12.00	985 lbs	22.0 lbs
14.00	1375 lbs	29.0 lbs
16.00	1700 lbs	42.0 lbs
18.00	2560 lbs	51.0 lbs
20.00	3425 lbs	57.0 lbs
22.00	5275 lbs	85.0 lbs
24.00	7200 lbs	91.0 lbs

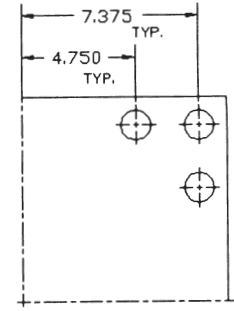
TIE ROD LAYOUT



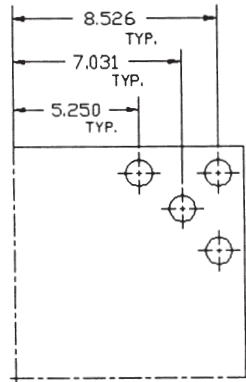
10.00 BORE
1 1/8" TIE RODS



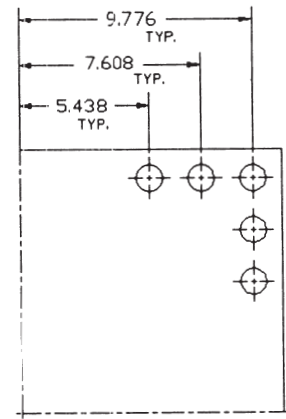
12.00 BORE
1 1/8" TIE RODS



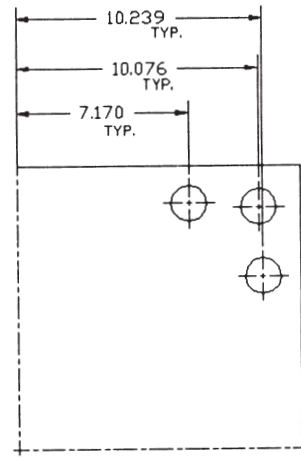
14.00 BORE
1 1/4" TIE RODS



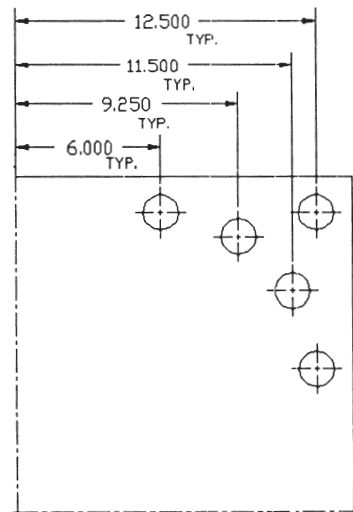
16.00 BORE
1 1/8" TIE RODS



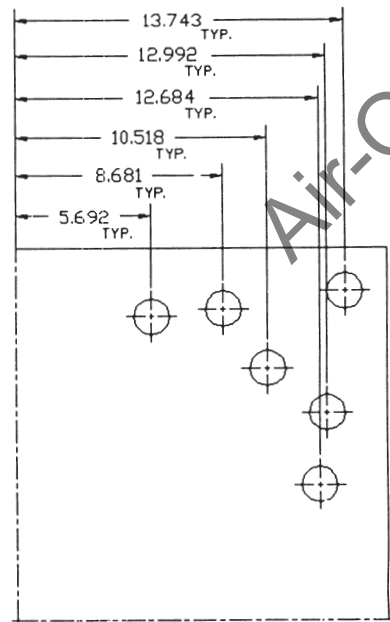
18.00 BORE
1 1/8" TIE RODS



20.00 BORE
1 1/2" TIE RODS



22.00 BORE
1 1/2" TIE RODS



24.00 BORE
1 1/2" TIE RODS

INSTALLATION:

The pipe ports of cylinders are sealed with plastic plugs. The plugs protect the precision internal parts by sealing out damaging dirt and grit. Do not remove port seals until ready to connect piping. To protect cylinders, clean all pipes and pipe fittings of dirt, scale, and thread chips. A filter is recommended to keep the operating fluid free of foreign matter.

Accurate mounting and alignment are essential to proper cylinder performance. By eliminating side loading, packing and bearing life will be increased. Mounting surfaces should be straight, bearings for pin and trunion mounting must be in line.

Dirt or abrasive matter adhering to the piston rod may cause excessive wear to the piston rod and gland. For best results, protect the cylinder from such dirt. A piston rod protective shield is ideal for this purpose.

OPERATION:

Needle valves in cylinder head and cap of adjustable cushioned cylinders, permit regulation of cushioning effect. Adjust needle valve with screwdriver, rotating clockwise to increase cushioning and counterclockwise to decrease cushioning effect. Cushion adjustment needles require only about one to one and half turn adjustment. **Do not unscrew beyond the point at which the head of the screw is flush with the surface of the head or cap.** Speed control valves are essential for obtaining the best cushioning operation. A proper balance of cushion needle and flow control valve adjustment should result in a smooth stop with no bouncing.

MAINTENANCE:

Parts which may need replacement in the course of normal use are the rod wiper and the packings for the piston rod.

The need for replacement of the piston rod packing will become evident through the escaping of fluid around the bearing assembly.

To replace rod wiper or rod packings, remove the rod bearing assembly from the cylinder. To remove the assembly, unbolt all screws (Part No. 21). Reinsert two screws in the two tapped holes provided in the bearing assembly flange (Part No. 14), turning the screws until the bearing assembly is forced away from the head. Remove worn wiper and rod packing. To reassemble, slip new rod wiper and rod packing into grooves. Care should be exercised not to nick the lips of the packings. Be sure to retorque bearing assembly screws to the specified torque for the cylinder.

For any service **beyond** replacement of rod packing and rod wiper, we strongly recommend returning the cylinder to the factory for any required service.

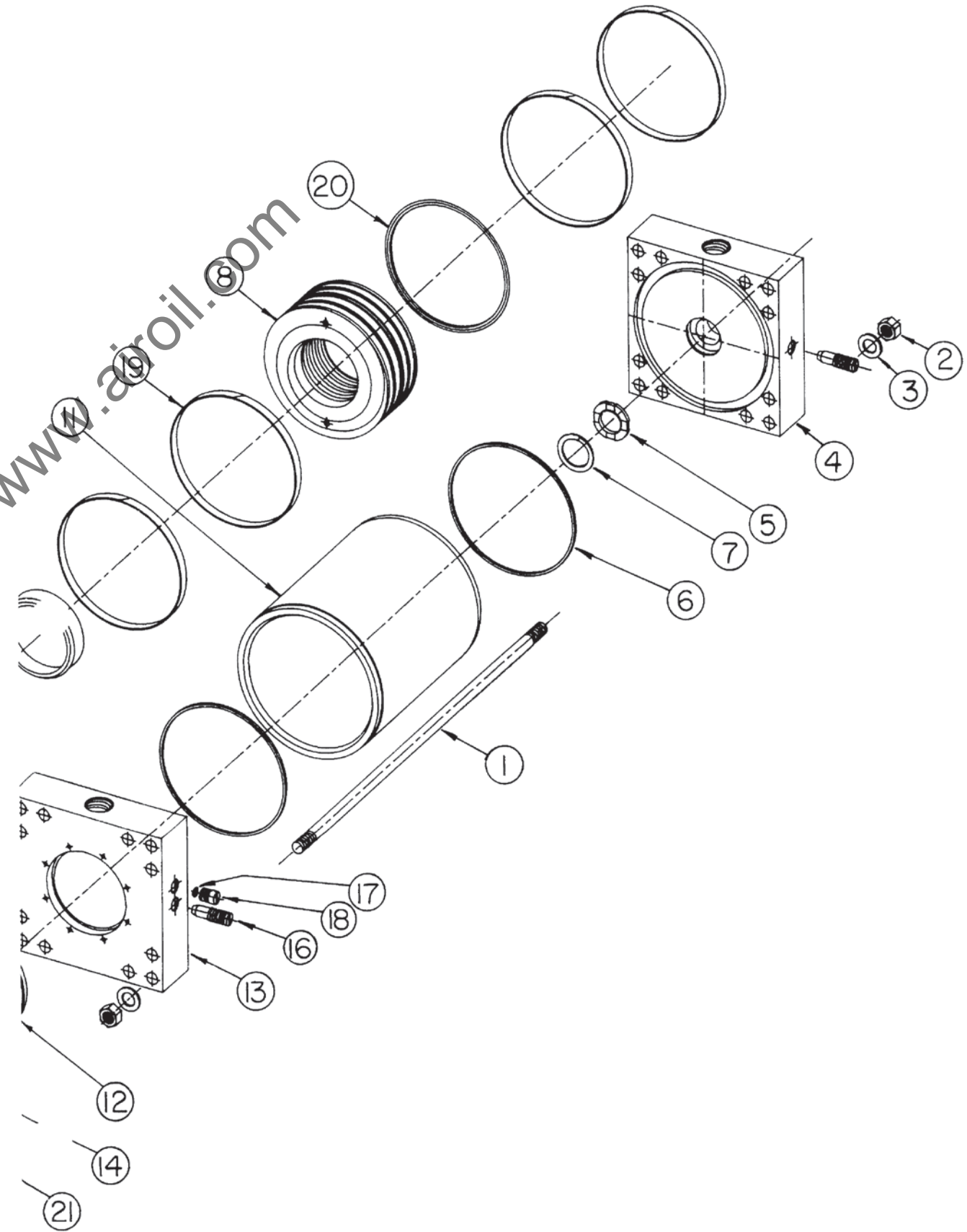
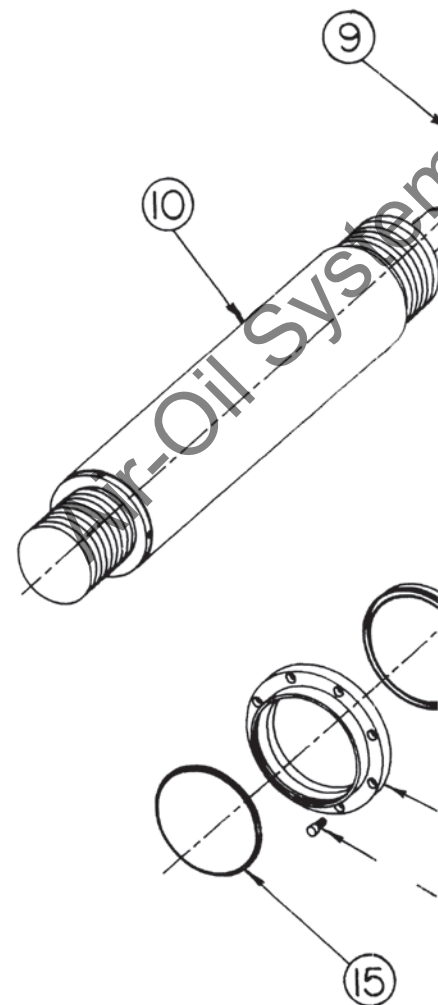
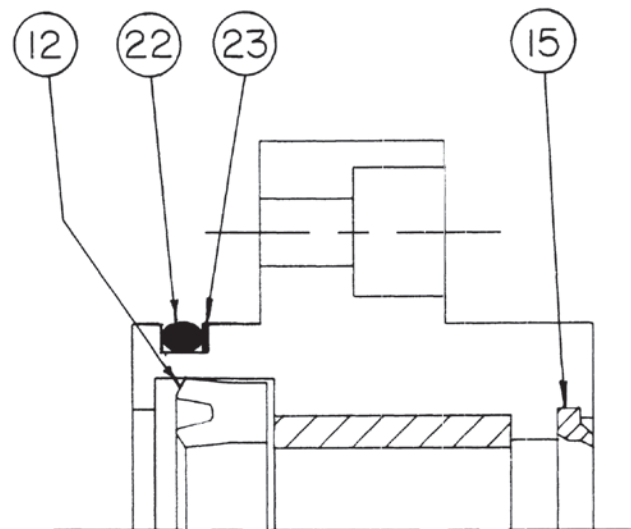
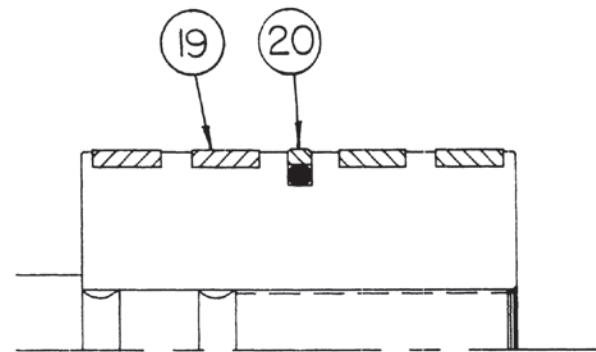
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned correctly with the load it is pushing or pulling. 4. That the piston packings or the piston rod packings are not worn, allowing pressure to escape.

Replacement packings can be furnished quickly, if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number, as shown. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

PARTS LIST

When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

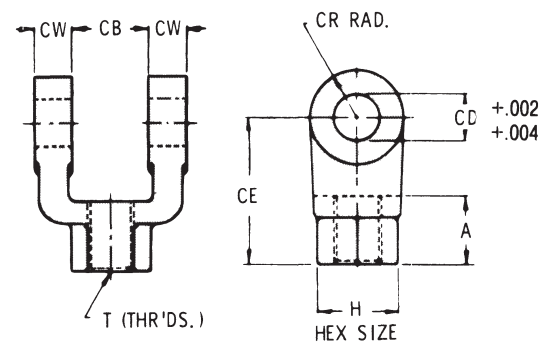
PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
1	Tie Rod	13	Front Head
2	Tie Rod Nut	14	Bearing Assembly
3	Tie Rod Washer	15	Rod Wiper
4	Cap	16	Cushion Needle
5	Cap Cushion Float	17	Ball
6	O-Ring	18	Ball Check Plug
7	Cap Retaining Ring	19	Wear Strip
8	Piston	20	Piston Seal Ring (with Expander)
9	Cushion Sleeve	21	Socket Head Cap Screw
10	Piston Rod	22	O-Ring (Bearing Assembly)
11	Tube	23	Back-up Washer (Bearing Assembly)
12	Rod Seal		



These are standard accessories matched to bore size and piston rod code. The Mounting Bracket fits the cap end of Model MP1. The Bracket also fits the piston Rod Clevis with the same number (i.e. B-10 Bracket fits V-10 Rod Clevis). The pin is furnished with additional pins are required. Pins also fit rod clevis and rod eyes. If you require accessories other than standard for that bore size or piston rod, specify the item number on your order.

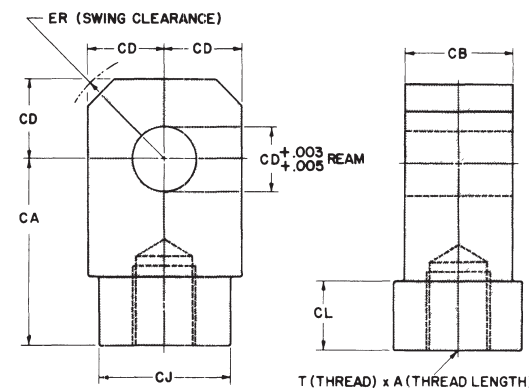
*** CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

Rod Clevis



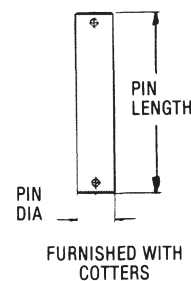
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-10	P	4.50	4.00	3.50	8.50	3.88	2.00	5.00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4.38	2.25	6.19	4.00-12	270,000

Rod Eye



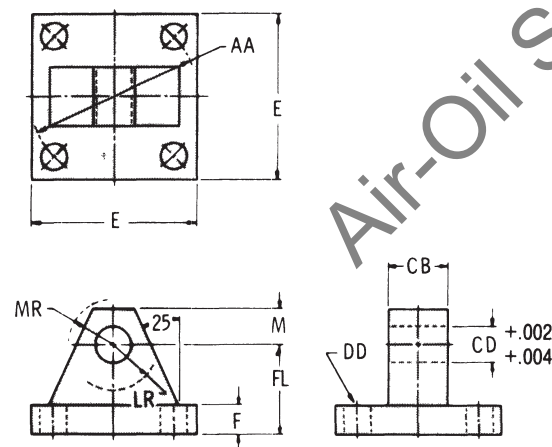
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-10	P	4.50	7.62	4.00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5.50	9.12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

Pin



PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

Brackets



3H SERIES BORE DIA.	BRACKET ITEM	AA	CB	CE	DD	E	F	FL	LR	M	MR	*LBS. CAPACITY
10.00	B-10	13.60	4.00	3.500	1.81	12.62	1.69	7.25	3.62	3.50	3.62	58,500
12.00	B-12	16.19	4.50	4.000	2.06	14.88	1.94	7.75	4.12	4.00	4.12	73,250

MOUNTING STYLE

- Head Square ME3
- Cap Square ME4
- Head Rectangular Flange ME5
- Cap Rectangular Flange ME6
- Cap Fixed Clevis MP1
- Head Trunnion MT1
- Side Lugs MS2

SERIES

- Hydraulic (Heavy Duty) 3H

CUSHION

- Non-Cushion NC
- Cushion, Both Ends CC
- Cushion, Cap End Only CB
- Cushion, Head End Only CR

For cushions on cylinders with bores over 14.00", consult factory.

When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

NPTF ports will be furnished as standard. Optional SAE flange ports may be specified—flange furnished by customer.

CAUTION:

Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. **Fluid velocities in the supply line in excess of 15 feet per second are not recommended.**

ME3-3H-NC-10.00"-9.00"-PSM1G

BORE SIZE
(Specify)

STROKE
(Specify)

ROD END STYLE

- Small Male SM
- Alternate Male (specify) AL
- Alternate Female (specify) ... AF

PISTON ROD PACKING, GLAND O-RING, ROD WIPER

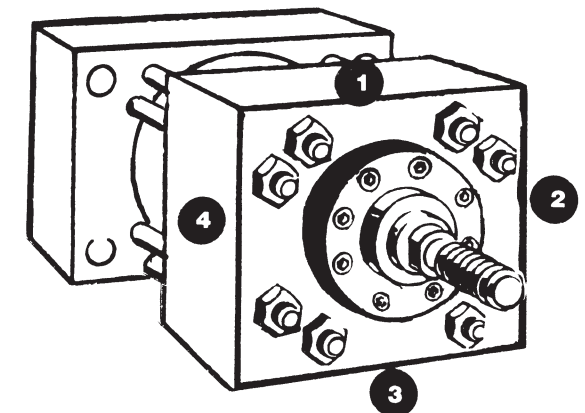
- STANDARD—Polyurethane Packing, Buna O-Ring, Polyurethane Wiper 1
- OPTIONAL —Buna Packing, O-Ring, Polyurethane Wiper 2
- OPTIONAL —Viton Packing, Viton O-Ring, Teflon Wiper 3

PISTON PACKING AND TUBE SEALS

- STANDARD—Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals G
- OPTIONAL —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals H

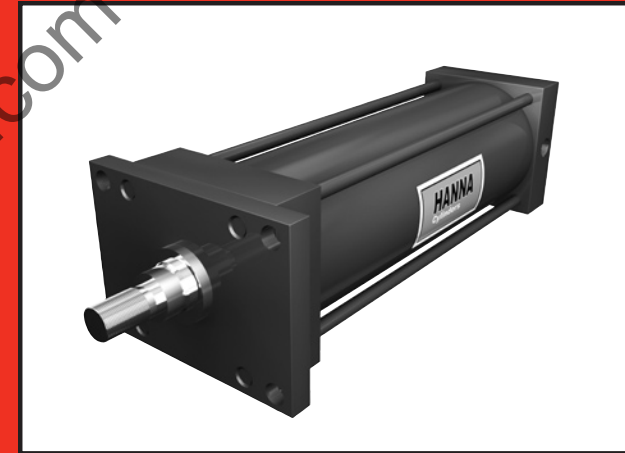
ROD DIAMETER

(Specify Piston Rod Code from dimensional chart)



Port location: if other than position 1, must be specified.

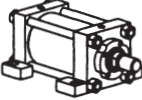
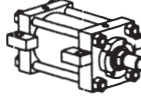
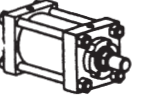
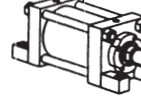
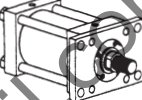
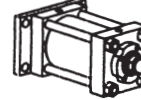
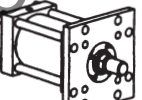
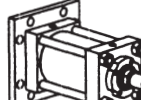
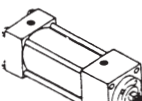
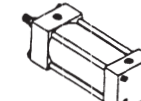


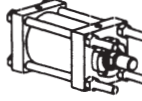
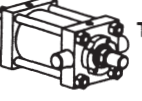
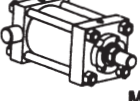
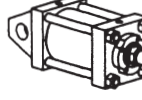
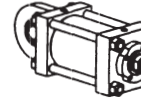
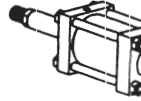
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**Series 3A and 3AN
for Heavy-Duty Service**

- High-Tech Duralon® Rod Bearing
- State-of-the-Art Rod and Piston Sealing System
- Heavy-Duty Piston-to-Rod Connection
- 1.50" – 14.00" Bores
- 150 – 250 PSI Pressure Ratings
- N.F.P.A. Interchangeability — 23 Mounting Styles
- No Lubrication Required with 3AN

SERIES 3A AND 3AN PNEUMATIC CYLINDERS

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HANNA
cylinders

Series 3A Pneumatic Cylinders

Hanna's Series 3A low-pressure pneumatic cylinders are designed and built to meet today's exacting industrial requirements. Rugged, performance-oriented units, 3A cylinders incorporate field proven design features which assure long, trouble-free service.

Series 3A cylinders give you virtually unlimited flexibility in machinery design, with a full range of bore sizes (1.50" through 14.00") offered. Developed for pressure ratings of 150 to 250 p.s.i., Series 3A cylinders are available in 23 N.F.P.A. mounting styles.

When ordering, specify piston packing code "A" for moderate temperatures, and code "B" for high temperature service.

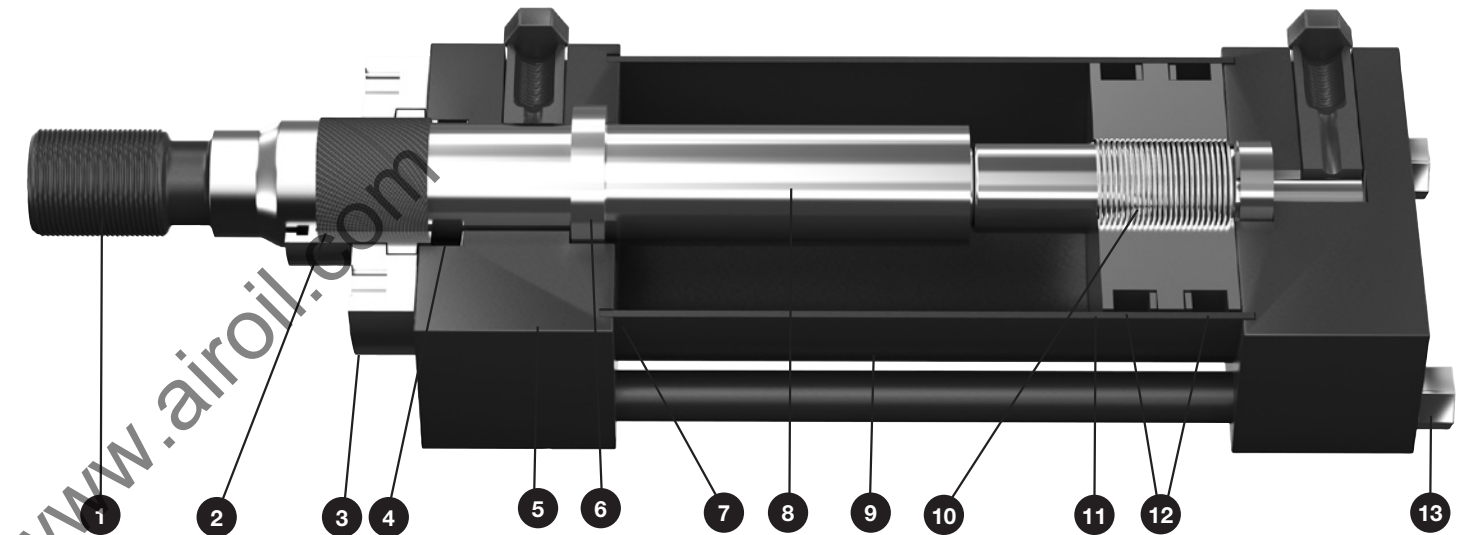
Series 3AN for Non-Lubricated Service

Hanna's Series 3AN cylinders are available in the same bore sizes and mounting styles as our 3A cylinders, and offer the added advantage of requiring no lubrication.

Extensive laboratory testing and countless field applications have proven conclusively that 3AN cylinders provide millions of maintenance and lubrication-free cycles. The reason: the combination of Hanna's unique Duralon® rod bearing and our glass-filled Teflon® piston seal with a bronze-impregnated bearing strip completely eliminates metal-to-metal contact at bearing surfaces. This is an absolute requirement for non-lube service and extended bearing life.

When ordering, specify piston packing code "G" for moderate temperature service.

Consult factory for special requirements.



Series 3A and 3AN Features

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity. Studded rod ends are available.

2. Duralon Rod Bearing

Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings are capable of sustaining much higher compressive loads than either bronze or cast iron, have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

3. Gland Construction

Two-piece (gland plus retainer plate), bolted-on or full-face retainer design. Packings may be captive in the gland or located in the head.

4. Rod Seal

Series 3A and 3AN cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance. Viton U-cup is available for higher temperature service.

5. Heads

Steel heads are precision-machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

6. Cushion Check Seals

With self-aligning, full-floating design, the cushion check seals are closely fitted to cushion sleeve and spear. The seals serve as both cushion seal and check valve, providing effective cushioning and fast breakaway.

7. Tube Seal

Buna-N O-ring seal. Viton available for higher temperature service.

8. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failures. The rods provide 100,000 minimum yield strength in diameters up to 3.50"; 59,000 average yield strength in 4.00" diameter and above. All sizes are hard chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish.

9. Tubing

Steel tubing is precision-honed to a 16-20 micro-inch finish for close tolerance between piston and tube wall, and chrome plated for corrosion resistance.

10. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

11. Piston

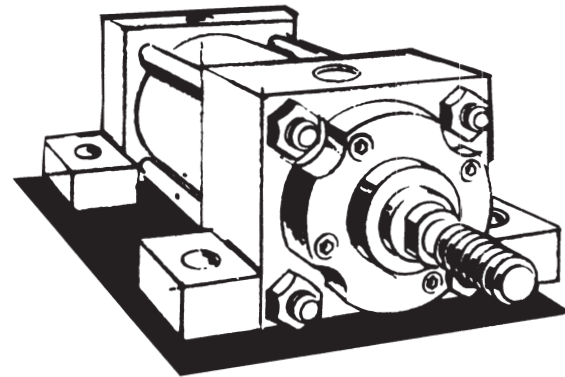
One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

12. Piston Sealing System

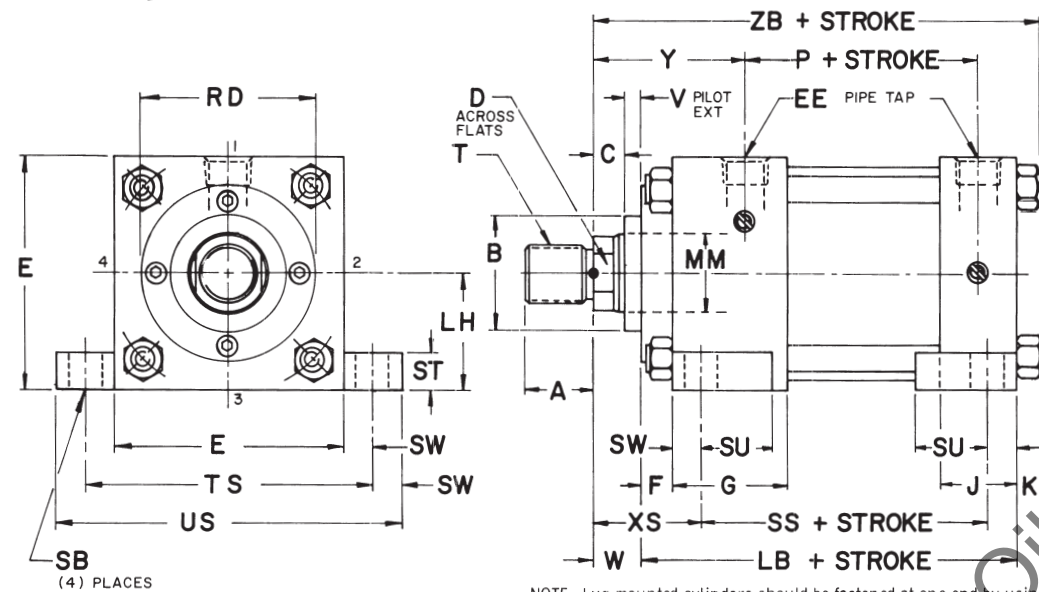
Two Buna-N U-cups are standard, with Viton U-cups available for higher temperature service. For non-lubricated service, 3AN cylinders utilize a glass-filled, O-ring energized piston seal that provides positive sealing. A bronze-filled Teflon bearing strip provides a non-metallic bearing point on the piston, assuring long life and extremely low friction.

13. Tie Rods

Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MS2
SIDE LUG MOUNT



These Dimensions are Constant Regardless of Rod Diameter

NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

BORE	E	LH -.006 -.008	EE (NPTF)	F	G	J	K	LB	P	SB +.005 -.000	SS	ST	SU	SW	TS ±.010	US
1.50	2.00	1.000	3/8	.38	1.50	1.00	.25	4.00	2.31	.438	2.88	.50	.94	.38	2.75	3.50
2.00	2.50	1.250	3/8	.38	1.50	1.00	.31	4.00	2.31	.438	2.88	.50	.94	.38	3.25	4.00
2.50	3.00	1.500	3/8	.38	1.50	1.00	.31	4.12	2.44	.438	3.00	.50	.94	.38	3.75	4.50
3.25	3.75	1.875	1/2	.62	1.75	1.25	.38	4.88	2.69	.562	3.25	.75	1.25	.50	4.75	5.75
4.00	4.50	2.250	1/2	.62	1.75	1.25	.38	4.88	2.69	.562	3.25	.75	1.25	.50	5.50	6.50
5.00	5.50	2.750	1/2	.62	1.75	1.25	.44	5.12	2.94	.812	3.12	.94	1.56	.69	6.88	8.25
6.00	6.50	3.250	3/4	.75	2.00	1.50	.44	5.75	3.19	.812	3.62	.94	1.56	.69	7.88	9.25
8.00	8.50	4.250	3/4	.75	2.00	1.50	.56	5.88	3.31	.812	3.75	.94	1.56	.69	9.88	11.25
10.00	10.62	5.312	1	.75	2.25	2.00	.66	7.12	4.19	1.062	4.62	1.25	2.00	.88	12.38	14.12
12.00	12.75	6.375	1	.75	2.25	2.00	.66	7.62	4.69	1.062	5.12	1.25	2.00	.88	14.50	16.25
14.00	14.75	7.375	1 1/4	.75	2.75	2.25	.75	8.88	5.62	1.312	5.88	1.50	2.50	1.12	17.00	19.25

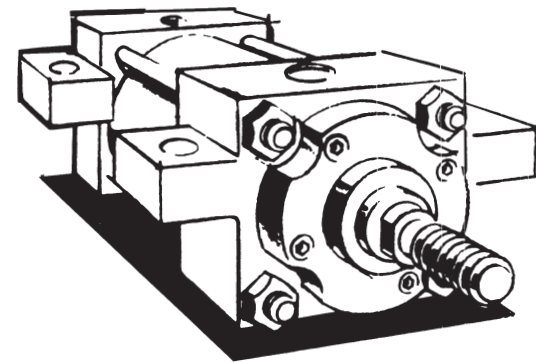
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to

Dimensions are Affected by the Rod Diameter

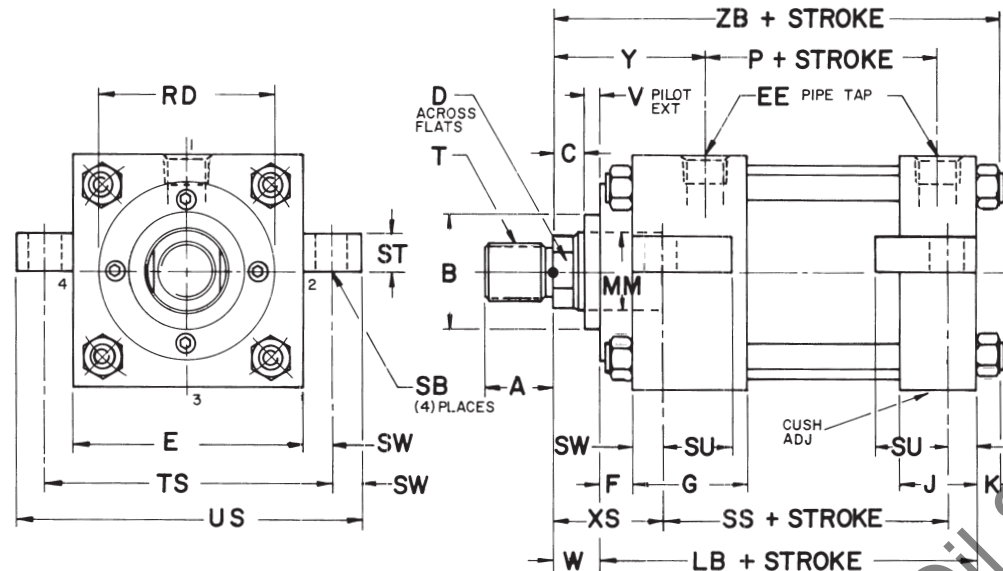
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XS	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.88	-	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.25	-	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.00	2.50	5.56	-	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.00	2.50	5.69	-	250
3.25	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	2.25	2.75	5.94	-	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.88	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.12	2.62	6.25	3.00	250
4.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.38	2.88	6.50	-	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.50	3.00	6.62	-	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.75	3.25	6.88	-	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.06	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.31	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.56	2.88	6.81	-	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.69	3.00	6.94	-	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.94	3.25	7.19	-	250
6.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.94	3.25	7.19	-	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.94	3.38	7.69	-	250
	N	4.00	4.50	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.69	-	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.31	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.56	3.00	7.31	4.00	250
8.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.69	3.12	7.44	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.94	3.38	7.69	-	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.94	3.38	7.94	-	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.94	-	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	2.94	3.38	7.94	-	250
10.00	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	2.94	3.38	7.94	-	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.75	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.88	3.19	9.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.12	3.44	9.31	-	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.12	3.44	9.31	-	150
12.00	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.12	3.44	9.31	-	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.12	3.44	9.31	-	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.12	3.44	9.31	-	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.88	3.19	9.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.12	3.44	9.81	5.12	150
14.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.12	3.44	9.81	-	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.12	3.44	9.81	-	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.38	3.69	11.19	-	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.38	3.69	11.19	-	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MS3
CENTERLINE LUG
MOUNT



These Dimensions are Constant Regardless of Rod Diameter

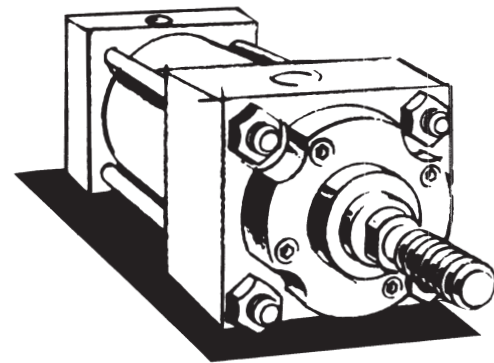
BORE	E	EE (NPTF)	F	G	J	K	LB	P	SB +.005 - .000	SS	ST	SU	SW	US
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	.438	2.88	.50	.94	.38	3.50
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	.438	2.88	.50	.94	.38	4.00
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	.438	3.00	.50	.94	.38	4.50
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	.562	3.25	.75	1.25	.50	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	.562	3.25	.75	1.25	.50	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	.812	3.12	.94	1.56	.69	8.25
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	.812	3.62	.94	1.56	.69	9.25
8.00	8.50	3/4	.75	2.00	1.50	.56	5.88	3.31	.812	3.75	.94	1.56	.69	11.25
10.00	10.62	1	.75	2.25	2.00	.66	7.12	4.19	1.062	4.62	1.25	2.00	.88	14.12
12.00	12.75	1	.75	2.25	2.00	.66	7.62	4.69	1.062	5.12	1.25	2.00	.88	16.25
14.00	14.75	1 1/4	.75	2.75	2.25	.75	8.88	5.62	1.312	5.88	1.50	2.50	1.12	19.25

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

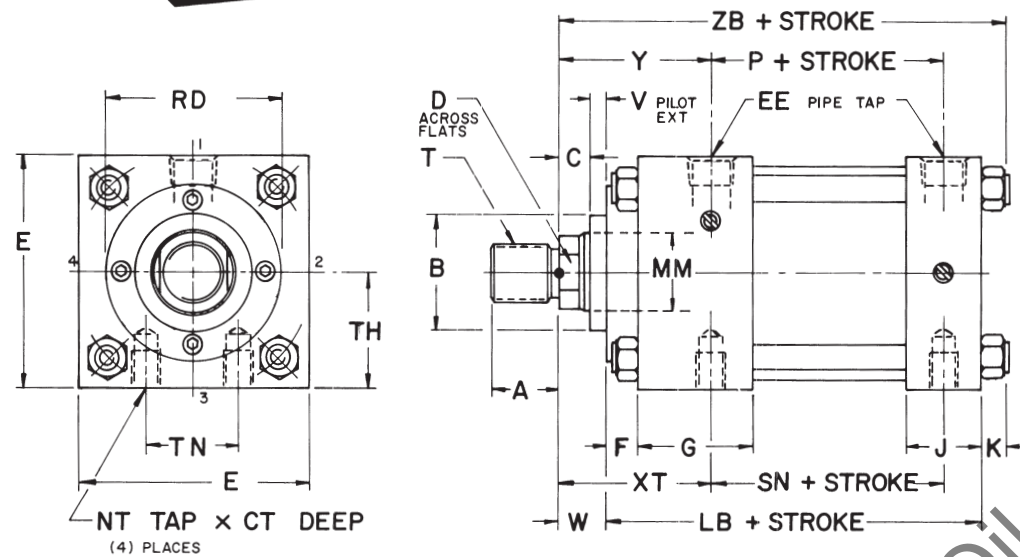
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XS	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.88	-	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.25	-	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.00	2.50	5.56	-	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.38	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.75	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.00	2.50	5.69	-	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	2.25	2.75	5.94	-	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.88	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.12	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.38	2.88	6.50	-	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.50	3.00	6.62	-	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.88	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.12	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.38	2.88	6.50	-	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.50	3.00	6.62	-	250
K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.75	3.25	6.88	-	250	
	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.75	3.25	6.88	-	250	
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.06	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.31	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.56	2.88	6.81	-	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.69	3.00	6.94	-	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.94	3.25	7.19	-	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.94	3.25	7.19	-	250
M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	2.94	3.25	7.19	-	250	
	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	2.94	3.25	7.19	-	250	
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.31	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.56	3.00	7.31	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.69	3.12	7.44	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.94	3.38	7.69	-	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.94	3.38	7.69	-	250
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.94	3.38	7.69	-	250
N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.69	-	250	
	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.69	-	250	
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.31	2.75	7.31	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.56	3.00	7.56	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.69	3.12	7.69	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.94	3.38	7.94	5.12	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.94	3.38	7.94	-	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.94	3.38	7.94	-	250
R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	2.94	3.38	7.94	-	250	
	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	2.94	3.38	7.94	-	250	
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	2.94	3.38	7.94	-	250	
	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	2.94	3.38	7.94	-	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.75	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.88	3.19	9.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.12	3.44	9.31	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.12	3.44	9.31	-	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.12	3.44	9.31	-	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.12	3.44	9.31	-	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.12	3.44	9.31	-	150	
	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.12	3.44	9.31	-	150	
12.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.88	3.19	9.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.12	3.44	9.81	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.12	3.44	9.81	-	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.12	3.44	9.81	-	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.12	3.44	9.81	-	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.12	3.44	9.81	-	150
14.00	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	3.69	11.19	5.12	150
	N	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	3.69	11.19	-	150
	R	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	3.69	11.19	-	150
	S	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.38	3.69	11.19	-	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.38	3.69	11.19	-	150	

*Where RD is not shown, square retainer is used. See section for Retainer Construction.
†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MS4
SIDE TAPPED MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	CT	E	TH -.006 -.008	EE (NPTF)	F	G	J	K	LB	NT	P	SN	TH ± .010
1.50	.38	2.00	1.000	3/8	.38	1.50	1.00	.25	4.00	.25-20	2.31	2.25	.62
2.00	.38	2.50	1.250	3/8	.38	1.50	1.00	.31	4.00	.31-18	2.31	2.25	.88
2.50	.50	3.00	1.500	3/8	.38	1.50	1.00	.31	4.12	.38-16	2.44	2.38	1.25
3.25	.50	3.75	1.875	1/2	.62	1.75	1.25	.38	4.88	.50-13	2.69	2.62	1.50
4.00	.75	4.50	2.250	1/2	.62	1.75	1.25	.38	4.88	.50-13	2.69	2.62	2.06
5.00	1.00	5.50	2.750	1/2	.62	1.75	1.25	.44	5.12	.62-11	2.94	2.88	2.69
6.00	1.12	6.50	3.250	3/4	.75	2.00	1.50	.44	5.75	.75-10	3.19	3.12	3.25
8.00	1.12	8.50	4.250	3/4	.75	2.00	1.50	.56	5.88	.75-10	3.31	3.25	4.50
10.00	1.50	10.62	5.312	1	.75	2.25	2.00	.66	7.12	1.00-8	4.19	4.12	5.50
12.00	1.50	12.75	6.375	1	.75	2.25	2.00	.66	7.62	1.00-8	4.69	4.62	7.25
14.00	1.88	14.75	7.375	1 1/4	.75	2.75	2.25	.75	8.88	1.25-7	5.62	5.50	8.38

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

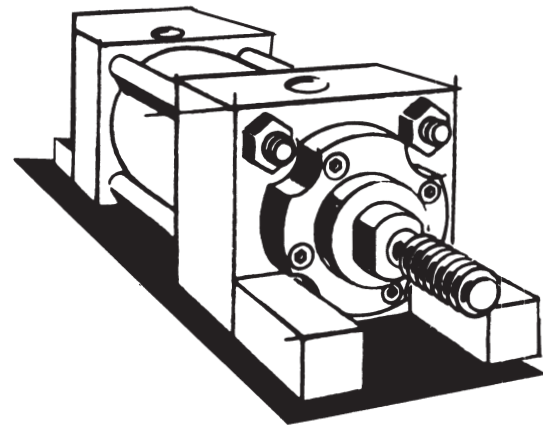
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XT	Y	ZB	RD**	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.94	1.88	4.88	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.31	2.25	5.25	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.94	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.31	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	2.50	5.56	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.94	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.31	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.56	2.50	5.69	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	2.75	5.94	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.44	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.69	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.94	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.06	3.00	6.62	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.44	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.69	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.94	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.06	3.00	6.62	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.44	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.69	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.94	2.88	6.81	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.06	3.00	6.94	--	250
6.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	3.31	3.25	7.19	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	3.31	3.25	7.19	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	3.31	3.25	7.19	--	250
	N	4.00	4.50	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	3.38	7.69	--	250
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.81	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.06	3.00	7.56	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.19	3.12	7.69	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.44	3.38	7.69	5.12	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.44	3.38	7.94	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	3.38	7.94	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.44	3.38	7.94	--	250
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.44	3.38	7.94	--	250
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.12	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.25	3.19	9.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.50	3.44	9.31	--	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.50	3.44	9.31	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.50	3.44	9.31	--	150
12.00	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.50	3.44	9.31	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.50	3.44	9.31	--	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.25	3.19	9.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.50	3.44	9.81	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.50	3.44	9.81	--	150
14.00	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.50	3.44	9.81	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.50	3.44	9.81	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.50	3.44	9.81	--	150
	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	3.81	3.69	11.19	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.81	3.69	11.19	--	150

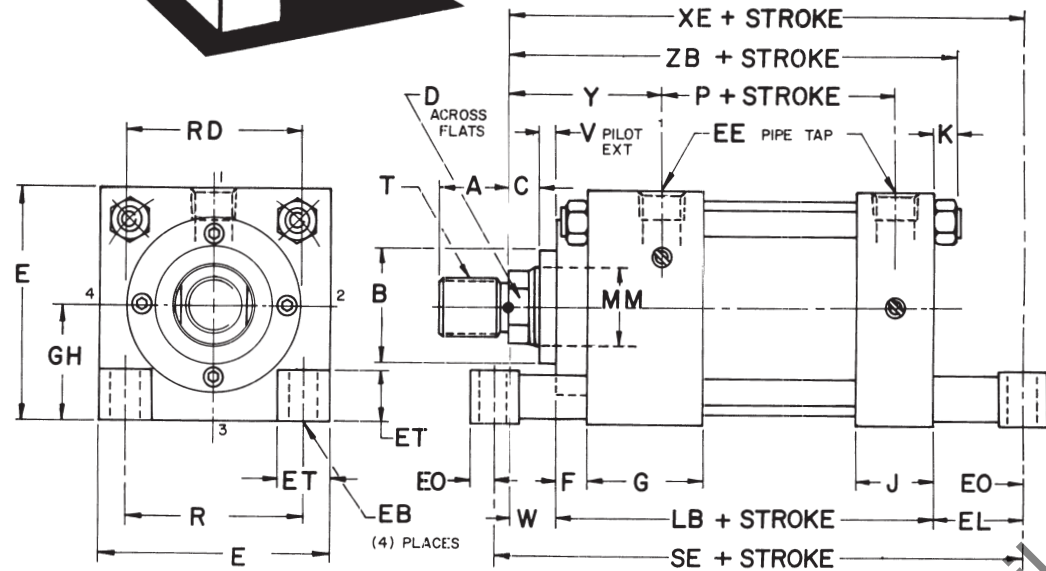
* Not available in MS4 Mount

**Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MS7
END LUG MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	GH -.006 -.008	EB	EE (NPTF)	EL	EO	ET	F	G	J	K	LB	P	R ±.010	SE
1.50	2.00	1.000	.31	3/8	.75	.34	.56	.38	1.50	1.00	.25	4.00	2.31	1.48	5.50
2.00	2.50	1.250	.38	3/8	.94	.31	.62	.38	1.50	1.00	.31	4.00	2.31	1.84	5.88
2.50	3.00	1.500	.38	3/8	1.06	.31	.81	.38	1.50	1.00	.31	4.12	2.44	2.19	6.25
3.25	3.75	1.875	.44	1/2	.88	.38	1.00	.62	1.75	1.25	.38	4.88	2.69	2.76	6.62
4.00	4.50	2.250	.44	1/2	1.00	.38	1.19	.62	1.75	1.25	.38	4.88	2.69	3.32	6.88
5.00	5.50	2.750	.56	1/2	1.06	.50	1.40	.62	1.75	1.25	.44	5.12	2.94	4.10	7.25
6.00	6.50	3.250	.56	3/4	1.00	.50	1.62	.75	2.00	1.50	.44	5.75	3.19	4.88	7.75
8.00	8.50	4.250	.69	3/4	1.12	.62	2.06	.75	2.00	1.50	.56	5.88	3.31	6.44	7.38
10.00	10.62	5.312	.81	1	1.31	.62	2.69	.75	2.25	2.00	.66	7.12	4.19	7.92	9.00
12.00	12.75	6.375	.81	1	1.31	.62	3.28	.75	2.25	2.00	.66	7.62	4.69	9.40	9.50
14.00	14.75	7.375	.94	1 1/4	1.50	.75	3.88	.75	2.75	2.25	.75	8.88	5.62	10.90	11.12

CAUTION: Check for interference between rod attachment and mounting lug. If necessary, specify longer than standard "C" dimension.

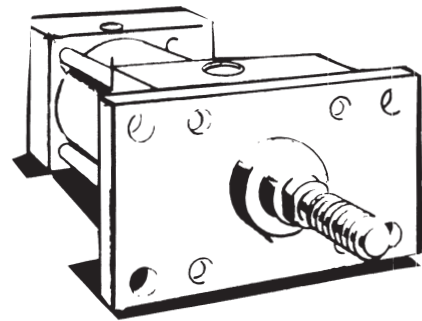
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

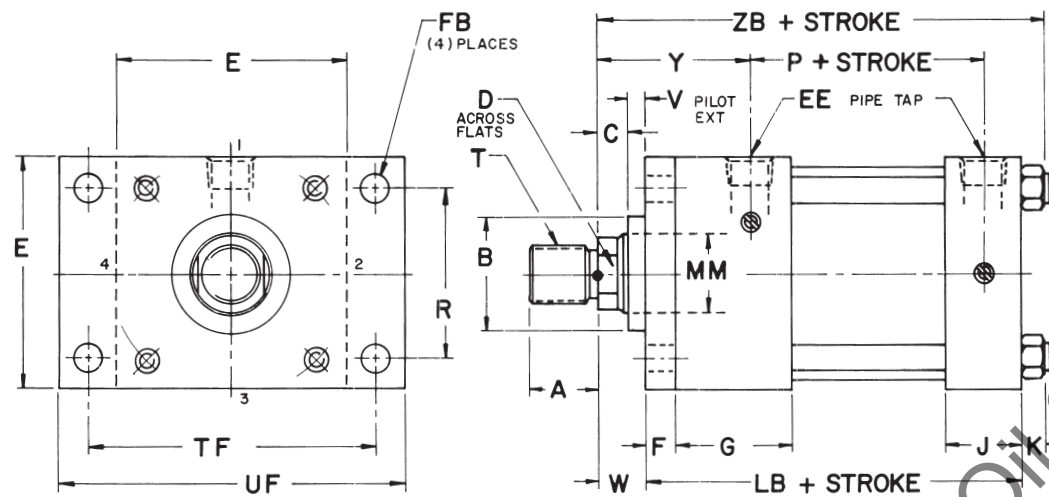
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XE	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.38	1.88	4.88	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.75	2.25	5.25	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.56	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.94	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	6.19	2.50	5.56	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.94	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	6.19	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	6.44	2.50	5.69	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	6.69	2.75	5.94	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	6.50	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	6.75	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.00	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.12	3.00	6.62	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	6.62	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	6.88	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.12	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.25	3.00	6.62	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	7.50	3.25	6.88	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	6.94	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	7.19	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.44	2.88	6.81	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.56	3.00	6.94	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	7.81	3.25	7.19	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	7.81	3.25	7.19	--	250
6.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	7.81	3.25	7.19	--	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	7.62	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	7.88	3.00	7.31	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	8.00	3.12	7.44	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	8.25	3.38	7.69	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.25	3.38	7.69	--	250
8.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	8.25	3.38	7.69	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.25	3.38	7.69	--	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	7.88	2.75	7.31	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.12	3.00	7.56	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	8.25	3.12	7.69	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	8.50	3.38	7.94	5.12	250
10.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.50	3.38	7.94	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.50	3.38	7.94	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	8.50	3.38	7.94	--	250
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	8.50	3.38	7.94	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	9.56	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	9.69	3.19	9.06	4.00	150
12.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	9.94	3.44	9.31	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	9.94	3.44	9.31	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	10.44	3.44	9.81	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	10.44	3.44	9.81	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	10.44	3.44	9.81	--	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	10.19	3.19	9.56	4.00	150
14.00	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	11.88	3.69	11.19	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	11.88	3.69	11.19	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	11.88	3.69	11.19	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	11.88	3.69	11.19	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	11.88	3.69	11.19	--	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 6.00"
BORE
MF1
HEAD RECTANGULAR
FLANGE MOUNT



These Dimensions are Constant Regardless of Rod Diameter

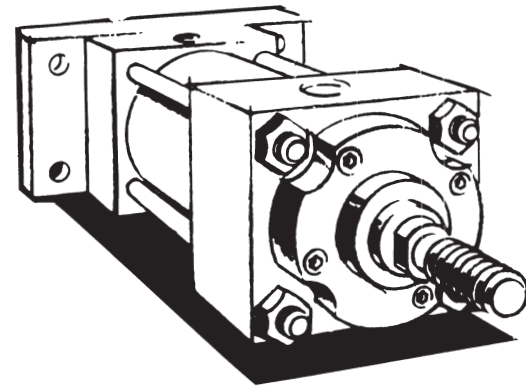
BORE	E	EE (NPTF)	F	FB +.005 - .003	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

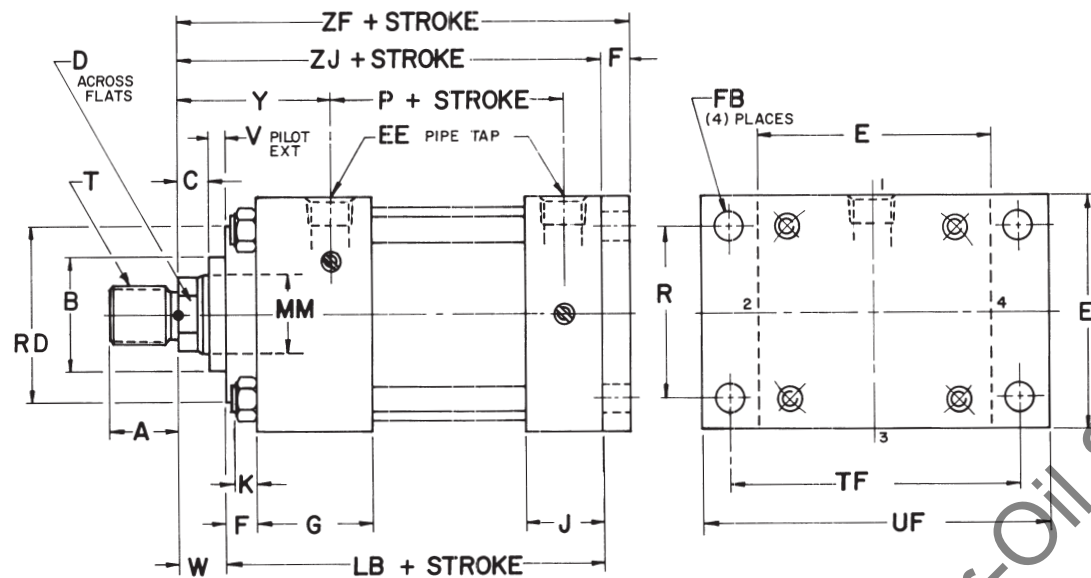
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.88	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.25	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.94	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.31	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.56	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	5.06	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.44	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	6.88	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.31	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.56	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	250
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	1.62	2.75	7.06	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.31	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	7.44	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.25	3.38	7.69	250
6.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	250

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 6.00"
BORE
MF2
CAP RECTANGULAR
FLANGE MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB +.005 - .000	G	J	K	LB	P	R ± .010	TF ± .010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

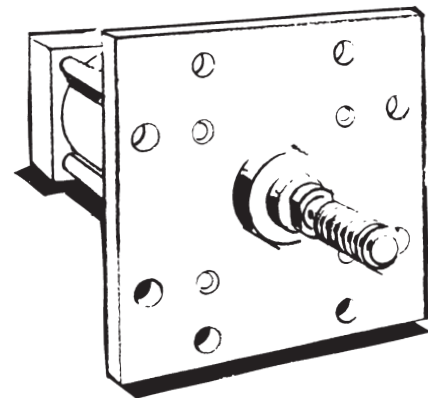
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	ZJ	Y	ZF	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.62	1.88	5.00	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.00	2.25	5.38	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.62	1.88	5.00	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.00	2.25	5.38	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	5.25	2.50	5.62	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.75	1.88	5.12	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.12	2.25	5.50	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	5.38	2.50	5.75	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	5.62	2.75	6.00	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.62	2.38	6.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.88	2.62	6.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.12	2.88	6.75	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.25	3.00	6.88	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.62	2.38	6.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.88	2.62	6.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.12	2.88	6.75	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.25	3.00	6.88	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.50	3.25	7.12	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.88	2.38	6.50	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	6.12	2.62	6.75	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.38	2.88	7.00	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.50	3.00	7.12	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.75	3.25	7.38	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	6.75	3.25	7.38	--	250
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	6.62	2.75	7.38	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.88	3.00	7.62	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	7.00	3.12	7.75	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	7.25	3.38	8.00	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	7.25	3.38	8.00	--	250
6.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	7.25	3.38	8.00	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	7.25	3.38	8.00	--	250

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



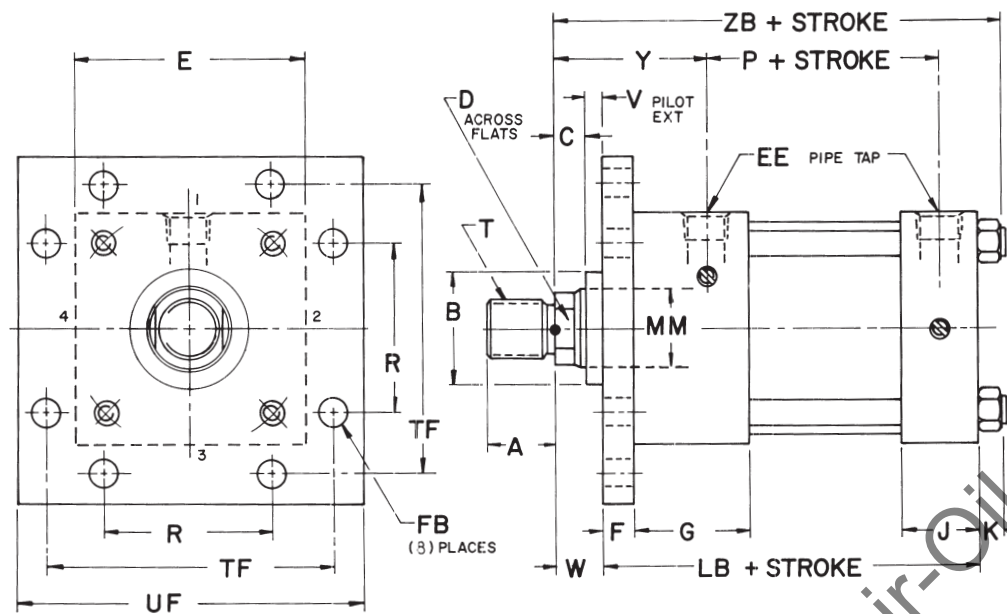
SERIES "3A"

PNEUMATIC CYLINDERS

1.50" - 6.00"
BORE

MF5

HEAD SQUARE FLANGE
MOUNT



These Dimensions are Constant Regardless of Rod Diameter

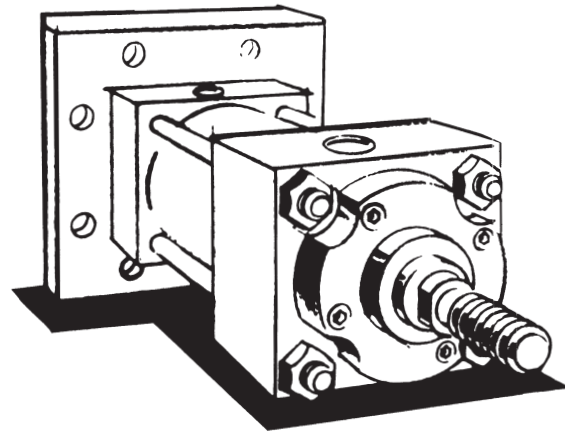
BORE	E	EE (NPTF)	F	FB +.005 - .000	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER			A	B -.001 -.003	C	D	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.88	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.25	250	
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.94	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.31	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.56	250	
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	5.06	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.44	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.69	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	250	
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	250	
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.00	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	250	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	6.88	250	
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	1.38	2.38	6.31	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.56	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	250	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	250	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	250	
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	1.62	2.75	7.06	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.31	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	7.44	250	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	250	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	2.25	3.38	7.69	250	
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	250	
N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	250		

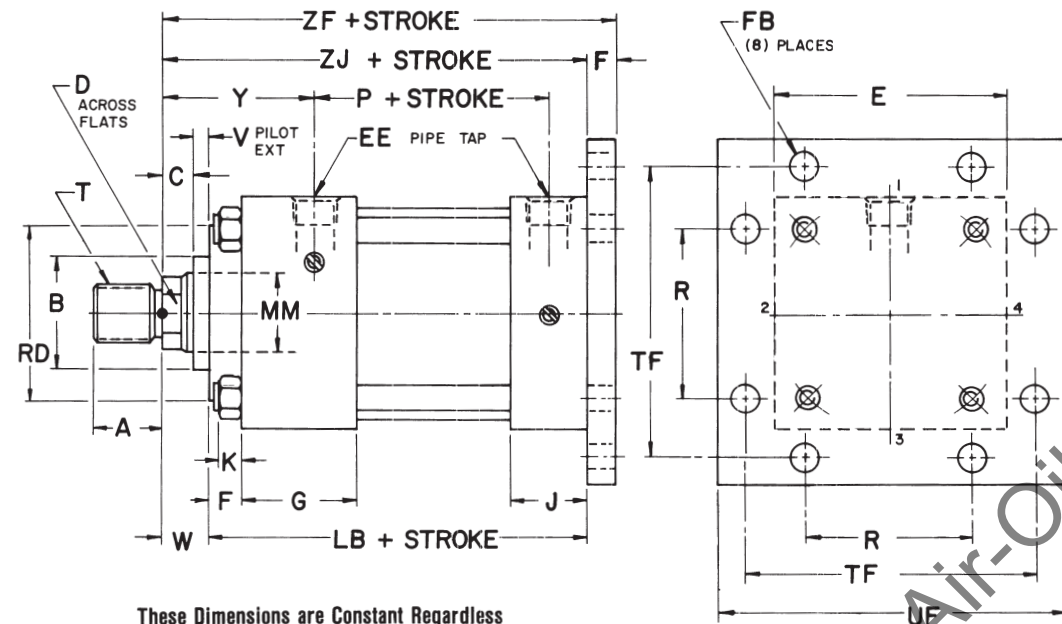
†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 6.00"
BORE
MF6
CAP SQUARE
FLANGE MOUNT

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	ZJ	Y	ZF	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.62	1.88	5.00	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.00	2.25	5.38	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.62	1.88	5.00	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.00	2.25	5.38	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	5.25	2.50	5.62	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.75	1.88	5.12	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.12	2.25	5.50	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	5.38	2.50	5.75	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	5.62	2.75	6.00	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.62	2.38	6.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.88	2.62	6.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.12	2.88	6.75	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.25	3.00	6.88	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.62	2.38	6.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.88	2.62	6.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.12	2.88	6.75	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.25	3.00	6.88	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.50	3.25	7.12	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.88	2.38	6.50	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	6.12	2.62	6.75	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	6.38	2.88	7.00	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	6.50	3.00	7.12	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.75	3.25	7.38	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	6.75	3.25	7.38	--	250
6.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	6.75	3.25	7.38	--	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	6.62	2.75	7.38	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.88	3.00	7.62	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	7.00	3.12	7.75	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	7.25	3.38	8.00	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	7.25	3.38	8.00	--	250
6.00	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	7.25	3.38	8.00	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	7.25	3.38	8.00	--	250



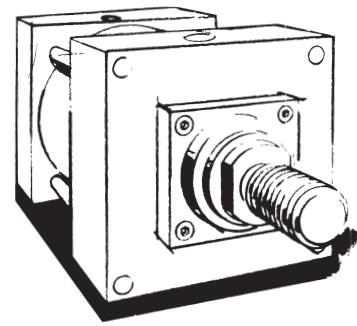
These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB +.005 -.000	G	J	K	LB	P	R ± .010	TF ± .010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

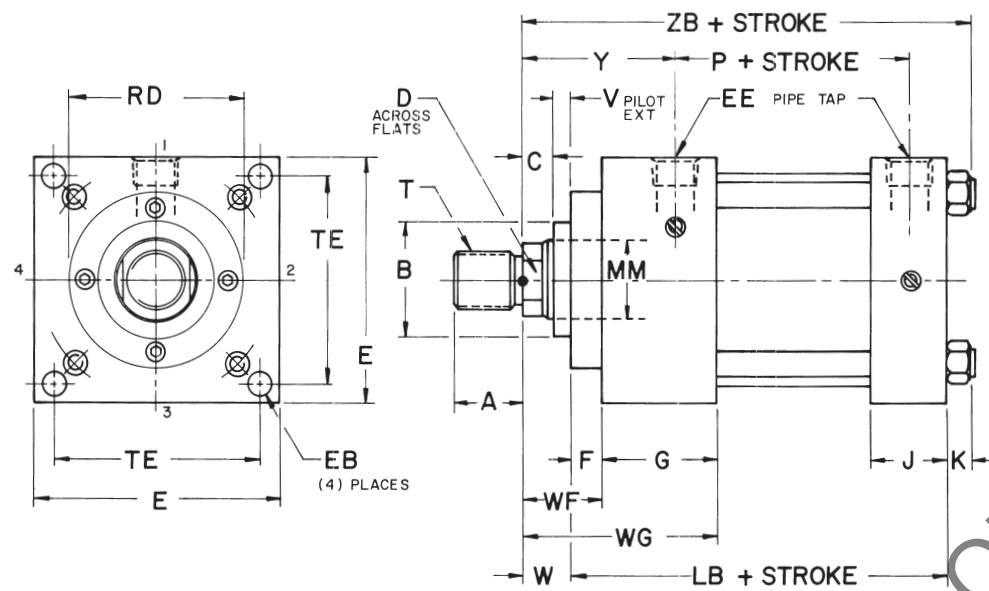
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
8.00" - 14.00"
BORE
ME3
HEAD SQUARE MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EB	EE (NPTF)	F	G	J	K	LB	P	TE ± .010
8.00	8.50	.69	3/4	.75	2.00	1.50	.56	5.88	3.31	7.57
10.00	10.62	.81	1	.75	2.25	2.00	.66	7.12	4.19	9.40
12.00	12.75	.81	1	.75	2.25	2.00	.66	7.62	4.69	11.10
14.00	14.75	.94	1 1/4	.75	2.75	2.25	.75	8.88	5.62	12.87

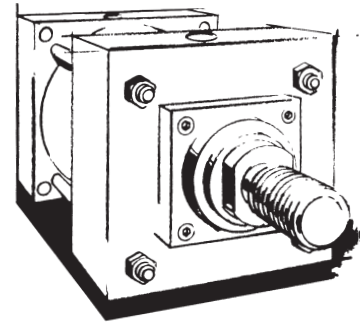
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

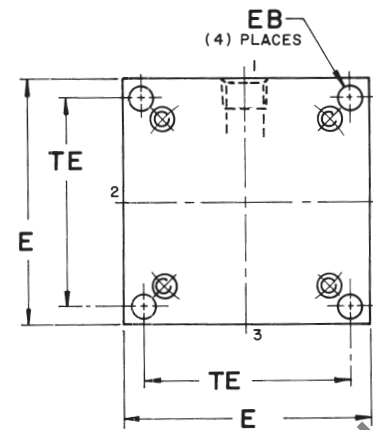
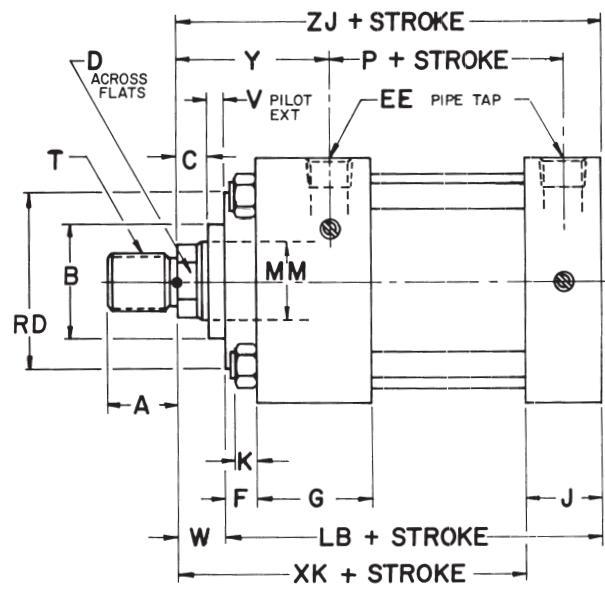
BORE	CYLINDER			A	B -.001 -.003	C	D	T (THREAD)			V	WF	WG	W	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF								
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	1.62	3.62	.88	2.75	7.31	4.00	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.88	3.88	1.12	3.00	7.56	4.00	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	2.00	4.00	1.25	3.12	7.69	4.00	250	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	2.25	4.25	1.50	3.38	7.94	5.12	250	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	2.25	4.25	1.50	3.38	7.94	--	250	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	2.25	4.25	1.50	3.38	7.94	--	250	
	S	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	2.25	4.25	1.50	3.38	7.94	--	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.88	4.12	1.12	3.06	8.94	4.00	150	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	2.00	4.25	1.25	3.19	9.06	4.00	150	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	2.25	4.50	1.50	3.44	9.31	5.12	150	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	2.25	4.50	1.50	3.44	9.31	--	150	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	2.25	4.50	1.50	3.44	9.31	--	150	
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	2.25	4.50	1.50	3.44	9.31	--	150	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	2.25	4.50	1.50	3.44	9.31	--	150	
12.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	2.00	4.25	1.25	3.19	9.56	4.00	150	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	2.25	4.50	1.50	3.44	9.81	5.12	150	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	2.25	4.50	1.50	3.44	9.81	--	150	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	2.25	4.50	1.50	3.44	9.81	--	150	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	2.25	4.50	1.50	3.44	9.81	--	150	
14.00	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	2.25	5.00	1.50	3.69	11.19	5.12	150	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	2.25	5.00	1.50	3.69	11.19	--	150	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	2.25	5.00	1.50	3.69	11.19	--	150	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	2.25	5.00	1.50	3.69	11.19	--	150	

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
8.00" - 14.00"
BORE
ME4
CAP SQUARE MOUNT



BORE	E	EB	EE (NPTF)	F	G	J	K	LB	P	TE ± .010
8.00	8.50	.69	3/4	.75	2.00	1.50	.56	5.88	3.31	7.57
10.00	10.62	.81	1	.75	2.25	2.00	.66	7.12	4.19	9.40
12.00	12.75	.81	1	.75	2.25	2.00	.66	7.62	4.69	11.10
14.00	14.75	.94	1 1/4	.75	2.75	2.25	.75	8.88	5.62	12.87

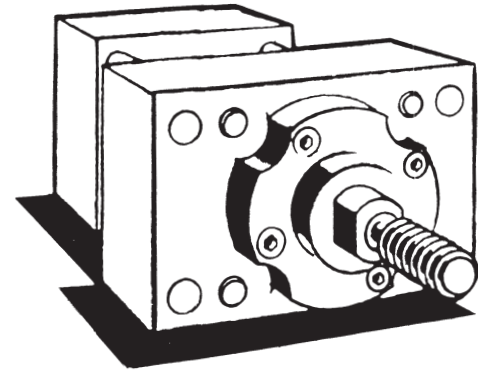
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

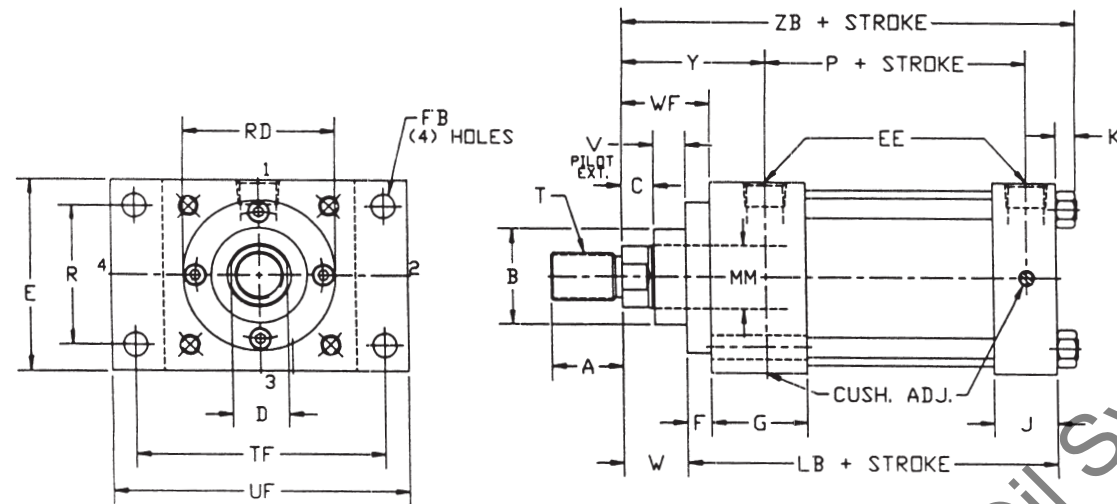
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XK	Y	ZJ	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	5.25	2.75	6.75	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	5.50	3.00	7.00	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	5.62	3.12	7.12	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	5.88	3.38	7.38	5.12	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	5.88	3.38	7.38	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	5.88	3.38	7.38	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	5.88	3.38	7.38	--	250
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	5.88	3.38	7.38	--	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.25	3.06	8.25	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	6.38	3.19	8.38	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	6.62	3.44	8.62	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	6.62	3.44	8.62	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	6.62	3.44	8.62	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	6.62	3.44	8.62	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	6.62	3.44	8.62	--	150
12.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	6.88	3.19	8.88	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	7.12	3.44	9.12	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	7.12	3.44	9.12	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	7.12	3.44	9.12	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	7.12	3.44	9.12	--	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	7.12	3.44	9.12	--	150	
14.00	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	8.12	3.69	10.38	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.12	3.69	10.38	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.12	3.69	10.38	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	8.12	3.69	10.38	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	8.12	3.69	10.38	--	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 6.00"
BORE
ME5
HEAD FLANGE MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB +.005 - .000	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

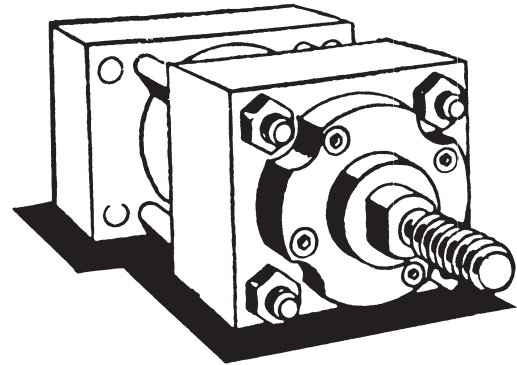
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

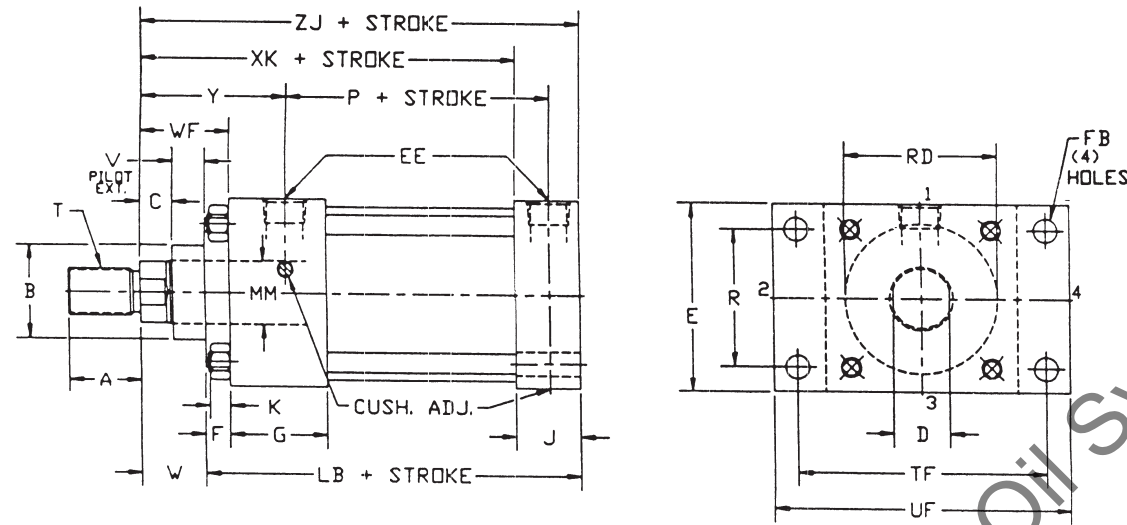
BORE	CYLINDER		A	B -.001 -.003	C	D	RO* ±.005	T (THREAD)			V	W	WF	Y	ZB	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	50-20	.44-20	.25	.62	1.00	1.88	4.88	250
	F	1.00	1.12	1.500	.50	.88	-	75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.25	250
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	.44-20	.25	.62	1.00	1.88	4.94	250
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.31	250
2.50	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	1.62	2.50	5.56	250
	H	.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	1.88	2.75	5.94	250
	D	.62	.75	1.125	.38	.50	2.38	44-20	50-20	.44-20	.25	.62	1.00	1.88	5.06	250
	F	1.00	1.12	1.500	.50	.88	2.38	75-16	88-14	.75-16	.50	1.00	1.38	2.25	5.44	250
3.25	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250
	D	.62	.75	1.125	.50	.88	3.00	75-16	88-14	.75-16	.25	.75	1.38	2.38	6.00	250
	F	1.00	1.12	1.500	.50	.88	3.00	100-14	125-12	100-14	.38	1.00	1.62	2.62	6.25	250
4.00	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	1.62	2.62	6.25	250
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.50	250
	D	.62	.75	1.125	.50	.88	3.00	75-16	88-14	.75-16	.25	.75	1.38	2.38	6.00	250
	F	1.00	1.12	1.500	.50	.88	3.00	100-14	125-12	100-14	.38	1.00	1.62	2.62	6.25	250
5.00	J	2.00	2.25	2.625	.88	1.69	4.12	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.62	250
	K	2.50	3.00	3.125	1.00	2.06	4.12	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	6.88	250
	D	.62	.75	1.125	.50	.88	3.00	75-16	88-14	.75-16	.25	.75	1.38	2.38	6.31	250
	F	1.00	1.12	1.500	.50	.88	3.00	100-14	125-12	100-14	.38	1.00	1.62	2.62	6.56	250
	H	1.75	2.00	2.375	.75	1.50	3.50	1.25-12	1.50-12	1.25-12	.50	1.25	1.88	2.88	6.81	250
	J	2.00	2.25	2.625	.88	1.69	4.12	1.50-12	1.75-12	1.50-12	.50	1.38	2.00	3.00	6.94	250
6.00	K	2.50	3.00	3.125	1.00	2.06	4.12	1.88-12	2.25-12	1.88-12	.62	1.62	2.25	3.25	7.19	250
	L	3.00	3.50	3.750	1.00	2.62	5.38	2.25-12	2.75-12	2.25-12	.62	1.62	2.25	3.25	7.19	250
	D	.62	.75	1.125	.50	.88	3.00	75-16	88-14	.75-16	.25	.88	1.62	2.75	7.06	250
	F	1.00	1.12	1.500	.50	.88	3.00	100-14	125-12	100-14	.38	1.12	1.88	3.00	7.31	250
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	1.88	3.00	7.31	250
	J	2.00	2.25	2.625	.88	1.69	4.00	1.50-12	1.75-12	1.50-12	.38	1.25	2.00	3.12	7.44	250
6.00	K	2.50	3.00	3.125	1.00	2.06	5.25	1.88-12	2.25-12	1.88-12	.50	1.50	2.25	3.38	7.69	250
	L	3.00	3.50	3.750	1.00	2.62	5.25	2.25-12	2.75-12	2.25-12	.50	1.50	2.25	3.38	7.69	250
	M	3.50	3.50	4.250	1.00	3.00	6.25	2.50-12	3.25-12	2.50-12	.50	1.50	2.25	3.38	7.69	250
	N	4.00	4.00	4.750	1.00	3.38	6.25	3.00-12	3.75-12	3.00-12	.50	1.50	2.25	3.38	7.69	250

*Where RD is not shown, MF1 retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 6.00"
BORE
ME6
CAP FLANGE MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB +.005 - .000	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	4.69	5.50
4.00	4.50	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	3.32	5.44	6.25
5.00	5.50	1/2	.62	.562	1.75	1.25	.44	5.12	2.94	4.10	6.62	7.62
6.00	6.50	3/4	.75	.562	2.00	1.50	.44	5.75	3.19	4.88	7.62	8.62

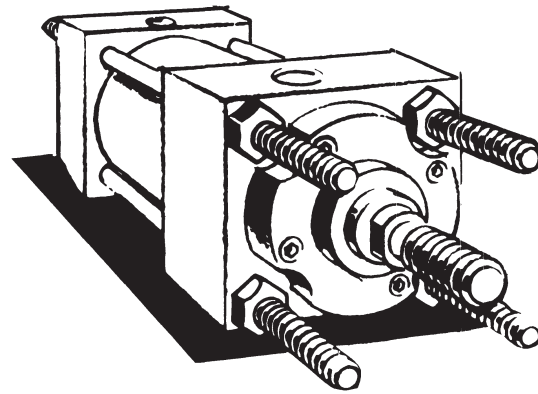
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -.001 -.003	C	D	RD*	T (THREAD)			V	W	Y	XK	ZJ	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	1.125	.38	.50	-	44-20	.50-20	.44-20	.25	.62	1.88	3.62	4.62	250
	F	1.00	1.12	1.500	.50	.88	-	.75-16	.88-14	.75-16	.50	1.00	2.25	4.00	5.00	250
2.00	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	.25	.62	1.88	3.62	4.62	250
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	4.00	5.00	250
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	4.25	5.25	250
2.50	D	.62	.75	1.125	.38	.50	2.38	44-20	.50-20	.44-20	.25	.62	1.88	3.75	4.75	250
	F	1.00	1.12	1.500	.50	.88	2.38	.75-16	.88-14	.75-16	.50	1.00	2.25	4.12	5.12	250
	G	1.38	1.62	2.000	.62	1.12	-	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	4.38	5.38	250
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	4.62	5.62	250
3.25	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	4.38	5.62	250
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.62	5.88	250
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	4.88	6.12	250
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.00	6.25	250
4.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	4.38	5.62	250
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.62	5.88	250
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	4.88	6.12	250
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.00	6.25	250
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	5.25	6.50	250
5.00	F	1.00	1.12	1.500	.50	.88	3.00	.75-16	.88-14	.75-16	.25	.75	2.38	4.62	5.88	250
	G	1.38	1.62	2.000	.62	1.12	3.00	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	4.88	6.12	250
	H	1.75	2.00	2.375	.75	1.50	-	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.12	6.38	250
	J	2.00	2.25	2.625	.88	1.69	-	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	5.25	6.50	250
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	5.50	6.75	250
6.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	.62	1.62	3.25	5.50	6.75	250
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	.50	1.50	3.38	5.75	7.25	250
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	5.75	7.25	250
	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	.25	.88	2.75	5.12	6.62	250
	H	1.75	2.00	2.375	.75	1.50	4.00	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	5.38	6.88	250

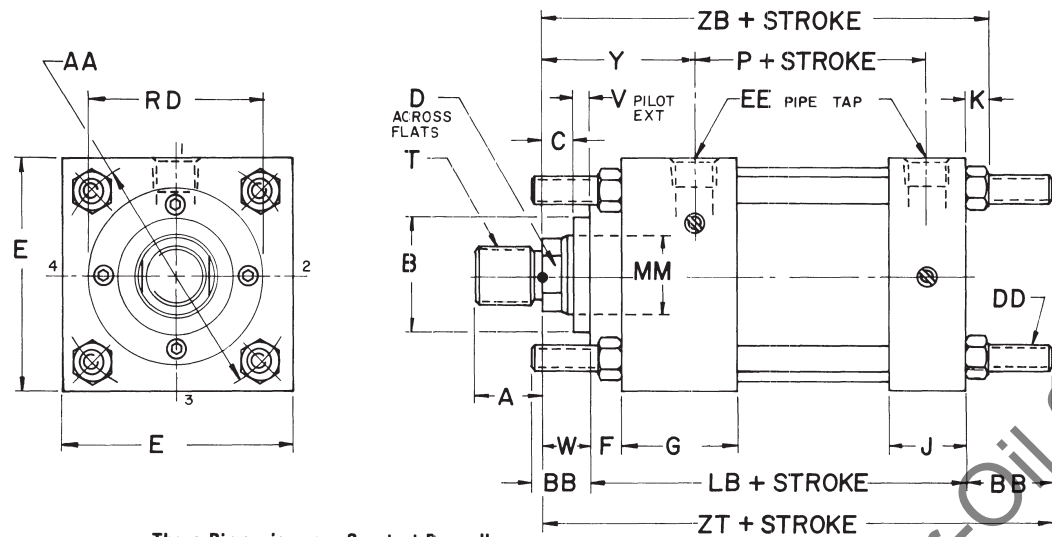
*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MX0, MX1, MX2, MX3, MX4
TIE ROD MOUNTS

NOTE: Specify Tie Rod Extension, "BB" dimension if other than standard.
MX0 = No Tie Rods Extended MX3 = 4 Tie Rods Extended Head End
MX1 = 4 Tie Rods Extended Both Ends MX4 = 2 Tie Rods Extended Both Ends
MX2 = 4 Tie Rods Extended Cap End



These Dimensions are Constant Regardless of Rod Diameter

BORE	AA	BB	DD	E	EE (NPTF)	F	G	J	K	LB	P
1.50	2.02	1.00	.25-28	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31
2.00	2.6	1.12	.31-24	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31
2.50	3.1	1.12	.31-24	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44
3.25	3.9	1.38	.38-24	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69
4.00	4.7	1.38	.38-24	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69
5.00	5.8	1.81	.50-20	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94
6.00	6.9	1.81	.50-20	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19
8.00	9.1	2.31	.62-18	8.50	3/4	.75	2.00	1.50	.56	5.88	3.31
10.00	11.2	2.69	.75-16	10.62	1	.75	2.25	2.00	.66	7.12	4.19
12.00	13.3	2.69	.75-16	12.75	1	.75	2.25	2.00	.66	7.62	4.69
14.00	15.4	3.19	.88-14	14.75	1 1/4	.75	2.75	2.25	.75	8.88	5.62

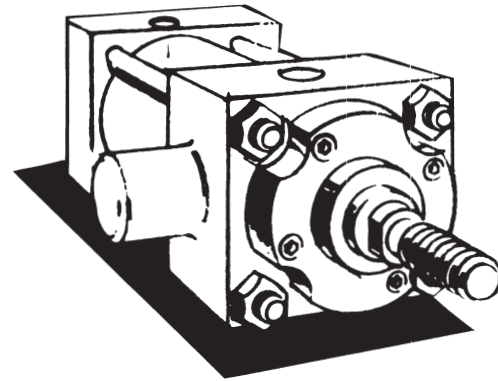
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

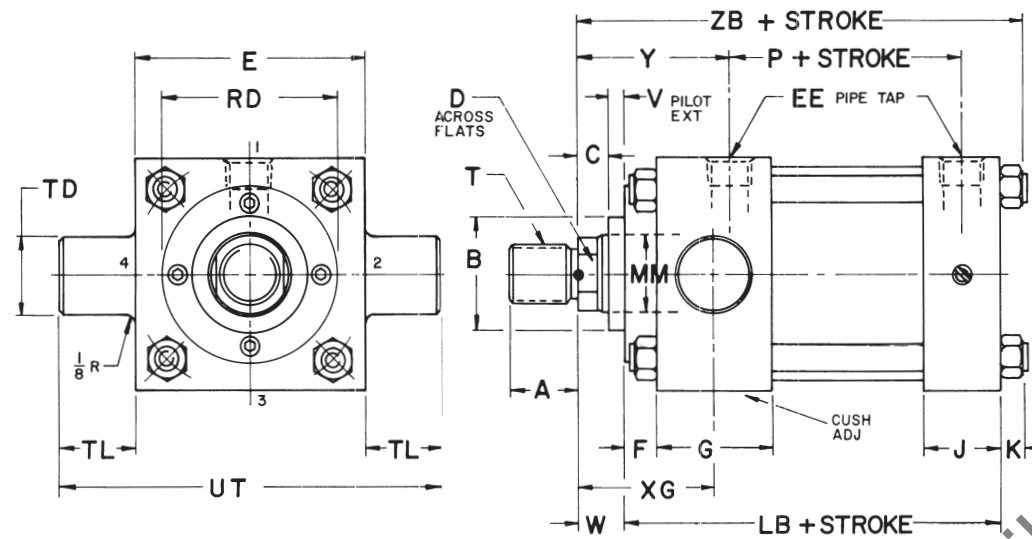
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	Y	ZB	ZT	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	4.88	5.62	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	5.31	6.12	2.38	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	4.94	5.75	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	5.31	6.12	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	5.56	6.38	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	5.06	5.88	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	5.44	6.25	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.50	5.69	6.50	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	2.75	5.94	6.75	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.00	7.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.25	7.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.50	7.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.62	7.62	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.00	7.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.25	7.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.50	7.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.62	7.62	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.31	7.69	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.62	6.56	7.94	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.88	6.81	8.19	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	3.00	6.94	8.31	--	250
6.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	3.25	7.19	8.56	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	3.25	7.19	8.56	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	3.25	7.19	8.56	--	250
	N	4.00	4.00	4.750	1.00	3.00	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	7.69	9.06	--	250
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.06	8.44	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	7.31	8.69	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	7.44	8.81	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	7.69	9.06	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	7.69	9.06	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	7.94	9.69	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.38	7.94	9.69	--	250
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.38	7.94	9.69	--	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.06	8.94	10.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.19	9.06	11.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.44	9.31	11.31	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.44	9.31	11.31	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	9.31	11.31	--	150
12.00	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.44	9.31	11.31	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.44	9.31	11.31	--	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.19	9.56	11.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.44	9.81	11.81	5.12	150
14.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.44	9.81	11.81	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	9.81	11.81	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.69	11.19	13.56	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.69	11.19	13.56	--	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MT1
HEAD TRUNNION MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 - .002	TL	UT
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	1.000	1.00	4.00
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	1.000	1.00	4.50
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	1.000	1.00	5.00
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	1.000	1.00	7.50
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	1.375	1.38	9.25
8.00	8.50	3/4	.75	2.00	1.50	.56	5.88	3.31	1.375	1.38	11.25
10.00	10.62	1	.75	2.25	2.00	.66	7.12	4.19	1.750	1.75	14.12
12.00	12.75	1	.75	2.25	2.00	.66	7.62	4.69	1.750	1.75	16.25
14.00	14.75	1 1/4	.75	2.75	2.25	.75	8.88	5.62	2.000	2.00	18.75

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

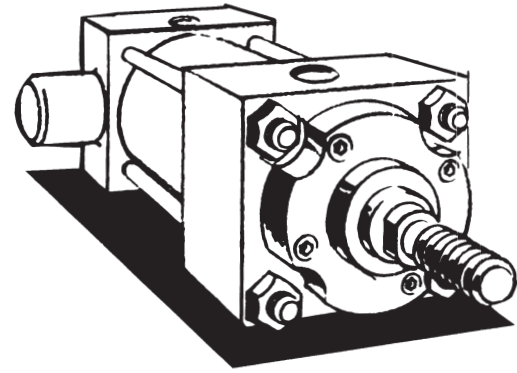
NOTE: Align and mount pillow blocks to avoid bending moments in Trunnions.

Dimensions are Affected by the Rod Diameter

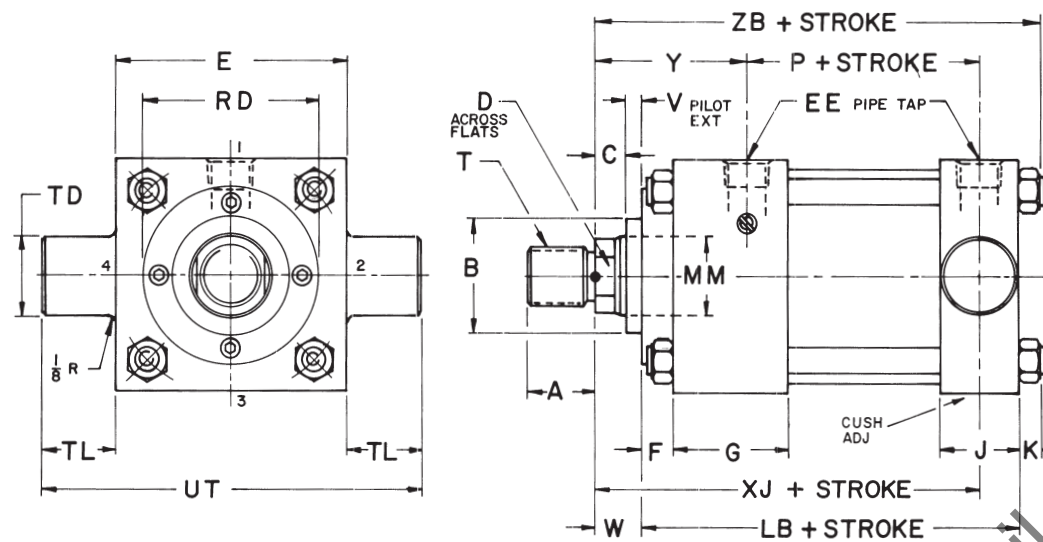
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XG	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.75	1.88	4.88	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.25	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.75	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.38	2.50	5.56	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.75	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.12	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	2.38	2.50	5.69	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	2.62	2.75	5.94	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.62	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.62	--	250
5.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	3.12	3.25	6.88	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.25	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	2.50	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	2.75	2.88	6.81	--	250
6.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	2.88	3.00	6.94	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	3.12	3.25	7.19	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	3.12	3.25	7.19	--	250
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	3.12	3.25	7.19	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.62	1.62	3.12	3.25	7.19	--	250
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.62	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	2.88	3.00	7.31	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.00	3.12	7.44	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.25	3.38	7.69	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.25	3.38	7.69	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.25	3.38	7.69	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.25	3.38	7.94	--	250
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.25	3.38	7.94	--	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	3.00	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	3.19	9.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	3.44	9.31	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	3.44	9.31	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	3.44	9.31	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.38	3.44	9.31	--	150
12.00	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.38	3.44	9.31	--	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	3.12	3.19	9.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	3.38	3.44	9.81	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	3.44	9.81	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	3.44	9.81	--	150
14.00	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.38	3.44	9.81	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.38	3.44	9.81	--	150
	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	3.62	3.69	11.19	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.62	3.69	11.19	5.12	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MT2
CAP TRUNNION MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 -.002	TL	UT
1.50	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	1.000	1.00	4.00
2.00	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	1.000	1.00	4.50
2.50	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	1.000	1.00	5.00
3.25	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	5.75
4.00	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	6.50
5.00	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	1.000	1.00	7.50
6.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	1.375	1.38	9.25
8.00	8.50	3/4	.75	2.00	1.50	.56	5.88	3.31	1.375	1.38	11.25
10.00	10.62	1	.75	2.25	2.00	.66	7.12	4.19	1.750	1.75	14.12
12.00	12.75	1	.75	2.25	2.00	.66	7.62	4.69	1.750	1.75	16.25
14.00	14.75	1 1/4	.75	2.75	2.25	.75	8.88	5.62	2.000	2.00	18.75

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

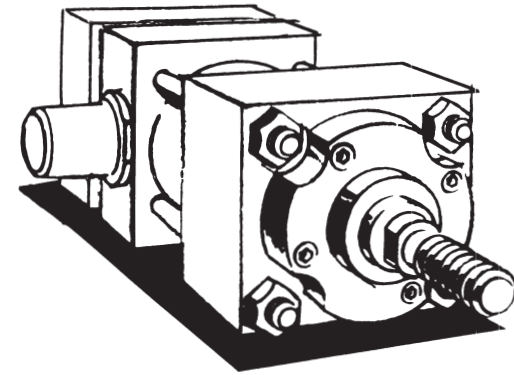
NOTE: Align and mount pillow blocks to avoid bending moments in Trunnions.

Dimensions are Affected by the Rod Diameter

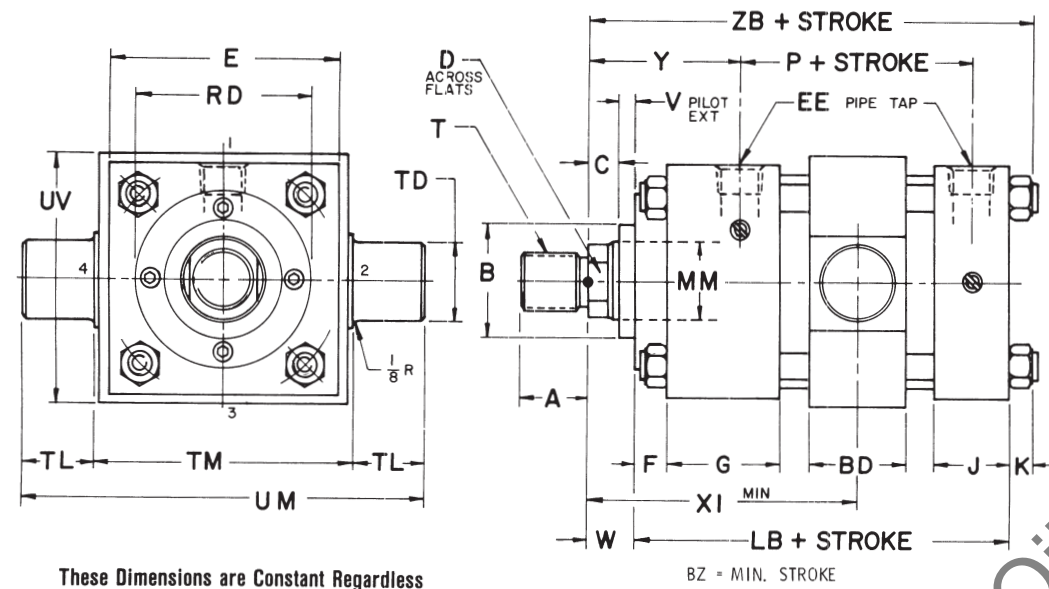
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XJ	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.12	1.88	4.88	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	4.50	2.25	5.25	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.12	1.88	4.94	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	4.50	2.25	5.31	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	4.75	2.50	5.56	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	4.25	1.88	5.06	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	4.62	2.25	5.44	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	4.88	2.50	5.69	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	5.12	2.75	5.94	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.00	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.25	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	5.50	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	5.62	3.00	6.62	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.00	2.38	6.00	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.25	2.62	6.25	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	5.50	2.88	6.50	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	5.62	3.00	6.62	--	250
K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.12	3.25	7.19	--	250	
	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	6.12	3.25	7.19	--	250	
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	5.25	2.38	6.31	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	5.50	2.62	6.56	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	5.75	2.88	6.81	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	5.88	3.00	6.94	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	6.12	3.25	7.19	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	6.12	3.25	7.19	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	6.12	3.25	7.19	--	250
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	5.88	2.75	7.06	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.12	3.00	7.31	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	6.25	3.12	7.44	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	6.50	3.38	7.69	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	6.50	3.38	7.69	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	6.50	3.38	7.69	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	6.50	3.38	7.69	--	250
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	6.00	2.75	7.31	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	6.25	3.00	7.56	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	6.38	3.12	7.69	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	6.62	3.38	7.94	5.12	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	6.62	3.38	7.94	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	6.62	3.38	7.94	--	250
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	6.62	3.38	7.94	--	250
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	6.62	3.38	7.94	--	250	
10.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	7.25	3.06	8.94	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	7.38	3.19	9.06	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	7.62	3.44	9.31	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	7.62	3.44	9.31	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	7.62	3.44	9.31	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	7.62	3.44	9.31	--	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	7.62	3.44	9.31	--	150	
12.00	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	7.88	3.19	9.56	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	8.12	3.44	9.81	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.12	3.44	9.81	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.12	3.44	9.81	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	8.12	3.44	9.81	--	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	8.12	3.44	9.81	--	150	
14.00	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	9.25	3.69	11.19	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	9.25	3.69	11.19	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	9.25	3.69	11.19	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	9.25	3.69	11.19	--	150
S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	9.25	3.69	11.19	--	150	

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MT4
INTERMEDIATE FIXED
TRUNNION MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	BD	BZ MIN. STROKE	E	EE (NPTF)	F	G	J	K	LB	P	TD +.000 - .002	TL	TM	UM	V	W	XI	Y	ZB	RD*	PSI RATING†	
1.50	1.25	.12	2.00	3/8	.38	1.50	1.00	.25	4.00	2.31	1.000	1.00	2.50	4.50	2.50							
2.00	1.50	.38	2.50	3/8	.38	1.50	1.00	.31	4.00	2.31	1.000	1.00	3.00	5.00	3.00							
2.50	1.50	.25	3.00	3/8	.38	1.50	1.00	.31	4.12	2.44	1.000	1.00	3.50	5.50	3.50							
3.25	2.00	.75	3.75	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	4.50	6.50	4.25							
4.00	2.00	.75	4.50	1/2	.62	1.75	1.25	.38	4.88	2.69	1.000	1.00	5.25	7.25	5.00							
5.00	2.00	.50	5.50	1/2	.62	1.75	1.25	.44	5.12	2.94	1.000	1.00	6.25	8.25	6.00							
6.00	2.00	1.00	6.50	3/4	.75	2.00	1.50	.44	5.75	3.19	1.375	1.38	7.62	10.38	7.00							
8.00	2.50	.88	8.50	3/4	.75	2.00	1.50	.56	5.88	3.31	1.375	1.38	9.75	12.50	9.50							
10.00	3.00	.88	10.62	1	.75	2.25	2.00	.66	7.12	4.19	1.750	1.75	12.00	15.50	11.75							
12.00	3.00	.38	12.75	1	.75	2.25	2.00	.66	7.62	4.69	1.750	1.75	14.00	17.50	13.75							
14.00	3.50	.38	14.75	1 1/4	.75	2.75	2.25	.75	8.88	5.62	2.000	2.00	16.25	20.25	16.00							

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

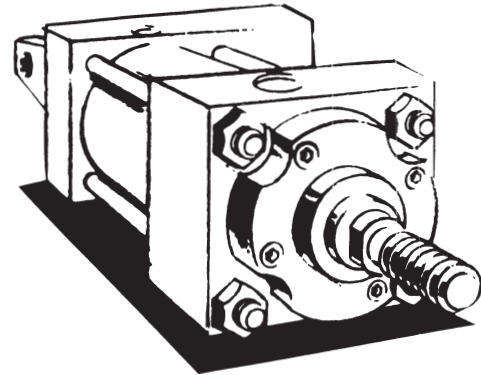
NOTE: Align and mount pillow blocks to avoid bending moments in Trunnions.

Dimensions are Affected by the Rod Diameter

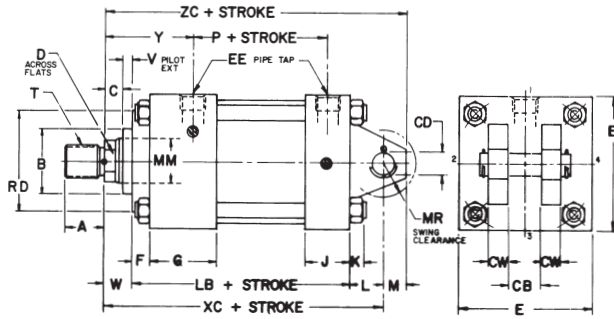
BORE	CYLINDER			A	B -.001 -.003	C	D	T (THREAD)			V	W	XI (MIN.)	Y	ZB	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF							
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	3.12	1.88	4.88	2.38	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	3.50	2.25	5.25	2.38	250	
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	3.25	1.88	4.94	2.38	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	3.62	2.25	5.31	2.38	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	3.88	2.50	5.56	--	250	
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	3.25	1.88	5.06	2.38	250	
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	3.62	2.25	5.44	2.38	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	3.88	2.50	5.69	--	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	4.12	2.75	5.94	--	250	
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	4.12	2.38	6.00	3.00	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	4.38	2.62	6.25	3.00	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	4.62	2.88	6.50	--	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	4.75	3.00	6.62	--	250	
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	4.12	2.38	6.00	3.00	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	4.38	2.62	6.25	3.00	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	4.62	2.88	6.50	--	250	
	K	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	4.75	3.00	6.62	--	250	
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	4.12	2.38	6.31	3.00	250	
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	4.38	2.62	6.56	3.00	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	4.62	2.88	6.81	--	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	4.75	3.00	6.94	--	250	
6.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	5.00	3.25	7.19	--	250	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	5.00	3.25	7.19	--	250	
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	5.00	3.25	7.19	--	250	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	5.50	3.38	7.69	--	250	
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	4.88	2.75	7.06	4.00	250	
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	5.12	3.00	7.31	4.00	250	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	5.25	3.12	7.44	4.00	250	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	5.50	3.38	7.69	--	250	
10.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	5.50	3.38	7.69	--	250	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	5.50	3.38	7.94	--	250	
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	5.50	3.38	7.94	--	250	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	5.50	3.38	7.94	--	250	
12.00	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	5.62	3.06	8.94	4.00	150	
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	5.75	3.19	9.06	4.00	150	
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	6.00	3.44	9.31	5.12	150	
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	6.00	3.44	9.31	--	150	
14.00	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	6.00	3.44	9.31	--	150	
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	6.00	3.44	9.31	--	150	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	6.00	3.44	9.31	--	150	
	K	2.50	3.00	3.125	1.00	2.12	1.88-12	2.25-12	1.88-12	.50	1.50	6.75	3.69	11.19	5.12	150	
15.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	6.75	3.69	11.19	--	150	
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	6.75	3.69	11.19	--	150	
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	6.75	3.69	11.19	--	150	
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	6.75	3.69	11.19	--	150	

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

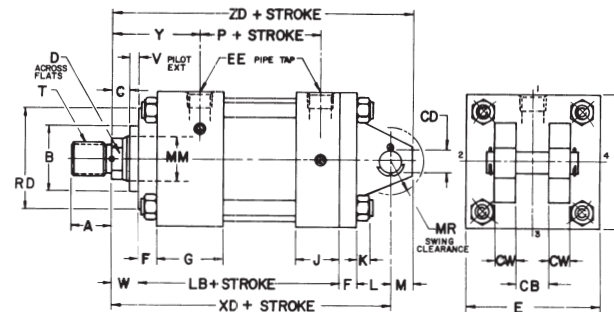
†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MP1 **MP2**
CAP FIXED **DETACHABLE CAP**
CLEVIS MOUNT **CLEVIS MOUNT**



MP1



MP2

(1.50" thru 6.00" only)

Pivot pin furnished with unit.

NOTE: 1.50", 2.00", and 3.25" BORES HAVE TAPPED CAP OR CLEVIS BRACKET.

These Dimensions are Constant Regardless of Rod Diameter

BORE	CB +.016 +.047	CD	CW	E	EE (NPTF)	F	G	J	K	L	LB	M	MR	P	BORE
1.50	.750	.500	.50	2.00	3/8	.38	1.50	1.00	.25	.75	4.00	.50	.62	2.31	1.50
2.00	.750	.500	.50	2.50	3/8	.38	1.50	1.00	.31	.75	4.00	.50	.62	2.31	2.00
2.50	.750	.500	.50	3.00	3/8	.38	1.50	1.00	.31	.75	4.12	.50	.62	2.44	2.50
3.25	1.250	.750	.62	3.75	1/2	.62	1.75	1.25	.38	1.25	4.88	.75	1.12	2.69	3.25
4.00	1.250	.750	.62	4.50	1/2	.62	1.75	1.25	.38	1.25	4.88	.75	1.12	2.69	4.00
5.00	1.250	.750	.62	5.50	1/2	.62	1.75	1.25	.44	1.25	5.12	.75	1.12	2.94	5.00
6.00	1.500	1.000	.75	6.50	3/4	.75	2.00	1.50	.44	1.50	5.75	1.00	1.38	3.19	6.00
8.00	1.500	1.000	.75	8.50	3/4	.75	2.00	1.50	.56	1.50	5.88	1.00	1.38	3.31	8.00
10.00	2.000	1.375	1.00	10.62	1	.75	2.25	2.00	.66	2.12	7.12	1.38	2.00	4.19	10.00
12.00	2.500	1.750	1.25	12.75	1	.75	2.25	2.00	.66	2.25	7.62	1.75	2.12	4.69	12.00
14.00	2.500	2.000	1.25	14.75	1 1/4	.75	2.75	2.25	.75	2.50	8.88	2.00	2.38	5.62	14.00

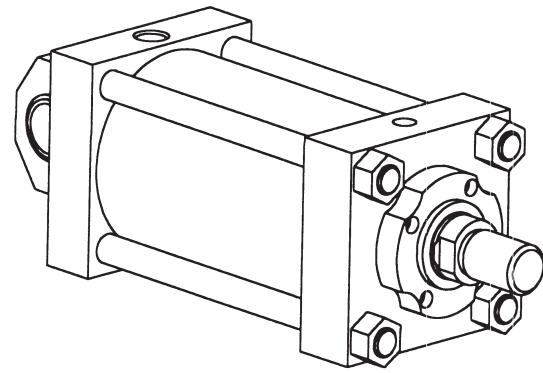
NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

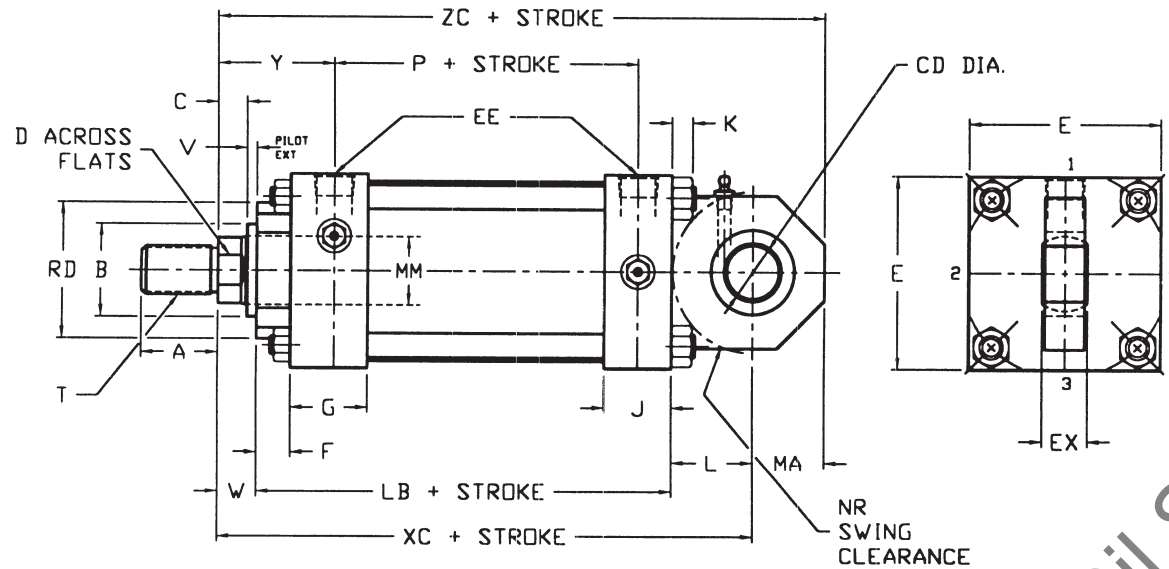
BORE	CYLINDER		A	B -.001 -.003	C	D	T (THREAD)			V	W	XC	XD	Y	ZC	ZD	RD*	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.					SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF									
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.38	5.75	1.88	5.88	6.25	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.75	6.12	2.25	6.25	6.62	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.38	5.75	1.88	5.88	6.25	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.75	6.12	2.25	6.25	6.62	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	6.00	6.38	2.50	6.50	6.88	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	5.50	5.88	1.88	6.00	6.38	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	5.88	6.25	2.25	6.38	6.75	2.38	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.62	1.25	6.12	6.50	2.50	6.62	7.00	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.75	1.50	6.38	6.75	2.75	6.88	7.25	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	6.88	7.50	2.38	7.62	8.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	7.12	7.75	2.62	7.88	8.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.38	8.00	2.88	8.12	8.75	--	250
	K	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.50	8.12	3.00	8.25	8.88	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	6.88	7.50	2.38	7.62	8.25	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	7.12	7.75	2.62	7.88	8.50	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.38	8.00	2.88	8.12	8.75	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.50	8.12	3.00	8.25	8.88	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	7.75	8.38	3.25	8.50	9.12	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	7.12	7.75	2.38	7.88	8.50	3.00	250
	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.38	1.00	7.38	8.00	2.62	8.12	8.75	3.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.50	1.25	7.62	8.25	2.88	8.38	9.00	--	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.50	1.38	7.75	8.38	3.00	8.50	9.12	--	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	8.00	8.62	3.25	8.75	9.38	--	250
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	8.12	8.88	2.75	9.12	9.88	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.38	9.12	3.00	9.38	10.12	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	8.50	9.25	3.12	9.50	10.25	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	8.75	9.50	3.38	9.75	10.50	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.75	9.50	3.38	9.75	10.50	--	250
	M	3.50	4.00	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.50	1.50	8.75	9.50	3.38	9.75	10.50	--	250
	N	4.00	4.50	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.75	9.50	3.38	9.75	10.50	--	250
	N	4.00	4.50	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.75	9.50	3.38	9.75	10.50	--	250
8.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	8.25	--	2.75	9.25	--	4.00	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	8.50	--	3.00	9.50	--	4.00	250
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	8.62	--	3.12	9.62	--	4.00	250
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	8.88	--	3.38	9.88	--	5.12	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	8.88	--	3.38	9.88	--	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	8.88	--	3.38	9.88	--	--	250
10.00	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	8.88	--	3.38	9.88	--	--	250
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	8.88	--	3.38	9.88	--	--	250
	H	1.75	2.00	2.375	.75	1.50	1.25-12	1.50-12	1.25-12	.38	1.12	10.38	--	3.06	11.75	--	4.00	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	10.50	--	3.19	11.88	--	4.00	150
	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	10.75	--	3.44	12.12	--	5.12	150
12.00	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	10.75	--	3.44	12.12	--	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	10.75	--	3.44	12.12	--	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	10.75	--	3.44	12.12	--	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	10.75	--	3.44	12.12	--	--	150
	J	2.00	2.25	2.625	.88	1.69	1.50-12	1.75-12	1.50-12	.38	1.25	11.12	--	3.19	12.88	--	4.00	150
14.00	K	2.50	3.00	3.125	1.00	2.06	1.88-12	2.25-12	1.88-12	.50	1.50	11.38	--	3.44	13.12	--	5.12	150
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	11.38	--	3.44	13.12	--	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	11.38	--	3.44	13.12	--	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	11.38	--	3.44	13.12	--	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	11.38	--	3.44	13.12	--	--	150

*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.



SERIES "3A"
PNEUMATIC CYLINDERS
1.50" - 14.00"
BORE
MPU3
SPHERICAL BEARING MOUNT



These Dimensions are Constant Regardless of Rod Diameter

BORE	CD -0.0005	E	EE NPTF	EX	F	G	J	K	L	LB	MA	NR	P
1.50	0.5000	2.00	3/8	0.44	0.38	1.50	1.00	0.25	0.75	4.00	0.75	0.62	2.31
2.00	0.5000	2.50	3/8	0.44	0.38	1.50	1.00	0.31	0.75	4.00	0.75	0.62	2.31
2.50	0.5000	3.00	3/8	0.44	0.38	1.50	1.00	0.31	0.75	4.12	0.75	0.62	2.44
3.25	0.7500	3.75	1/2	0.66	0.62	1.75	1.25	0.38	1.25	4.88	1.25	1.00	2.69
4.00	0.7500	4.50	1/2	0.66	0.62	1.75	1.25	0.38	1.25	4.88	1.25	1.00	2.69
5.00	0.7500	5.50	1/2	0.66	0.62	1.75	1.25	0.44	1.25	5.12	1.25	1.00	2.94
6.00	1.0000	6.50	3/4	0.88	0.75	2.00	1.50	0.44	1.50	5.75	1.50	1.25	3.19
8.00	1.0000	8.50	3/4	0.88	0.75	2.00	1.50	0.56	1.50	5.88	1.50	1.25	3.31
10.00	1.3750	10.62	1	1.19	0.75	2.25	2.00	0.66	2.12	7.12	1.88	1.62	4.19
12.00	1.7500	12.75	1	1.53	0.75	2.25	2.00	0.66	2.25	7.62	2.25	2.06	4.69
14.00	2.0000	14.75	1-1/4	1.75	0.75	2.75	2.25	0.75	2.50	8.88	2.50	2.38	5.62

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	CYLINDER		A	B -0.001 -0.003	C	D	RD*	T(THREAD)			V	W	XC	Y	ZC	PSI RATING†
	ROD DIA. CODE	MM ROD DIA.						SMALL MALE SM	INTER- MEDIATE MALE M	SHORT FEMALE SF						
1.50	D	0.62	0.75	1.125	0.38	0.50	-	.44-20	.50-20	.44-20	0.25	0.62	5.38	1.88	6.12	250
	F	1.00	1.12	1.500	0.50	0.88	-	.75-16	.88-14	.75-16	0.50	1.00	5.75	2.25	6.50	250
2.00	D	0.62	0.75	1.125	0.38	0.50	2.38	.44-20	.50-20	.44-20	0.25	0.62	5.38	1.88	6.12	250
	F	1.00	1.12	1.500	0.50	0.88	2.38	.75-16	.88-14	.75-16	0.50	1.00	5.75	2.25	6.50	250
	G	1.38	1.62	2.000	0.62	1.12	-	1.00-14	1.25-12	1.00-14	0.62	1.25	6.00	2.50	6.75	250
2.50	D	0.62	0.75	1.125	0.38	0.50	2.38	.44-20	.50-20	.44-20	0.25	0.62	5.38	1.88	6.25	250
	F	1.00	1.12	1.500	0.50	0.88	2.38	.75-16	.88-14	.75-16	0.50	1.00	5.88	2.25	6.62	250
	G	1.38	1.62	2.000	0.62	1.12	-	1.00-14	1.25-12	1.00-14	0.62	1.25	6.12	2.50	6.88	250
	H	1.75	2.00	2.375	0.75	1.50	-	1.25-12	1.50-12	1.25-12	0.75	1.50	6.38	2.75	7.12	250
3.25	F	1.00	1.12	1.500	0.50	0.88	3.00	.75-16	.88-14	.75-16	0.25	0.75	6.88	2.38	8.12	250
	G	1.38	1.62	2.000	0.62	1.12	3.00	1.00-14	1.25-12	1.00-14	0.38	1.00	7.12	2.62	8.38	250
	H	1.75	2.00	2.375	0.75	1.50	-	1.25-12	1.50-12	1.25-12	0.50	1.25	7.38	2.88	8.62	250
4.00	H	1.75	2.00	2.375	0.75	1.50	-	1.25-12	1.50-12	1.25-12	0.50	1.25	7.38	2.88	8.62	250
	J	2.00	2.25	2.625	0.88	1.69	-	1.50-12	1.75-12	1.50-12	0.50	1.38	7.50	3.00	8.75	250
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	0.62	1.62	7.75	3.25	9.00	250
5.00	F	1.00	1.12	1.500	0.50	0.88	3.00	.75-16	.88-14	.75-16	0.25	0.75	7.12	2.38	8.38	250
	G	1.38	1.62	2.000	0.62	1.12	3.00	1.00-14	1.25-12	1.00-14	0.38	1.00	7.38	2.62	8.62	250
	H	1.75	2.00	2.375	0.75	1.50	-	1.25-12	1.50-12	1.25-12	0.50	1.25	7.62	2.88	8.88	250
	J	2.00	2.25	2.625	0.88	1.69	-	1.50-12	1.75-12	1.50-12	0.50	1.38	7.75	3.00	9.00	250
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	0.62	1.62	8.00	3.25	9.25	250
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	0.62	1.62	8.00	3.25	9.25	250
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	0.62	1.62	8.00	3.25	9.25	250
6.00	G	1.38	1.62	2.000	0.62	1.12	4.00	1.00-14	1.25-12	1.00-12	0.25	0.88	8.12	2.75	9.62	250
	H	1.75	2.00	2.375	0.75	1.50	4.00	1.25-12	1.50-12	1.25-12	0.38	1.12	8.38	3.00	9.88	250
	J	2.00	2.25	2.625	0.88	1.69	4.00	1.50-12	1.75-12	1.50-12	0.38	1.25	8.50	3.12	10.00	250
	K	2.50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	0.50	1.50	8.75	3.38	10.25	250
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	0.50	1.50	8.75	3.38	10.25	250
	M	3.50	3.50	4.250	1.00	3.00	-	2.50-12	3.25-12	2.50-12	0.50	1.50	8.75	3.38	10.25	250
8.00	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	0.50	1.50	8.75	3.38	10.25	250
	G	1.38	1.62	2.000	0.62	1.12	4.00	1.00-14	1.25-12	1.00-14	0.25	0.88	8.25	2.75	9.75	250
	H	1.75	2.00	2.375	0.75	1.50	4.00	1.25-12	1.50-12	1.25-12	0.38	1.12	8.50	3.00	10.00	250
	J	2.00	2.25	2.625	0.88	1.69	4.00	1.50-12	1.75-12	1.50-12	0.38	1.25	8.62	3.12	10.12	250
	K	2.50	3.00	3.125	1.00	2.06	5.12	1.88-12	2.25-12	1.88-12	0.50	1.50	8.88	3.38	10.38	250
10.00	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	0.50	1.50	8.88	3.38	10.38	250
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	0.50	1.50	8.88	3.38	10.38	250
	R	5.00	5.00	5.750	1.00	4.25	-	3.50-12	4.75-12	3.50-12	0.50	1.50	8.88	3.38	10.38	250
	S	5.50	5.50	6.250	1.00	4.62	-	4.00-12	5.25-12	4.00-12	0.50	1.50	8.88	3.38	10.38	250
	12.00	J	2.00	2.25	2.625	0.88	1.69	4.00	1.50-12	1.75-12	1.50-12	0.38	1.25	11.12	3.19	13.38
K		2.50	3.00	3.125	1.00	2.06	5.12	1.88-12	2.25-12	1.88-12	0.50	1.50	11.38	3.44	13.62	150
L		3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	0.50	1.50	11.38	3.44	13.62	150
N		4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	0.50	1.50	11.38	3.44	13.62	150
S		5.00	5.00	5.750	1.00	4.25	-	3.50-12	4.75-12	3.50-12	0.50	1.50	11.38	3.44	13.62	150
14.00	S	5.50	5.50	6.250	1.00	4.62	-	4.00-12	5.25-12	4.00-12	0.50	1.50	11.38	3.44	13.62	150
	K	2.50	3.00	3.125	1.00	2.12	5.12	1.88-12	2.25-12	1.88-12	0.50	1.50	12.88	3.69	15.38	150
	L	3.00	3.50	3.750	1.00	2.62	-	2.25-12	2.75-12	2.25-12	0.50	1.50	12.88	3.69	15.38	150
	N	4.00	4.00	4.750	1.00	3.38	-	3.00-12	3.75-12	3.00-12	0.50	1.50	12.88	3.69	15.38	150
14.00	R	5.00	5.00	5.750	1.00	4.25	-	3.50-12	4.75-12	3.50-12	0.50	1.50	12.88	3.69	15.38	150
	S	5.50	5.50	6.250	1.00	4.62	-	4.00-12	5.25-12	4.00-12	0.50	1.50	12.88	3.69	15.38	150

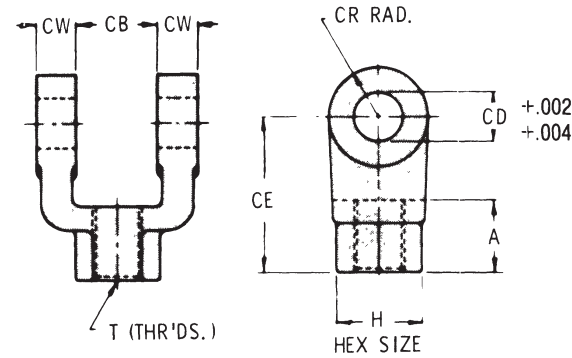
*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†CAUTION: P.S.I. Ratings shown are HANNA recommended maximum operating pressures. Check Stroke Limitation Data section which may reduce maximum operating pressure. Check Stop Tube Data section to determine if stop tube is required.

These are standard accessories matched to bore size and piston rod code. The Mounting Bracket fits the cap end of Model MP1. The Bracket also fits the piston Rod Clevis with the same number (i.e. B-7 Bracket fits V-7 Rod Clevis). The pin is furnished with Model MP1 and fits the bracket, however, specify if additional pins are required. Pins also fit rod clevis and rod eyes. If you require accessories other than standard for that bore size or piston rod, specify the item number on your order.

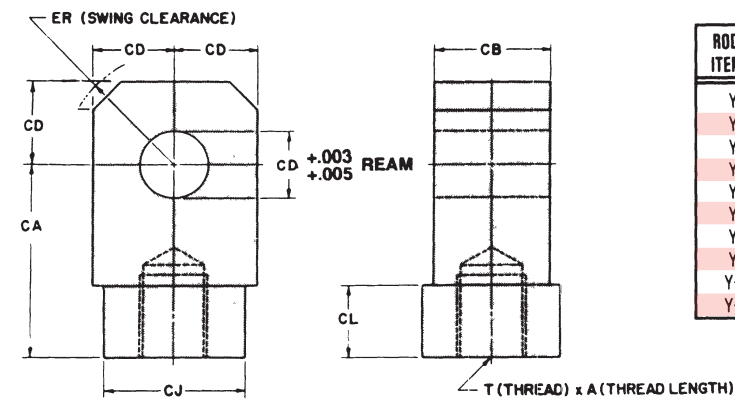
***CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

Rod Clevis



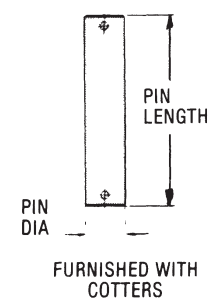
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-1	D	.75	.75	.50	1.50	.62	.50	1.00	.44-20	5,360
V-2	F	1.12	1.25	.75	2.38	.88	.62	1.25	.75-16	14,000
V-3	G	1.62	1.50	1.00	3.12	1.12	.75	1.75	1.00-14	22,500
V-4	H	2.00	2.00	1.37	4.12	1.62	1.00	2.00	1.25-12	41,250
V-5	J	2.25	2.50	1.75	4.50	2.00	1.25	2.75	1.50-12	57,000
V-6	K	3.00	2.50	2.00	5.50	2.25	1.25	3.00	1.88-12	75,000
V-7	L	3.50	3.00	2.50	6.50	2.88	1.50	3.50	2.25-12	112,500
V-8	M	3.50	3.00	3.00	6.75	3.12	1.50	3.88	2.50-12	135,000
V-10	P	4.50	4.00	3.50	8.50	3.88	2.00	5.00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4.38	2.25	6.19	4.00-12	270,000

Rod Eye



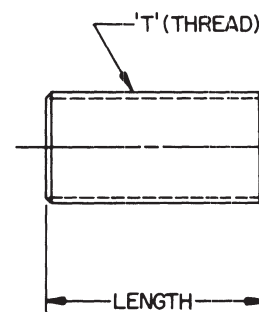
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-1	D	.75	1.50	.75	.50	-	-	.75	44-20	5,060
Y-2	F	1.12	2.06	1.25	.75	-	-	1.12	.75-16	12,500
Y-3	G	1.62	2.81	1.50	1.00	-	-	1.44	1.00-14	20,250
Y-4	H	2.00	3.44	2.00	1.37	-	-	2.00	1.25-12	37,000
Y-5	J	2.25	4.00	2.50	1.75	-	-	2.50	1.50-12	59,000
Y-6	K	3.00	5.00	2.50	2.00	3.25	2.50	2.88	1.88-12	67,500
Y-7	L	3.50	5.81	3.00	2.50	4.00	2.81	3.56	2.25-12	101,250
Y-8	M	3.50	6.12	3.00	3.00	5.00	2.50	4.25	2.50-12	121,500
Y-10	P	4.50	7.62	4.00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5.50	9.12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

Pin



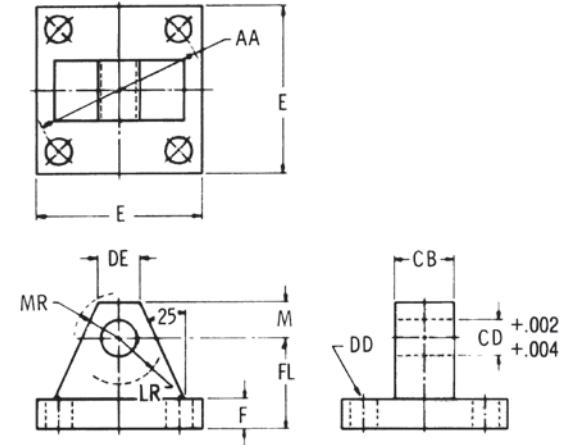
PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P1	2.28	.50	6,125
P2	3.09	.75	13,800
P3	3.60	1.00	24,500
P4	4.66	1.37	46,500
P5	5.66	1.75	75,150
P6	5.72	2.00	98,150
P7	6.94	2.50	153,400
P8	7.19	3.00	220,900
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

Piston Rod Stud



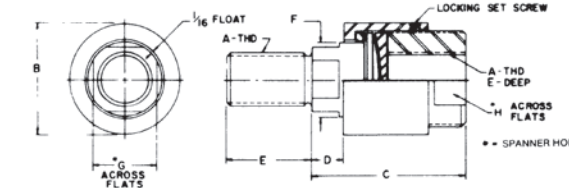
ITEM NO.	T	LENGTH
Stud 1	44-20	1.50
Stud 2	75-16	2.25
Stud 3	1 00-14	3.25
Stud 4	1 25-12	4.00
Stud 5	1 50-12	4.50

Brackets



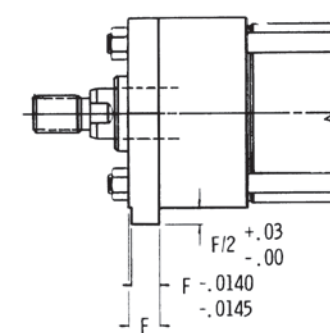
BORE DIA.	BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
1.50, 2.00 2.50	B-1	2.30	.75	.500	.44	.56	2.50	.38	1.12	.62	.50	.62	2,500
3.25, 4.00 5.00	B-2	3.60	1.25	.750	.56	.88	3.50	.62	1.88	.88	.75	.88	6,300
6.00 8.00	B-3	4.60	1.50	1.000	.69	1.38	4.50	.75	2.25	1.25	1.00	1.25	10,000
10.00	B-4	5.40	2.00	1.375	.69	1.75	5.00	.88	3.00	1.75	1.38	1.75	19,250
12.00	B-5	7.00	2.50	1.750	.94	2.25	6.50	.88	3.12	2.12	1.75	2.12	21,200
14.00	B-6	8.10	2.50	2.000	1.06	2.56	7.50	1.00	3.50	2.38	2.00	2.38	24,500
—	B-7	9.30	3.00	2.500	1.19	3.12	8.50	1.00	4.00	2.94	2.50	2.94	25,000
—	B-8	10.60	3.00	3.000	1.31	3.25	9.50	1.00	4.25	3.19	2.75	3.19	22,500
—	B-10	13.60	4.00	3.500	1.81	—	12.62	1.69	7.25	3.62	3.50	3.62	58,500
—	B-12	16.19	4.50	4.000	2.06	—	14.88	1.94	7.75	4.12	4.00	4.12	73,250

Linear Alignment Coupler



PART NO.	A	B	C	D	E	F	G	H	MAX. PULL LOAD
S-1	7/16 - 20	1-1/4	2	1/2	3/4	5/8	1/2	13/16	2,535
S-2	3/4 - 16	1-3/4	2-5/16	1/2	1-1/8	31/32	13/16	1-1/8	8,750
S-3	1 - 14	2-1/2	2-15/16	17/32	1-5/8	1-11/32	1-5/32	1-5/8	16,125
S-4	1-1/4 - 12	2-1/2	2-15/16	17/32	1-5/8	1-11/32	1-5/32	1-5/8	19,600
S-5	1-1/2 - 12	3-1/4	4-3/8	7/8	2-1/4	1-31/32	1-3/4	2-3/8	34,000
S-6	1-7/8 - 12	3-3/4	5-5/8	1	3	2-15/32	—	—	41,250

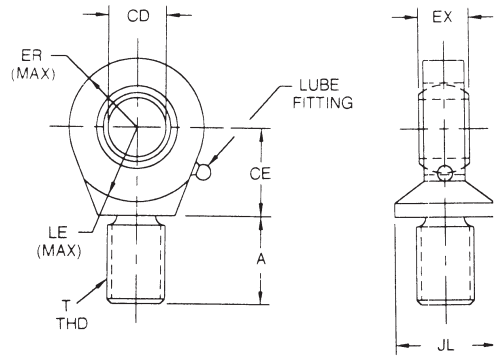
Thrust Key



Thrust keys are available on most side type mountings. Please refer to model dimension charts for F dimensions. A thrust key eliminates the need for fitted bolts or external keys. It adds extra rigidity to your cylinder mounting when the key is fitted to a keyway milled into your mounting surface.

Spherical Rod Eyes

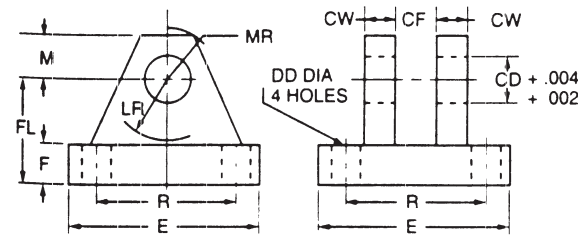
Order to fit Piston Rod thread size.



ROD EYE ITEM NO.	CD -0.0005	A	CE	EX	ER	LE	T	JL	*LBS. CAPACITY
SBY-1	0.5000	.69	.88	.44	.88	.75	44-20	.88	2,644
SBY-2	0.7500	1.00	1.25	.66	1.25	1.06	75-16	1.31	9,441
SBY-3	1.0000	1.50	1.88	.88	1.38	1.44	1.00-14	1.50	16,860
SBY-4	1.3750	2.00	2.13	1.19	1.81	1.88	1.25-12	2.00	28,562
SBY-5	1.7500	2.13	2.50	1.53	2.19	2.13	1.50-12	2.25	43,005
SBY-6	2.0000	2.88	2.75	1.75	2.63	2.50	1.88-12	2.75	70,193

Spherical Clevis Brackets

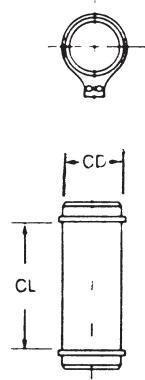
Order to fit Mounting Plate or Rod Eye.



BRACKET ITEM	E	F	M	R	CD	CF	CW	DD	FL	LR	MR	*LBS. CAPACITY
SBB-1	3.00	.50	.50	2.05	0.500	.44	.50	.41	1.50	.94	.62	5,770
SBB-2	3.75	.62	.88	2.76	0.750	.66	.62	.53	2.00	1.38	1.00	9,450
SBB-3	5.50	.75	1.00	4.10	1.000	.88	.75	.53	2.50	1.69	1.19	14,300
SBB-4	6.50	.88	1.38	4.95	1.375	1.19	1.00	.66	3.50	2.44	1.62	20,322
SBB-5	8.50	1.25	1.75	6.58	1.750	1.53	1.25	.91	4.50	2.88	2.06	37,800
SBB-6	10.62	1.50	2.00	7.92	2.000	1.75	1.50	.91	5.00	3.31	2.38	50,375

Pivot Pins

Pivot Pins are furnished with two retainer rings.



PIN ITEM NO.	CD	CL	*LBS. CAPACITY
SBP-1	.4997-.0004	1.56	8,600
SBP-2	.7497-.0005	2.03	19,300
SBP-3	.9997-.0005	2.50	34,300
SBP-4	1.3746-.0006	3.31	65,000
SBP-5	1.7496-.0006	4.22	105,200
SBP-6	1.9996-.0007	4.94	137,400

*CAUTION

Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

DESCRIPTION

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Cylinder Cushions.....	172

PIPE PORT SIZE & LOCATION

Numbers 1, 2, 3 and 4 around end view of cylinder drawings are for describing optional pipe port locations. Position 1 is standard. In many cases ports can be positioned at 2, 3 or 4 by rotating the heads at assembly. In other cases where it is undesirable to rotate the heads because of corresponding rotation of cylinder mountings, additional ports can usually be placed at positions 2, 3 or 4. Orders or inquiries should state port locations for rod and cap end heads, if other than standard. When changing port locations, careful attention should be paid to clearance between pipes, cylinder mountings, and the heads of any mounting screws.

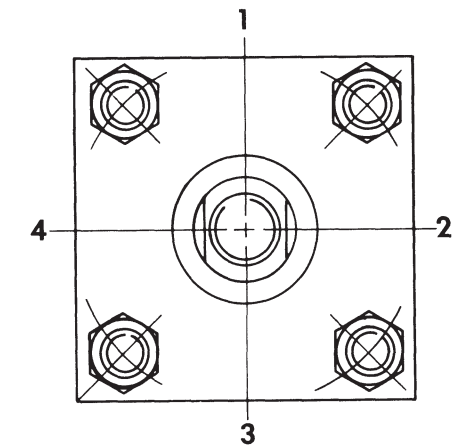
Standard N. P. T. dryseal ports will be supplied at position 1. Orders should state pipe port locations if other than standard. S. A. E. straight thread ports and bossed ports are available. Refer to the charts below to select the appropriate port.

SERIES "3A" OPTIONAL PORTING

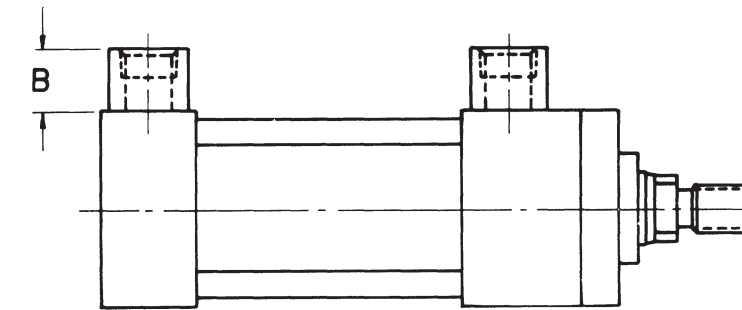
BORE	STANDARD NPT PORT	OVERSIZE BOSSSED NPT*	DIM B	STANDARD SAE PORT	OVERSIZE* BOSSSED SAE
1.50	3/8	1/2	15/16	9/16-18	7/8-14
2.00	3/8	1/2	15/16	9/16-18	7/8-14
2.50	3/8	1/2	15/16	9/16-18	7/8-14
3.25	1/2	3/4	15/16	7/8-14	1 1/16-12
4.00	1/2	3/4	15/16	7/8-14	1 1/16-12
5.00	1/2	3/4	15/16	7/8-14	1 1/16-12
6.00	3/4	1	1-1/8		1 5/16-12
8.00	3/4	1	1-1/8	1 1/16-12	1 5/16-12
10.00	1	1-1/4	1-1/4	1 5/16-12	1 5/8-12
12.00	1	1-1/4	1-1/4	1 5/16-12	1 5/8-12
14.00	1-1/4	1-1/2	1-1/2	1 5/8-12	1 7/8-12

*Available at Position #5, rear face blind end

PIPE PORT NUMBERING AND POSITIONING

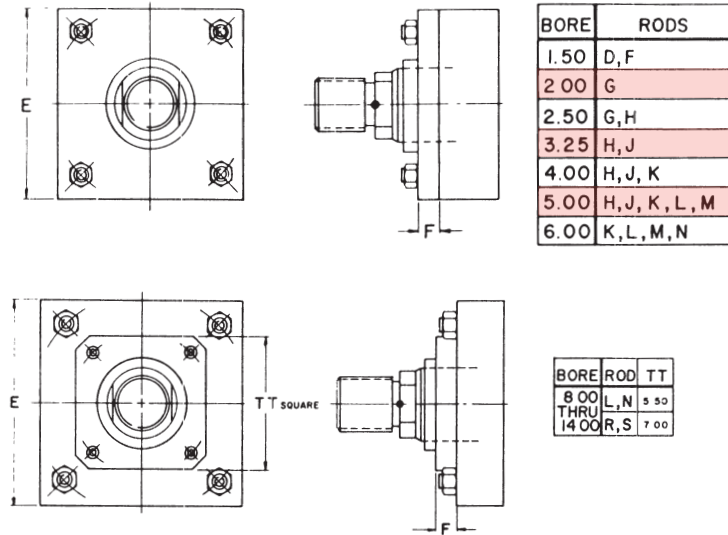


Position location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End.

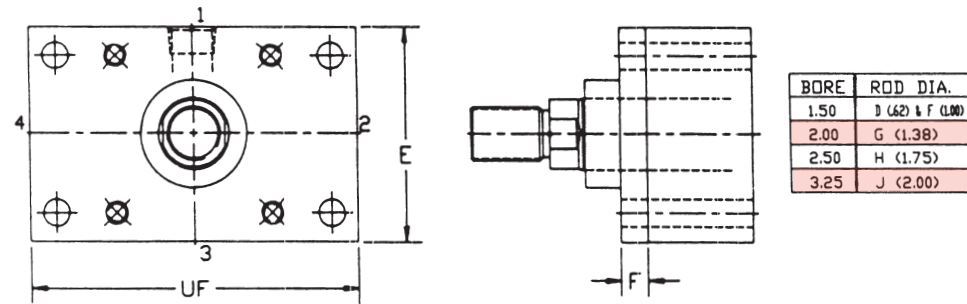


RETAINER PLATE CONSTRUCTION

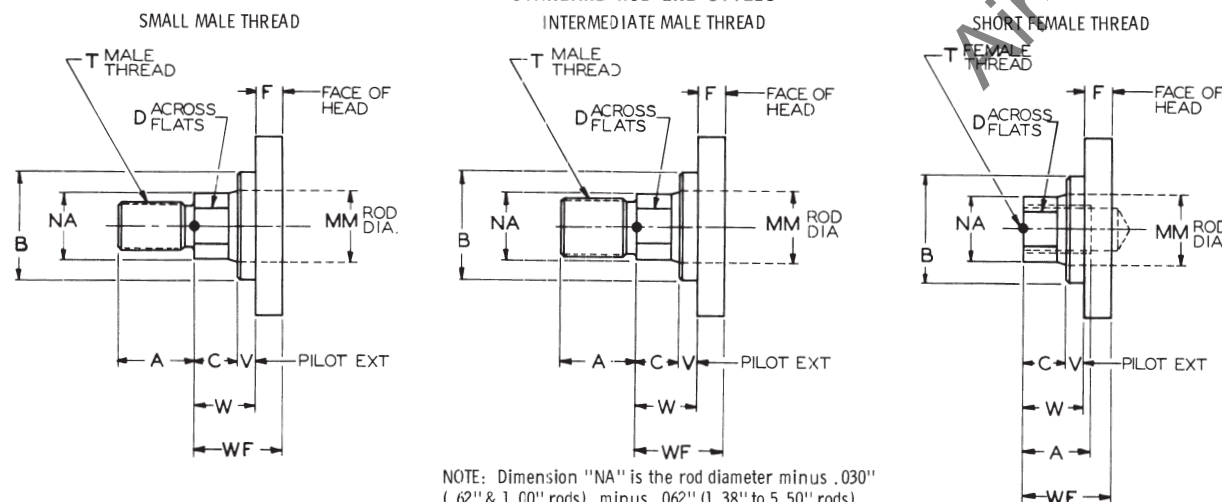
SQUARE RETAINER CONSTRUCTION



ME5 RETAINER CONSTRUCTION



STANDARD ROD END STYLES



NOTE: Dimension "NA" is the rod diameter minus .030" (.62" & 1.00" rods), minus .062" (1.38" to 5.50" rods).

For actual dimensions, see mounting style page desired.

ROD END STYLES SERIES "3A"

FORCE CHART

1.50" THROUGH 14.00" CYLINDER CAPACITY

NOTE: Cylinder ratings may be lower than pressures shown in force charts. Consult mounting page, stroke limitation data and any accessory capacities if used to determine maximum permissible operating pressure.

CYL BORE DIA	ROD CODE	PISTON ROD DIA	CYL WORK ACTION	WORK AREA SQ. IN	PNEUMATIC PRESSURE					FLUID REQUIRED PER INCH OF STROKE CU FT
					50	70	90	100	150	
1.50	PDQ	D .62	PUSH	1.77	89	124	160	177	266	.00102
		F 1.00		1.46	73	102	131	146	219	.00084
2.00	PDQ	D .62	PUSH	3.14	157	220	283	314	471	.00182
		F 1.00		2.83	142	198	255	283	424	.00164
		G 1.38		2.36	118	165	212	236	354	.00136
2.50	PDQ	D .62	PUSH	4.91	245	344	442	491	736	.00284
		F 1.00		4.60	230	322	414	460	690	.00266
		G 1.38		4.13	206	289	372	413	620	.00239
		H 1.75		3.43	172	240	309	343	515	.00198
3.25	PDQ	F 1.00	PUSH	8.29	414	580	746	829	1244	.00480
		G 1.38		7.51	375	525	676	751	1126	.00435
		H 1.75		6.81	340	477	613	681	1022	.00394
		J 2.00		5.88	294	412	529	588	882	.00341
4.00	PDQ	F 1.00	PUSH	12.57	628	880	1131	1257	1886	.00727
		G 1.38		11.78	589	825	1060	1178	1767	.00682
		H 1.75		11.08	554	776	997	1108	1662	.00641
		J 2.00		10.15	508	710	914	1015	1522	.00588
		K 2.50		9.43	472	660	849	943	1416	.00545
5.00	PDQ	F 1.00	PUSH	19.64	982	1375	1768	1964	2946	.01136
		G 1.38		18.85	942	1319	1696	1885	2827	.01091
		H 1.75		18.15	908	1270	1633	1815	2722	.01050
		J 2.00		17.22	861	1205	1550	1722	2583	.00997
		K 2.50		16.50	825	1155	1485	1650	2475	.00954
		L 3.00		14.73	737	1031	1326	1473	2210	.00852
6.00	PDQ	L 3.00	PUSH	12.57	628	880	1131	1257	1886	.00727
		M 3.50		10.02	501	701	902	1002	1503	.00580
		G 1.38		28.27	1413	1979	2544	2827	4240	.01636
		H 1.75		26.79	1339	1875	2411	2679	4018	.01550
		J 2.00		25.86	1293	1810	2327	2586	3879	.01497
		K 2.50		25.13	1256	1759	2262	2513	3770	.01454
		L 3.00		23.36	1168	1635	2102	2336	3504	.01352
8.00	PDQ	L 3.00	PUSH	21.20	1060	1484	1908	2120	3180	.01227
		M 3.50		18.65	933	1306	1678	1865	2798	.01079
		G 1.38		50.26	2513	3518	4523	5026	7539	.02909
		H 1.75		48.78	2439	3415	4390	4878	7317	.02823
		J 2.00		47.85	2392	3350	4306	4785	7178	.02770
		K 2.50		47.12	2356	3298	4241	4712	7068	.02727
		L 3.00		43.35	2268	3174	4082	4535	6804	.02625
		N 4.00		43.19	2160	3023	3887	4319	6478	.02500
10.00	PDQ	N 4.00	PUSH	37.69	1884	2638	3392	3769	5655	.02182
		R 5.00		30.62	1531	2143	2756	3062	4593	.01773
		S 5.50		26.50	1325	1855	2385	2650	3975	.01534
		H 1.75		78.54	3927	5498	7069	7854	11781	.04545
		J 2.00		76.13	3806	5329	6852	7613	11420	.04406
		K 2.50		75.40	3770	5279	6787	7540	11310	.04363
		L 3.00		73.63	3681	5154	6627	7363	11044	.04261
		N 4.00		71.47	3573	5003	6432	7147	10720	.04136
		R 5.00		65.97	3298	4618	5937	6597	9896	.03818
12.00	PDQ	R 5.00	PUSH	58.90	2945	4123	5301	5890	8835	.03409
		S 5.50		54.78	2739	3835	4930	5478	8217	.03170
		J 2.00		113.10	5655	7917	10179	11310	16965	.06545
		K 2.50		109.96	5498	7697	9896	10996	16494	.06363
		L 3.00		108.19	5409	7573	9737	10819	16228	.06261
		N 4.00		106.03	5302	7422	9543	10603	15904	.06136
		R 5.00		100.53	5026	7037	9048	10053	15080	.05818
		S 5.50		93.47	4673	6543	8412	9347	14020	.05409
				89.34	4467	6254	8041	8934	13401	.05170
		14.00		PDQ	K 2.50	PUSH	153.94	7697	10776	13855
L 3.00	149.03		7452		10432		13413	14903	22355	.0862
N 4.00	146.87		7344		10281		13218	14687	22031	.0850
R 5.00	141.37		7068		9896		12723	14137	21205	.0818
S 5.50	143.30		6715		9401		12087	13430	20145	.0777

STROKE LIMITATION DATA

The rod diameter has to be capable of withstanding any compressive force developed by the cylinder working against the load. A piston rod diameter with adequate column strength to handle the compressive force of the application can be selected from the convenient pre-calculated chart below.

To use this chart find the force value, developed by the application, in the left column. Next, select the figure which resembles your application and then multiply "D" times the factor given in that figure. Finally, opposite the corresponding force value, find the value of "L" which is equal to, or greater than, the figure derived from factoring "D". Directly above is the rod diameter which is capable of withstanding the forces developed in the application.

NOTE: See application figures on next page.

EXAMPLE: Cylinder Bore = 4.00" Operating PSI = 250
 Force Value 3140 lbs.
 Application - Resembles Fig. 2 - Foot Lug Mtg.
 Stroke = 40"
 "L" = 0.7 x 40; L = 28"
 Correct Rod Diameter = 1.00"

The total force is 3140 lbs., and the value of "L" is 28 inches in this application. The smallest diameter rod capable of handling this situation is 1.00 inches.

If a stop tube is required for the application be sure to include the stop tube length when determining the length of "D".

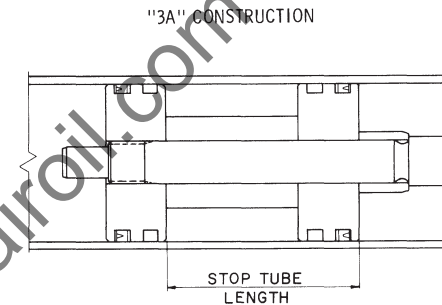
FORCE VALUE	VALUE OF "L" IN INCHES												
	PISTON ROD DIAMETER												
in pounds	.62	1.00	1.38	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	7.00
100	66												
200	47												
400	33	85											
600	27	70	132										
800	24	60	114	184									
1000	21	54	102	165	215								
1300	18	47	90	145	188								
1700	16	41	78	127	165	258							
2100	14	37	71	114	149	232							
2500	13	34	65	104	136	213	304						
3000	12	31	58	95	124	192	280	381					
4000	10	27	51	83	108	162	242	330	430				
5000	9	24	46	74	96	150	217	295	385				
6000	8	22	42	67	89	137	198	269	352	443			
8000	7	19	36	58	76	119	172	233	305	384	475		
10000		17	32	52	68	106	153	209	273	344	426	514	
12000		15	29	48	62	97	139	190	249	314	328	468	761
16000		13	26	42	54	84	121	165	215	272	316	407	659
20000			23	38	48	75	109	148	193	243	301	365	590
30000			18	31	39	61	89	120	153	198	245	297	481
40000				27	34	53	77	104	136	172	213	257	417
50000				23	31	48	69	93	122	153	190	230	373
60000				21	28	44	63	85	111	140	174	210	340
80000					24	38	54	74	96	122	143	192	295
100000						34	48	66	86	109	132	168	264
120000						31	44	60	79	100	121	142	240
140000							41	56	73	92	112	135	223
160000							38	52	63	86	105	129	209
200000								47	61	77	93	115	187
250000								42	54	69	84	103	167
300000													152
350000													141
400000													131
500000													118

If a stop tube is required for the application be sure to include the stop tube length when determining the length of "D".

STOP TUBE DATA

Long stroke cylinders can be subjected to a buckling action and excessive bearing wear due to the weight of the exposed rod. To reduce wear a stop tube is recommended.

All cylinders cushioned and non-cushioned are supplied with the double piston construction. General construction of cylinder stop tube is illustrated below.



"3A" SERIES	
MINIMUM STOP TUBE LENGTHS	
1.50 BORE	1.12 LG.
2.00 BORE	1.12 LG.
2.50 BORE	1.25 LG.
3.25 BORE	1.25 LG.
4.00 BORE	1.25 LG.
5.00 BORE	1.50 LG.
6.00 BORE	1.50 LG.
8.00 BORE	1.62 LG.
10.00 BORE	2.12 LG.
12.00 BORE	2.62 LG.
14.00 BORE	3.12 LG.

To determine if a stop tube is required, find the total value of "L" using the stroke limitation chart. Compare this value with the stop tube chart. If the value of "L" exceeds 40 inches, you can find the recommendation for stop tube length at the bottom of the chart.

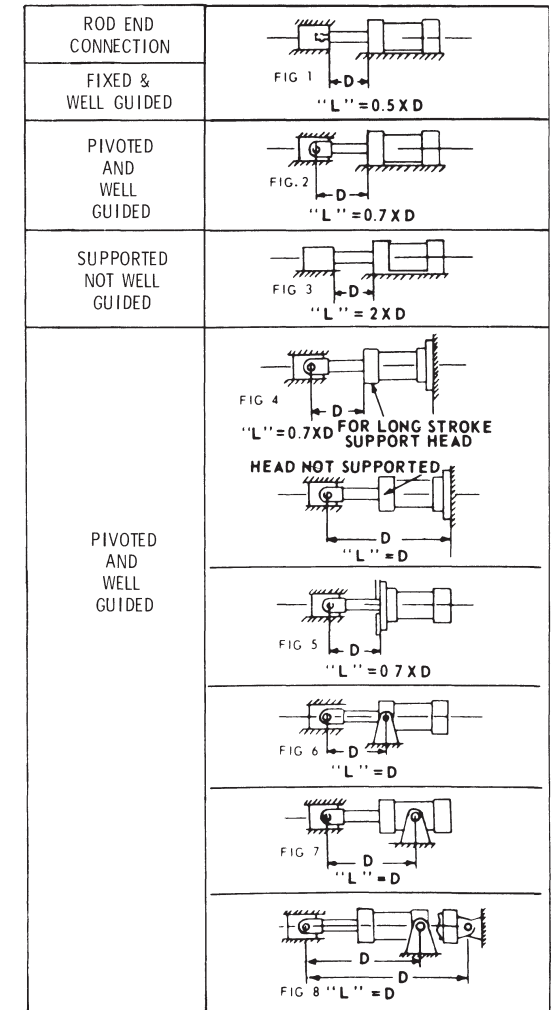
EXAMPLE PROBLEM:
 Cylinder Model MP1-3A-NC-4-27-KSM-1A
 Accessory - V-6 Clevis
 Pressure - 250 PSI
 Clevis Mount - Horizontal

From the description, the cylinder falls into Fig. 8. To determine the value of "L":

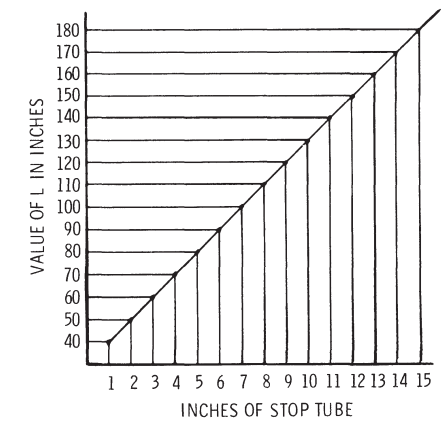
ADD: MP1 "XC" Dimension 7-3/4"
 V-6 "CE" Dimension 5-1/2"
 Two times stroke (2 x 27) 54"
 Total Value of "L" 67-1/4"

Looking this up on the chart, you'll find a recommended stop tube length of 4 inches.

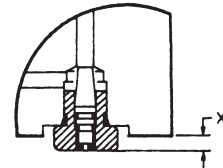
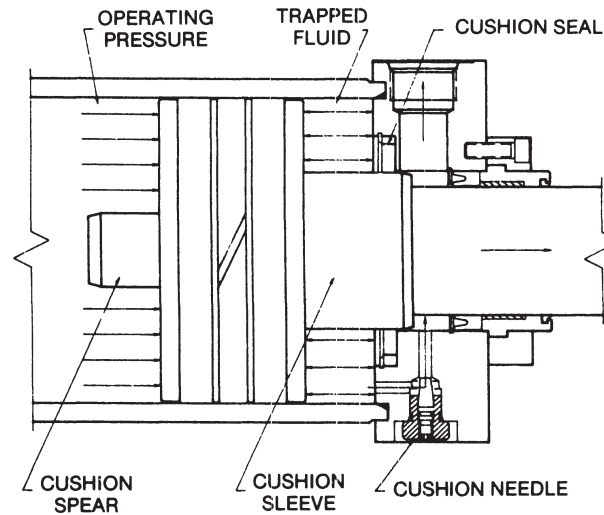
The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and re-check column strength on stroke limitation chart.



STOP TUBE CHART



CYLINDER CUSHION



NOTE: Cushion needle extends beyond the edge of head on the following:

Bore	F.H. B.H.	
	X	X
1.50	.235	.195
2.00	.235	.195
2.50	.235	.195
3.25	.125	.085

DETERMINING ENERGY OF THE APPLICATION

Cushions in cylinders are primarily intended to protect the cylinder from damaging impacts at the ends of the stroke. Properly selected and adjusted cushions may also reduce noise, reduce loading damage, may increase machine output.

As a general guide line, the use of pneumatic cushions should be considered whenever the velocity of the piston approaches 20 to 25 feet per minute. When piston velocity exceeds 35 to 40 feet per minute, the amount of energy being generated will usually demand the use of cushions to decelerate the piston. Cushions should also be seriously considered when a large mass imparts inertia loading to the cylinder.

Cushions work by trapping a volume of fluid at the end of the stroke to create a back pressure which resists the force being exerted on the working side of the piston. As shown above, this back pressure is developed when the cushion sleeve or spear enters into the cushion seal and the fluid is bled down through the orifice at the cushion seal and past the cushion adjustment needle. The back pressure developed must be sufficient to resist the force developed by the application. To determine if a suitable cushion can be provided in the cylinder selected for the application calculate the total energy which must be absorbed, as outlined below, and compare with the cushion capacity listed in the cushion capacity table.

NOTE: On Series "3A", Cushions are not available on the Head End of 1.50" Bore (F) Rod, 2.00" Bore (G) Rod and 2.50" Bore (H) Rod.

Things to consider:

1. Kinetic energy.
 2. Propelling energy (including gravity).
- I. To solve for kinetic energy:
 $0.1865 \times W \times V^2 = K.E.$
 W = Weight of the entire moving mass (pounds) (include cylinder piston rod in the mass figure)
 V = Velocity at entering the cushion (feet/sec.)
 K.E. = Kinetic Energy (inch pounds).
- II. To solve for propelling energy:
 $F \times S = P_1$
 F = Force exerted by the cylinder (Piston Area x PSI at relief valve setting).
 S = Cushion length (inches)
 $P_1 =$ Propelling Energy (inch pounds).
- III. Gravity effects must also be considered if the cylinder is mounted in a vertical plane. If the mass is moving down into the cylinder cushion, the energy due to gravity must be added to the propelling energy, P_1 . If the mass is moving into the cushion, the gravity is negative and this may be subtracted from the propelling energy, P_1 .

To solve for propelling energy due to gravity:
 $W \times S = P_2$
 W = Weight of moving mass
 S = Length of cushion
 $P_2 =$ Propelling energy due to gravity (inch pounds).

If the load is horizontal, the effect of gravity is zero and will not affect the total propelling energy.

TOTAL ENERGY IS:
 $K.E. + P_1 \pm P_2 =$
 K.E. = Total Kinetic Energy Formula I.
 $P_1 =$ Total Propelling Energy Formula II.
 $P_2 =$ Gravity Propelling Energy Formula III.

*Add if gravity is positive -
 Subtract if gravity is negative -
 Disregard if cylinder travel is horizontal.

CUSHION CAPACITY CHART

SERIES "3A" CUSHION CAPACITIES

BORE	ROD DIA.	HEAD END		CAP END	
		CUSHION LENGTH	CAPACITY (IN. -LBS.)	CUSHION LENGTH	CAPACITY (IN. -LBS.)
1.50	.62	.62	144	.50	150
	1.00	N/A	N/A		
2.00	.62	.62	245	.50	270
	1.00	.62	245		
	1.38	N/A	N/A		
2.50	.62	.62	435	.50	425
	1.00	.62	435		
	1.38	.62	356		
	1.75	N/A	N/A		
3.25	1.20	.81	945	.61	850
	1.38	.81	945		
	1.75	.81	645		
	2.00	.81	645		
4.00	1.00	.81	1,550	.61	1,305
	1.38	.81	1,550		
	1.75	.81	1,250		
	2.00	.81	1,250		
	2.50	.81	1,250		
5.00	1.00	.81	2,555	.61	2,060
	1.38	.81	2,555		
	1.75	.81	2,250		
	2.00	.81	2,250		
	2.50	.81	2,015		
	3.00	.81	1,320		
3.50	.81	1,320			
6.00	1.38	.81	3,780	.73	3,535
	1.75	.81	3,475		
	2.00	.81	3,475		
	2.50	.81	3,240		
	3.00	.81	2,595		
	3.50	.81	2,595		
8.00	1.38	1.00	8,510	.81	7,040
	1.75	1.00	8,140		
	2.00	1.00	8,140		
	2.50	1.00	7,850		
	3.00	1.00	7,050		
	4.00	1.00	6,525		
10.00	5.00	1.00	4,545	1.31	10,720
	5.50	1.00	4,545		
	1.75	1.00	7,850		
	2.00	1.00	7,850		
	2.50	1.00	7,675		
	3.00	1.00	7,200		
12.00	4.00	1.00	6,885	1.03	12,056
	5.00	1.00	5,695		
	5.50	1.00	5,695		
	2.00	1.00	11,480		
	2.50	1.00	11,305		
	3.00	1.00	10,825		
14.00	4.00	1.00	10,510	1.28	20,471
	5.00	1.00	9,325		
	5.50	1.00	9,325		
	2.50	1.00	15,595		
	3.00	1.00	15,115		
	4.00	1.00	14,800		
5.00	1.00	13,610			
5.50	1.00	13,610			

TYPICAL APPLICATION PROBLEM

You have tentatively chosen an "3A" Series cylinder with a 3-1/4" bore to move a 50 pound mass horizontally at 3 feet per second. The system relief valve setting is 80 psi. The cylinder is equipped with the standard 1.00" diameter piston rod and the effective cushion stroke or length is .81 inch.

Kinetic Energy:
 $0.1865 \times 50 \text{ lbs.} \times (3)^2$
 $9.32 \times 9 = 84 \text{ in. lbs.}$
 Propelling Energy:
 $8.29 \times 80 \times .81 = 537$
 Total Application Energy:
 $84 + 537 = 621 \text{ in. lbs.}$

The total energy seen by the cushion in this application is 621 inch pounds. By referring to the cushion capacity chart shown above, we find the standard 3-1/4" bore "3A" Series cushion can adequately handle the energy. If the energy developed exceeds the capacity of the standard cushion consider use of supercushions or changes in the pneumatic circuit which will reduce the amount of energy the cushions must absorb. (Supercushions have the same physical appearance as the standard cushion described above, except that the effective cushion length is doubled. An additional head or cap on both are added to accommodate the longer cushion sleeve or spear. The overall length of the cylinder body changes accordingly. Capacities of supercushions are double those shown in the cushion capacity chart.)

If in doubt about selecting a cushion, consult the factory with detailed application information and a recommendation will be made.

Caution: Cushion adjustment needles require only about one to one and one-half turn adjustment. Do not unscrew beyond the point at which the head of the screw is flushed with the surface of the head or cap.

STORAGE:

If cylinders are to be stored before use, make sure the piston rod is fully retracted. Any portion of the rod that is exposed should be coated with a lubricant. Cylinders in storage should always be fully protected against the elements or other adverse conditions.

INSTALLATION:

The pipe ports of cylinders are sealed with plastic plugs. The plugs protect the precision internal parts by sealing out damaging dirt and grit. Do not remove port plugs until ready to connect piping. To protect cylinders, clean all pipes and pipe fittings of dirt, scale, and thread chips. A filter is recommended to keep operating air free of foreign matter.

Accurate mounting and alignment are essential to proper cylinder performance. By eliminating side loading, packing and bearing life will be extended. Mounting surfaces should be straight; bearings for pin and trunnion mounting must be in line.

OPERATION:

Needle valves in cylinder head and cap of adjustable cushioned cylinders permit regulation of cushioning effect. Adjust needle valve using an Allen wrench, rotating clockwise to increase cushioning, and counter-clockwise to decrease cushioning effect. Speed control valves are essential for obtaining the best cushioning operation. A proper balance of cushion needle and flow control valve adjustment should result in a smooth stop with no bouncing.

MAINTENANCE:

Parts which may need replacement in the course of normal use are the rod wiper, rod seal and piston seals.

The need for replacement of rod seal will become evident through the escaping of air around the gland.

To replace rod wiper or rod seal, remove the gland from the cylinder. Remove worn rod wiper and rod seal. To reassemble, slip new rod wiper and rod seal into grooves. Care should be exercised not to nick the lips of the seals. Be sure to retorque gland screws to the specified torque for the cylinder. (See torque chart).

To replace **Series 3A** piston seals, cut the old seals and remove them. Carefully work the new U-cup seals into the grooves. Care should be exercised not to nick the lips of the seals.

To replace **Series 3AN** piston seals, cut the old piston seal, and remove it and the old O-ring from the groove. Install new O-ring. Next, slightly stretch the Teflon piston seal and work it into the groove. Replace wear strip. Carefully insert the ram assembly into the tube. This will assure the Teflon seal is reshaped equally.

It is recommended that new O-rings be installed each time the cylinder is disassembled for maintenance. This applies to tube and gland O-rings. The cushion needle valve O-rings should also be replaced if these parts are disassembled. When reassembling, be sure to apply proper tie rod torque. (See torque chart).

If the cushion action of the cylinder fails, check the cushion float sealing. Check to determine if the bronze ring has been worn on its internal diameter, and if foreign particles have become lodged between the face of the ring and the cylinder head recess face. A free play of the ring, both radially and axially, is normal to allow for centering and cushion float action.

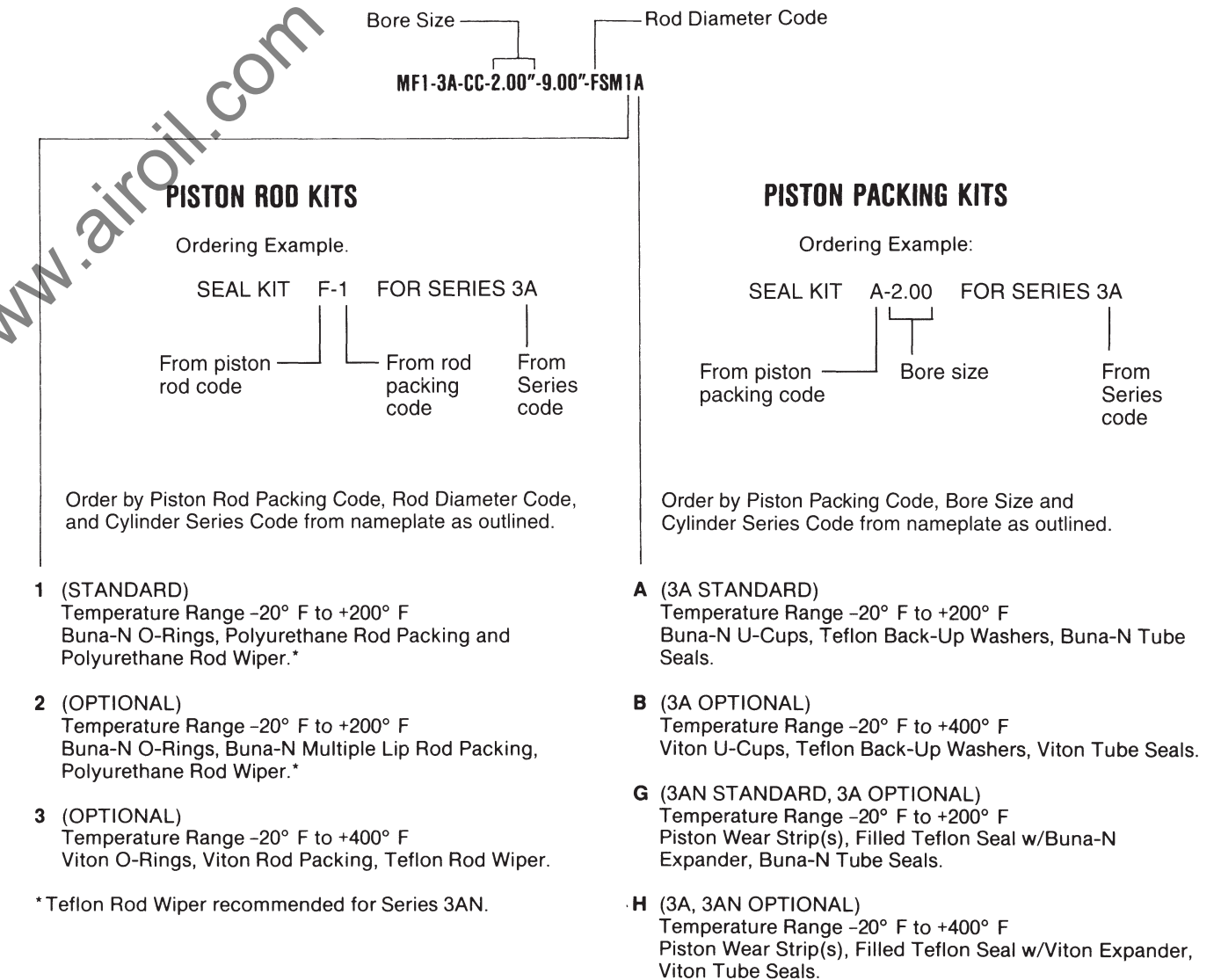
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned correctly with the load it is pushing or pulling. 4. That the piston packings or the piston rod packings are not worn, allowing pressure to escape.

Replacement parts can be furnished quickly if you will indicate the serial number of the cylinder as shown on the nameplate, and the part name and number, as shown on the drawing. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

SEAL KITS

All cylinders are fully field identifiable, including packing option codes.

NAMEPLATE CODE EXAMPLE

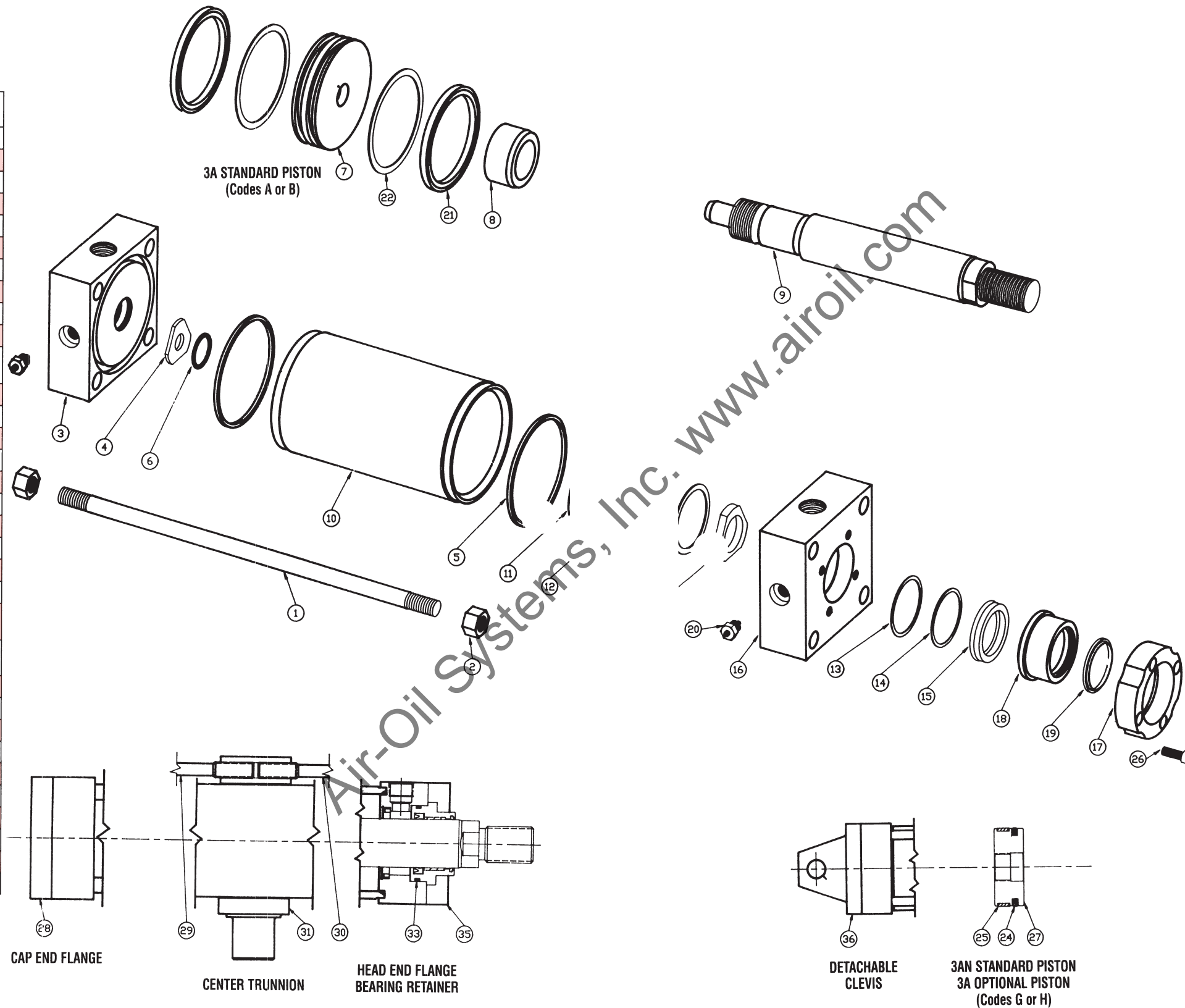


PARTS LIST

When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

PART NO.	NO. REQ'D.	DESCRIPTION
1	**	Tie Rod
2	**	Tie Rod Nut
3	1	Cap
4	1	Cap Cushion Float
5	2	O-Ring (Tube)
6	1	Cap Retaining Ring
7	1	3A Standard Piston
8	1	Cushion Sleeve
9	1	Piston Rod
10	1	Tube
11	1	Head Cushion Retaining Ring
12	1	Head Cushion Float
13	1	Packing Retaining Ring
14	1	Rod Washer
15	1	Rod Packing
16	1	Front Head
17	1	Retainer Plate
18	1	Gland Assembly
19	1	Rod Wiper
20	2	Cushion Needle
21	2	Piston U-Cup
22	2	Back-Up (1.50-4.00" Bores)
24	1	Filled Teflon Seal with Buna Expander
25	1	Wear Strip
26	4/8	Gland Screw
27	1	3AN Standard Piston
28	1	Cap End Flange
29	**	Cap End Tie Rod
30	**	Head End Tie Rod
31	1	Center Trunnion Band
33	1	O-Ring (Gland)
35	1	Front Flange
36	1	Detachable Clevis

** As required



FASTENER TORQUES

3A & 3AN SERIES TIE ROD TORQUE			
BORE	SIZE	TORQUE	TORQUE MX1, 2, 3, 4
1.5	.25-28	8 ft-lbs.	8 ft-lbs.
2.0	.31-24	14	14
2.5	.31-24	14	14
3.25	.38-24	25	28
4.00	.38-24	25	28
5.00	.50-20	35	48
6.00	.50-20	35	48
8.00	.62-18	85	115
10.00	.75-16	130	170
12.00	.75-16	130	170
14.00	.875-14	230	375

3A & 3AN SERIES GLAND SCREW TORQUES			
BORE	ROD	SCREW SIZE	TORQUE
1.5	ALL	—	—
2.0	ALL	#10-32	4 ft-lbs.
2.5	ALL	#10-32	4
3.25	ALL	#10-32	4
4.00	ALL	#10-32	4
5.00	ALL	#10-32	4
6.00	ALL	.25-28	10
8.00	GHJ	.25-28	10
8.00	KLNRS	.38-24	42
10.00	HJ	.25-28	10
10.00	KLNRS	.38-24	42
12.00	J	.25-28	10
12.00	KLNRS	.38-24	42
14.00	ALL	.38-24	42

CYLINDER WEIGHTS

3A & 3AN SERIES		
CYLINDER BORE	BASE WEIGHT AT ZERO STROKE	WEIGHT PER INCH OF STROKE
1.50	5 lbs.	.4 lbs.
2.00	6.5	.5
2.50	10	.6
3.25	20	.9
4.00	27	1.0
5.00	40	1.2
6.00	68	1.6
8.00	102	2.0
10.00	198	2.5
12.00	297	4.0
14.00	486	4.8

Hanna offers a wide variety of modifications and options to our Standard 3A and 3AN Product Lines. Please contact your authorized Distributor for more information.

SERIES 3A & 3AN

- | | | |
|-----------------------------|---------------------------------|---------------------------------|
| Stroke Adjustable Cylinders | Epoxy Painting Full Face | Retainer Plates |
| Metallic Rod Scrapers | Rod Boots | MP3 Mount |
| Super Cushions | Heavy Chrome Plated Piston Rods | MS1 Mount |
| Spring Return Cushions | Intermediate Center Supports | Self Aligning Rod End Couplings |
| Stainless Steel Piston Rods | Tightened Stroke Tolerance | Tandem Mounted Cylinders |

Contact factory for other special options.

MOUNTING STYLE

- Side Lugs.....**MS2**
- Centerline Lugs.....**MS3**
- Side Tapped.....**MS4**
- Head Square Flange.....**MF5**
- Cap Square Flange.....**MF6**
- Head Trunnion.....**MT1**
- Cap Trunnion.....**MT2**
- Intermediate Fixed Trunnion.....**MT4**
- Head Rectangular Flange.....**MF1**
- Cap Rectangular Flange.....**MF2**
- Head Square.....**ME3**
- Cap Square.....**ME4**
- Head Flange.....**ME5**
- Cap Flange.....**ME6**
- Tie-Rods.....**MX0,MX1,MX2, MX3,MX4**
- Side End Lugs.....**MS7**
- Cap Fixed Clevis.....**MP1**
- Cap Detachable Clevis.....**MP2**
- Spherical Bearing.....**MPU3**
- Double Rod (Available in most mounting styles).....**MX0-D**
- Double Rod End.....**D**
(Specify only if required)

SERIES

- Pneumatic . . . 3A
- Non-Lube . . . 3AN†

CUSHION

- Non-Cushion **NC**
- Cushion, Both Ends* **CC**
- Cushion, Cap End Only **CB**
- Cushion, Head End Only* **CR**

*Cushion on Head End of 1.50" Bore (F) Rod, 2.00" Bore (G) Rod and 2.50" Bore (H) Rod are not available.

When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

†Must be ordered with G or H piston code.

MF1 * 3A-CC-2.00"-9.00"-FSM1A

BORE SIZE
(Specify)

STROKE
(Specify)

ROD END STYLE

- Small Male **SM**
- Intermediate Male **IM**
- Short Female **SF***
- Alternate Male (Specify) **AL**
- Alternate Female (Specify) **AF**
- Special (Specify) **SP**

*Specify rod stud if required—up thru 2" diameter piston rod.

PISTON ROD PACKING, GLAND O-RING, ROD WIPER

- STANDARD**—Polyurethane Packing, Buna O-Ring, Polyurethane Wiper . . . **1**
- OPTIONAL** —Buna Packing, O-Ring, Polyurethane Wiper . . . **2**
- OPTIONAL** —Viton Packing, Viton O-Ring, Teflon Wiper **3**

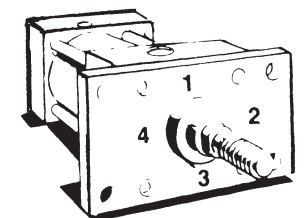
PISTON PACKING AND TUBE SEALS

- STANDARD** —Buna Packings with Teflon Back-Ups, Buna Tube Seals . . . **A**
- OPTIONAL** —Viton Packings with Teflon Back-Ups, Viton Tube Seals . . . **B**
- OPTIONAL** —Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals **G**
- OPTIONAL** —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals **H**

NOTE: Cushion needles furnished with viton seals.

ROD DIAMETER

(Specify Piston Rod Code from dimensional chart)



Port location: if other than position 1, must be specified. Mounting accessories must be specified if required.

Air-Oil Systems, Inc. www.airoil.com



Series MT Mill-Type Hydraulic Cylinders

- High-Tech Duralon® Rod Bearing
- State-of-the-Art Rod and Piston Sealing System
- Heavy-Duty Piston-to-Rod Connection
- 2,000 PSI Pressure Ratings
- 2.00" – 16.00" Standard Bore Sizes
- 7 Mounting Styles

SERIES MT MILL-TYPE CYLINDERS

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Air-Oil Systems, Inc. www.airoil.com

HANNA
cylinders

Series MT Mill-Type Extra-Heavy-Duty Hydraulic Cylinders

Hanna's Series MT Mill-Type Hydraulic Cylinders are designed and built for heavy-duty industrial applications that demand high performance, precision tolerances and extra ruggedness.

Designed for specifying engineers, this catalog presents full details about the Series MT's latest technology design features, complete dimensional drawings, technical application information, options and accessories, plus installation, operation and maintenance data. Clear and concise ordering information facilitates proper cylinder selection for specific applications and operating conditions.

Cylinder Design and Construction

The Series MT product line has been truly value-engineered from the ground up. During the design stage, each and every cylinder component was thoroughly analyzed and tested. Individual component design and material selection were evaluated on the basis of performance, longevity, fatigue resistance, ease of servicing, and cost.

Proven technologies were applied in critical areas such as seals and bearings. For instance, Hanna's unique, non-metallic Duralon rod bearing, and our glass-filled Teflon, O-ring energized piston seal with bronze-filled bearing strips, combine to eliminate metal-to-metal contact at bearing surfaces. This assures extremely low friction and long service life. In addition, it makes Series MT cylinders the most suitable units available for high pressure applications requiring ruggedness, precision, zero leakage and day-in, day-out performance.

Design Flexibility

Series MT cylinders offer maximum flexibility for machine design. They are available in seven standard mounting styles, and 12 standard bore sizes from 2.00" through 16.00". 14 standard rod sizes from 1.00" through 8.00" are also offered, with a minimum of two to a maximum of six rod sizes for each bore size.

This wide selection of standard rod and bore diameters means you can more accurately and economically size the cylinder to meet specific application requirements. Optional piston and rod seal materials and configurations also are available to further increase your design flexibility.

In addition, Hanna offers a wide range of options and accessories to enhance the performance of MT cylinders. Included are proximity switches and, for the ultimate in precision control, our Closed Loop Electronic Feedback device.

Custom Capabilities

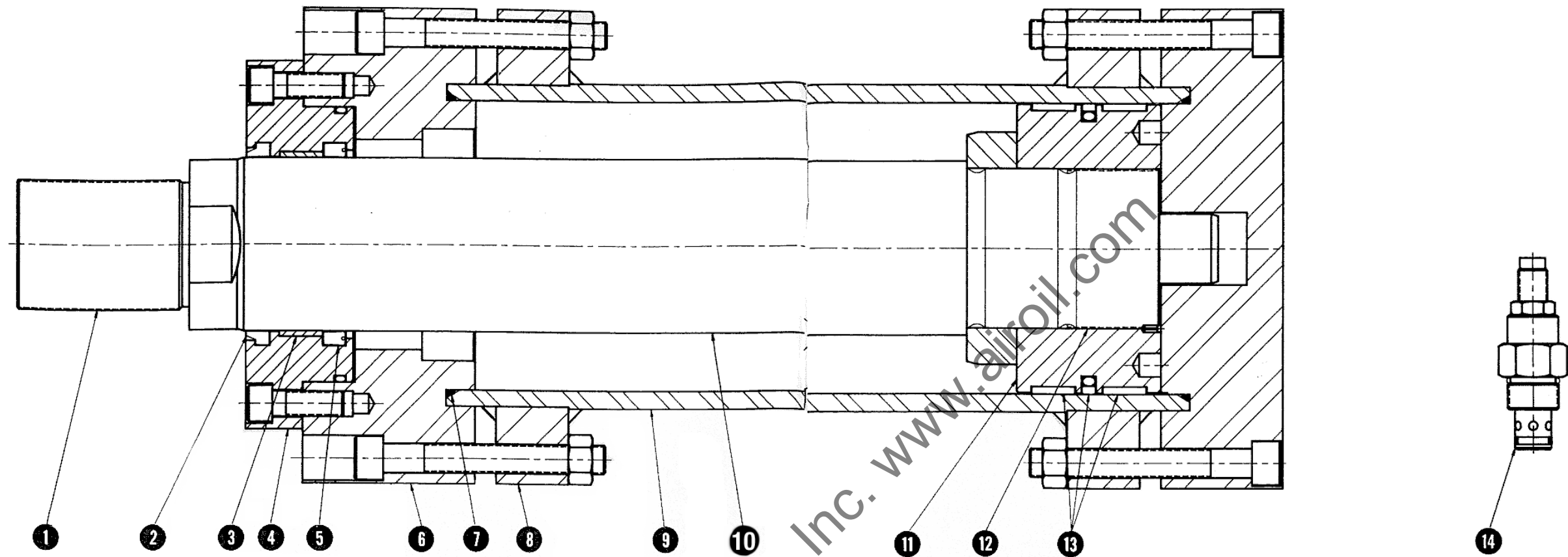
If your needs cannot be met by the standard units presented in this catalog, be assured that Hanna has significant "Beyond-the-Catalog" capabilities. We can custom-design and manufacture MT cylinders to meet virtually any requirement—including greater pressures, larger bore sizes through 30", larger rod sizes, custom mountings and special seals for specific applications. In addition, metric cylinders can be designed and manufactured to meet customer requirements.



If you involve us during the design phase of your project, you'll find our problem-solving orientation can provide creative, cost-effective solutions to the most difficult cylinder application problems.

The Company Behind the Cylinders

For more than 85 years, Hanna Corporation has earned its reputation as a major manufacturer of premium quality, industrial grade cylinders. With our Series MT, our Series RT Rotating cylinders, our heavy-duty N.F.P.A. tie-rod type air and hydraulic cylinders, plus custom-welded cylinders manufactured by our T.J. Brooks Division, **Hanna offers a single source for virtually any heavy-duty cylinder requirement.** Add to this the responsive sales and service support from the factory and from our highly qualified distributor organization, and you are assured of getting the right cylinder for your application—on time and at a competitive price.



Series MT Features

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity. Studded rod ends and metric threads are available.

2. Rod Wiper

The first line of defense in preventing ingestion of dust, dirt or other contaminants into the cylinder. The snap-in wiper that comes standard on Series MT cylinders is made of extremely durable polyurethane. A heavy wiper lip ensures that contact is always maintained with the surface of the rod to effectively remove dirt, mud, etc. The outside diameter has a sealed outer lip to prevent moisture from entering the groove. Molded ribs on the inside diameter add stability and prevent pressure traps. Metallic rod wiper is optionally available.

3. Duralon Rod Bearing

Hanna's high-tech Duralon Rod Bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings are capable of sustaining much higher compressive loads than other materials commonly used for bearings, have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

4. Rod Bearing Cartridge

One-piece, machined ductile iron with integral flange. Precision piloted and held to extremely close concentricity to cylinder bore. Flange has two tapped holes to facilitate easy removal for rod packing replacement.

5. Polyurethane Rod Seal

Series MT cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance. Viton Poly-Pak U-cup is available for use with non-petroleum based fluids or for higher temperature service. Multiple-lip Buna rod seal is also available.

6. Steel Heads

High strength steel heads are precision machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

7. Tube Seal

Tube ends are piloted to end caps and fitted with Buna-N O-ring seals. Viton seals are available for use with non-petroleum based fluids, or for higher temperature service.

8. Welded Retaining Flanges

Precision machined and permanently welded for extra ruggedness. End caps are retained to flanges with high-

alloy, heat-treated through bolts, counter-bored into the caps, and torqued to flanges with SAE Grade 8 lock nuts. Bolts provide minimum yield strength of 150,000 p.s.i.

9. Heavy Wall Tubing

Heavy wall tubing is precision honed or skived, and then polished to 16 to 20 Rms. This process provides excellent corrosion resistance and an ideal surface to seal against. The result is enhanced piston seal longevity.

10. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failure. The rods provide 100,000 p.s.i. minimum yield strength in diameters up to 3.50"; 59,000 p.s.i. average yield strength in 4.00" diameters and above. All sizes are hard chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish.

11. Piston

One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side. Bronze piston with U-cup seals is available as an extra-cost option.

12. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned. This procedure virtually eliminates the possibility of the piston backing off the piston rod.

13. Piston Sealing System

Hanna's glass-filled Teflon, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with U-cup type seals. Glass-filled Nylon wear rings provide non-metallic bearing points on the piston, assuring long life and extremely low friction, while increasing bearing load characteristics.

14. Cushion Adjustment Cartridge

Available as an option on 4.00" bore sizes and above. Ball check and flow control needle adjustment are incorporated into a single cartridge. The needle is always restrained under full adjustment, and provides a wide range of cushion adjustments with minimal restrictions on return stroke.

High-Tech Duralon Rod Bearing

The high-tech Duralon rod bearing is supplied as standard on all Hanna Series MT Mill-Type Cylinders. A traditional bronze bearing is also available as an option.

Hanna strongly recommends the Duralon bearing, which has proven to be superior to all other bearing materials in countless cylinder applications. Here's why:

The useful life of any hydraulic cylinder is determined by the performance of the piston rod bearing. It is responsible for true alignment of the piston rod to the cylinder bore, and must carry the forces generated by both external and internally-generated eccentric loads.

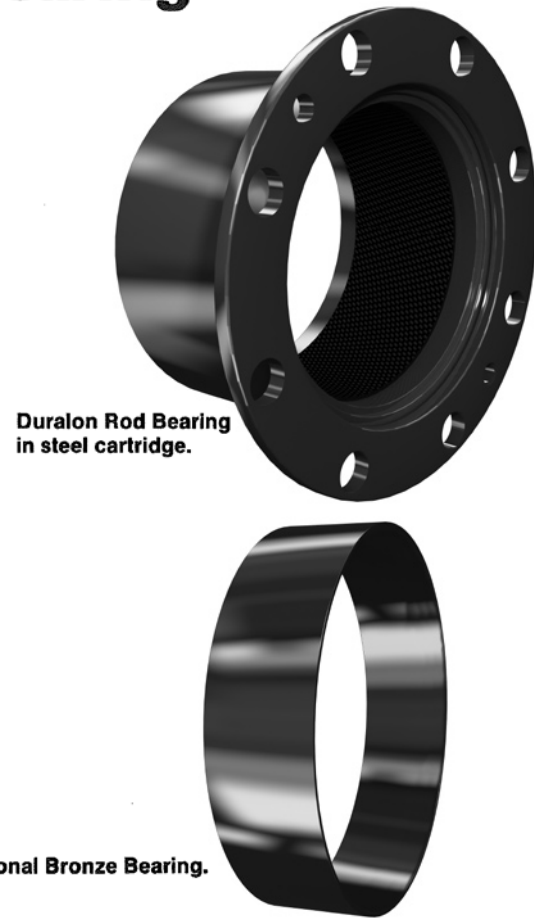
Traditional bronze or cast iron bearings require constant lubrication to help minimize friction and resultant wear. Once the cylinder rod bearings begin to wear, the piston moves off true center of the cylinder bore, thus shortening cylinder life. Additionally, the wear pattern accelerates, causing deterioration in the piston rod wiper, letting contaminants into the cylinder and in the piston rod seal, thereby causing fluid leakage.

Hanna Corporation has solved this critical design problem with the unique, non-metallic Duralon bearing. An exact combination of woven Teflon® and Dacron® fibers bonded to a fiberglass shell, Duralon bearings are capable of sustaining much higher compressive loads than either bronze or cast iron. In addition, Duralon bearings have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

As a result, cylinders with Duralon bearings are ideal for use in heavy-duty applications, and servo systems requiring minimal actuator friction. Because of the low coefficient of friction, very little heat gen-

eration occurs, thereby prolonging both bearing and seal life.

Duralon bearings are compatible with most known fluids, including water, water glycols, standard petroleum-based fluids, phosphate esters and water/oil, oil/water fluids. They can operate in environments ranging from -65° F to +325° F.



Duralon Rod Bearing in steel cartridge.

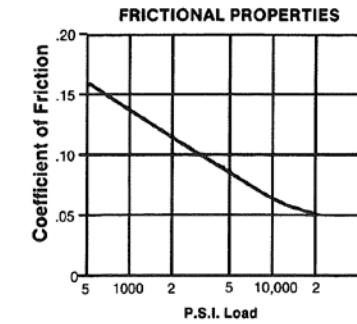
Optional Bronze Bearing.

DURALON VS. COMPETITIVE BEARING MATERIALS

COMPARISON OF NON-LUBRICATED BEARINGS AND THEIR OPERATING LIMITS		LOAD CAPACITY (PSI)
Porous Bronze	MOST CYLINDER MANUFACTURERS	4500
Porous Iron		8000
Reinforced Teflon®		2500
Duralon Bearing*		60,000

*Not to be used for design purposes.

Duralon is a Trademark of Rexnord, Inc. Nylon, Teflon and Dacron are Trademarks of DuPont Company.



The low friction characteristic of the Duralon bearing is due to the Teflon fabric liner. Increased loading, at constant speed, results in a marked decrease in the coefficient of friction.

COMPARISON OF FRICTION PROPERTIES OF JOURNAL BEARING MATERIALS		
	COEFFICIENT	SLIP/STICK
Steel-on-Steel	.50	Yes
Bronze-on-Steel	.35	Yes
Aluminum		
Bronze-on-Steel	.45	Yes
Sintered Bronze-on-Steel (Mineral Oil)	.13	No
Bronze-on-Steel (Mineral Oil)	.16	No
Copper Film Deposited on Steel	.30	Yes
Teflon®-on-Steel	.04	No
Duralon®-on-Steel	.05-.16	No

Extra-Rugged Polyurethane Rod Seal

POLYURETHANE ROD SEAL ADVANTAGES

- Extremely high durometer (90)
- Extra-wide cross section
- Broad temperature range
- Compatible with most fluids
- Line contact minimizes friction

Series MT cylinders incorporate the industry's heaviest cross-section polyurethane U-cup piston rod seal. As a seal material, polyurethane is acknowledged to be the toughest, most abrasion-resistant compound available.

The abrasion and wear resistance thus associated with polyurethane, along with the pressure and wear compensating U-cup design, produces a seal that's unmatched for long life and zero-leakage performance.

A second lip further enhances seal life by acting as a wiper to prevent dirt and other contaminants from reaching the primary lip. The second lip also serves as a back-up to the primary lip.

In addition, the heavy cross-section of the polyurethane material produces a seal with outstanding stability in high pressure applications. This stability prevents extrusion and rollover common with small cross section designs.

Furthermore, recent advances in polymer technology have expanded the compatibility of polyurethane seals with most water additive fluids. Viton Poly-Pak seal option is available as well.



Standard Polyurethane Rod Seal (Code 1)



Optional Poly-Pak Viton U-Cup Seal (Code 3)

State-of-the-Art Piston Sealing System

STANDARD PISTON SEAL ADVANTAGES

- Positive Sealing
- No rollover or extrusion
- Extremely low friction
- Long service life

The unique, standard piston sealing system on Series MT cylinders combines the sealing capability of U-cups with the longevity of cast iron rings.

The glass-filled Teflon, O-ring energized seal provides positive sealing without problems such as rollover or extrusion that are associated with U-cup type seals.

In addition, two bronze-filled bearing strips provide non-metallic bearing points on the piston, assuring long life and extremely low friction. Located on each side of the seal, the wear strips also wipe the cylinder tube in both directions of piston travel, further extending seal life. These wear strips are capable of withstanding high side loads, and thus prevent galling of the tube, catastrophic cylinder failure, and subsequent damage to valves and other hydraulic system components. They virtually never need to be replaced.

The piston seal has no slip stick and minimal friction. It is ideal for servo-type conditions as well as high water based service.

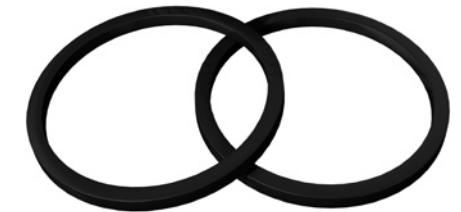
If you are using a zero-leak check valve circuit, however, it may require the use of optional zero-drift U-cup seals to maintain absolute position. The miniscule by-pass with our standard seal may result in some very minor drift. Both Poly-Pak and Viton U-cups seals are available.



Standard glass-filled Teflon, O-ring energized piston seal with two bronze-filled bearing strips—installed on a ductile iron piston. (Code G)

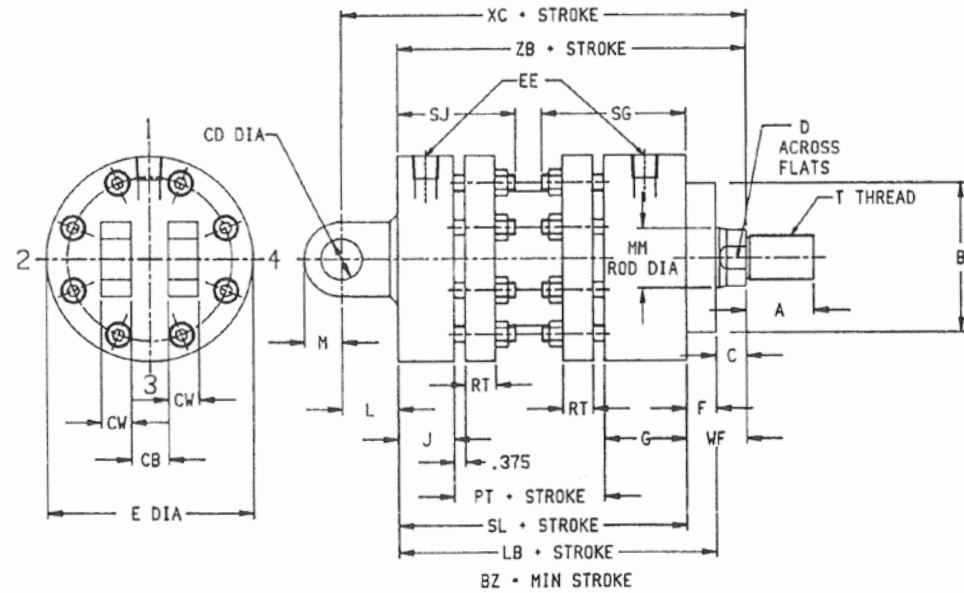


Optional bronze piston with two Poly-Pak U-cup seals. Viton U-cup seals also available. (Code A)



Optional Poly-Pak U-cup seals (2) with one bronze-filled bearing strip—installed on a ductile iron piston. Viton U-cup seals also available (Code B)

SERIES MT 2.00"-16.00" Bores MP1 Fixed Double Ear Clevis Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	CB +.016 +.047	CD +.003 +.005	CW	E	EE		F	G	J	L	LB	M	PT
								SAE STRAIGHT THREAD	NPTF*							
2.00	3.25	1.38	0.81	1.00	0.750	0.75	4.12	#8 (1.750-16)	0.50	1.00	2.25	1.38	1.31	6.00	0.75	1.38
3.00	4.50	1.75	0.88	1.25	1.250	0.88	5.38	#12 (1.062-12)	0.75	1.12	2.62	1.75	1.62	7.25	1.12	1.75
4.00	5.00	2.38	1.00	1.25	1.375	1.00	6.88	#12 (1.062-12)	0.75	1.00	2.75	1.88	1.88	7.62	1.25	2.00
5.00	6.38	2.88	1.00	1.25	1.500	1.25	8.25	#12 (1.062-12)	0.75	1.00	3.00	2.12	2.50	8.62	1.38	2.50
6.00	7.38	3.25	1.00	1.50	1.750	1.50	9.62	#16 (1.312-12)	1.00	1.25	3.25	2.25	3.12	9.62	1.62	2.88
7.00	8.25	3.38	1.00	3.00	2.000	1.50	10.75	#16 (1.312-12)	1.00	1.25	3.25	2.25	3.12	9.75	1.62	3.00
8.00	9.75	3.25	1.12	3.00	2.000	1.50	12.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	3.62	11.06	1.88	3.50
9.00	9.75	3.25	1.12	3.00	2.000	1.50	13.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	3.62	11.31	1.88	3.75
10.00	10.75	3.25	1.00	3.50	2.500	1.75	15.50	#24 (1.875-12)	1.50	1.43	4.25	3.12	4.06	13.56	2.38	4.75
12.00	10.75	3.25	1.12	4.50	3.000	2.25	18.75	#24 (1.875-12)	1.50	1.43	4.50	3.62	4.43	15.19	2.88	5.62
14.00	12.00	4.00	1.00	5.00	3.500	2.50	21.50	#32 (2.500-12)	2.00	2.00	5.00	4.25	5.19	17.00	3.38	5.75
16.00	12.00	3.00	2.25	6.00	4.250	3.00	23.62	#32 (2.500-12)	2.00	2.00	6.00	5.00	5.00	19.00	4.00	6.00

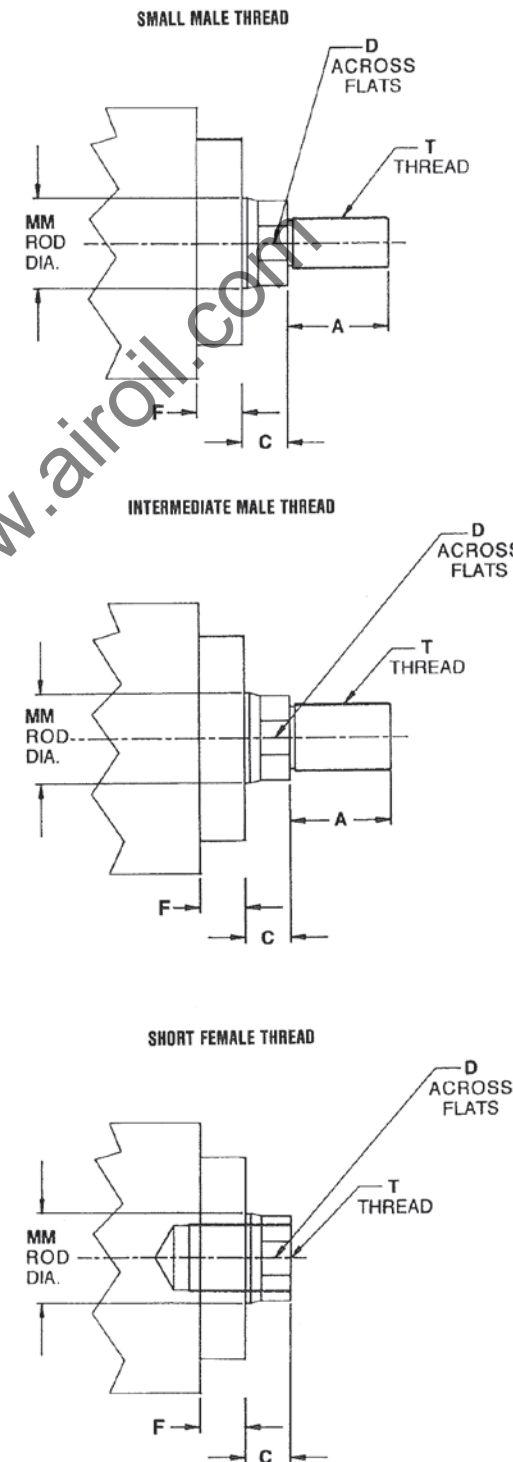
*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	RT	SG	SJ	SL	WF	XC	ZB
2.00	0.50	3.47	2.59	5.00	1.81	8.12	6.81
3.00	0.75	4.22	3.34	6.12	2.00	9.75	8.12
4.00	1.00	4.78	3.91	6.62	2.00	10.50	8.62
5.00	1.25	5.41	4.53	7.62	2.00	12.12	9.62
6.00	1.62	6.19	5.19	8.38	2.25	13.75	10.62
7.00	1.75	6.69	5.69	8.50	2.25	13.88	10.75
8.00	1.88	6.81	5.69	9.62	2.56	15.81	12.19
9.00	2.00	6.81	5.69	9.88	2.56	16.06	12.43
10.00	2.38	7.91	6.78	12.12	2.43	18.62	14.56
12.00	2.75	8.78	7.91	13.75	2.56	20.75	16.31
14.00	3.25	9.66	8.91	15.00	3.00	23.19	18.00
16.00	3.75	10.03	9.03	17.00	4.25	26.25	21.25

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

NOTE: Pivot Pin included.

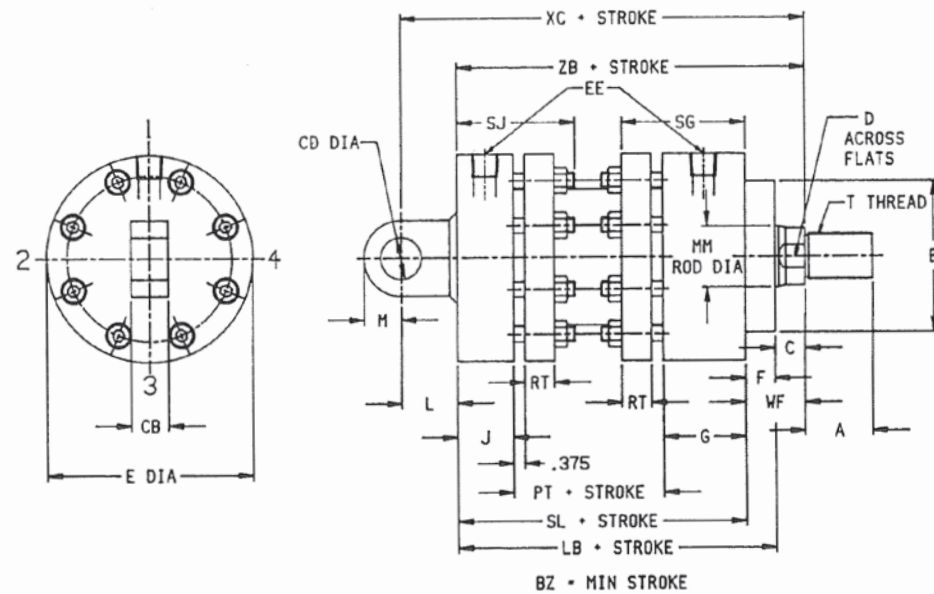
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **MP1**

BORE	ROD DIA. CODE	MM ROD DIA.	CYLINDER		T (THREAD)		
			A	D	SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
7.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
8.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
9.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
12.00	T	7.00	7.00	—	5.50-12	—	—
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
14.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
U	8.00	8.00	—	6.50-12	—	—	

SERIES MT 2.00"-16.00" Bores MP3 Fixed Single Ear Clevis Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	CB ±.005	CD ±.003 +.005	E	EE		F	G	J	L	LB	M	PT	RT
							SAE STRAIGHT THREAD	NPTF*								
2.00	3.25	1.38	0.81	1.00	0.750	4.12	#8 (.750-16)	0.50	1.00	2.25	1.38	1.31	6.00	0.75	1.38	0.50
3.00	4.50	1.75	0.88	1.25	1.250	5.38	#12 (1.062-12)	0.75	1.12	2.62	1.75	1.62	7.25	1.12	1.75	0.75
4.00	5.00	2.38	1.00	1.25	1.375	6.88	#12 (1.062-12)	0.75	1.00	2.75	1.88	1.88	7.62	1.25	2.00	1.00
5.00	6.38	2.88	1.00	1.25	1.500	8.25	#12 (1.062-12)	0.75	1.00	3.00	2.12	2.50	8.62	1.38	2.50	1.25
6.00	7.38	3.25	1.00	1.50	1.750	9.62	#16 (1.312-12)	1.00	1.25	3.25	2.25	3.12	9.62	1.62	2.88	1.62
7.00	8.25	3.38	1.00	3.00	2.000	10.75	#16 (1.312-12)	1.00	1.25	3.25	2.25	3.12	9.75	1.62	3.00	1.75
8.00	9.75	3.25	1.12	3.00	2.000	12.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	3.62	11.06	1.88	3.50	1.88
9.00	9.75	3.25	1.12	3.00	2.000	13.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	3.62	11.31	1.88	3.75	2.00
10.00	10.75	3.25	1.00	3.50	2.500	15.50	#24 (1.875-12)	1.50	1.43	4.25	3.12	4.06	13.56	2.38	4.75	2.38
12.00	10.75	3.25	1.12	4.50	3.000	18.75	#24 (1.875-12)	1.50	1.43	4.50	3.62	4.43	15.19	2.88	5.62	2.75
14.00	12.00	4.00	1.00	5.00	3.500	21.50	#32 (2.500-12)	2.00	2.00	5.00	4.25	5.19	17.00	3.38	5.75	3.25
16.00	12.00	3.00	2.25	6.00	4.250	23.62	#32 (2.500-12)	2.00	2.00	6.00	5.00	5.00	19.00	4.00	6.00	3.75

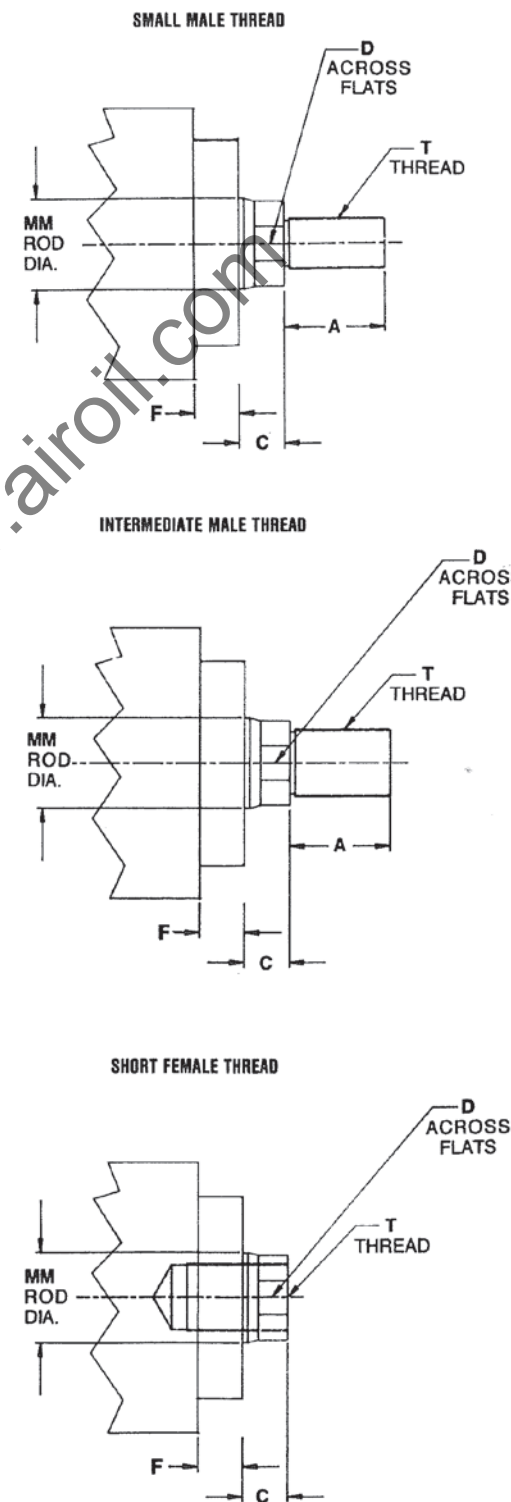
*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	SG	SJ	SL	WF	XC	ZB
2.00	3.47	2.59	5.00	1.81	8.12	6.81
3.00	4.22	3.34	6.12	2.00	9.75	8.12
4.00	4.78	3.91	6.62	2.00	10.50	8.62
5.00	5.41	4.53	7.62	2.00	12.12	9.62
6.00	6.19	5.19	8.38	2.25	13.75	10.62
7.00	6.69	5.69	8.50	2.25	13.88	10.75
8.00	6.81	5.69	9.62	2.56	15.81	12.19
9.00	6.81	5.69	9.88	2.56	16.06	12.43
10.00	7.91	6.78	12.12	2.43	18.62	14.56
12.00	8.78	7.91	13.75	2.56	20.75	16.31
14.00	9.66	8.91	15.00	3.00	23.19	18.00
16.00	10.03	9.03	17.00	4.25	26.25	21.25

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

NOTE: Pivot Pin not included.

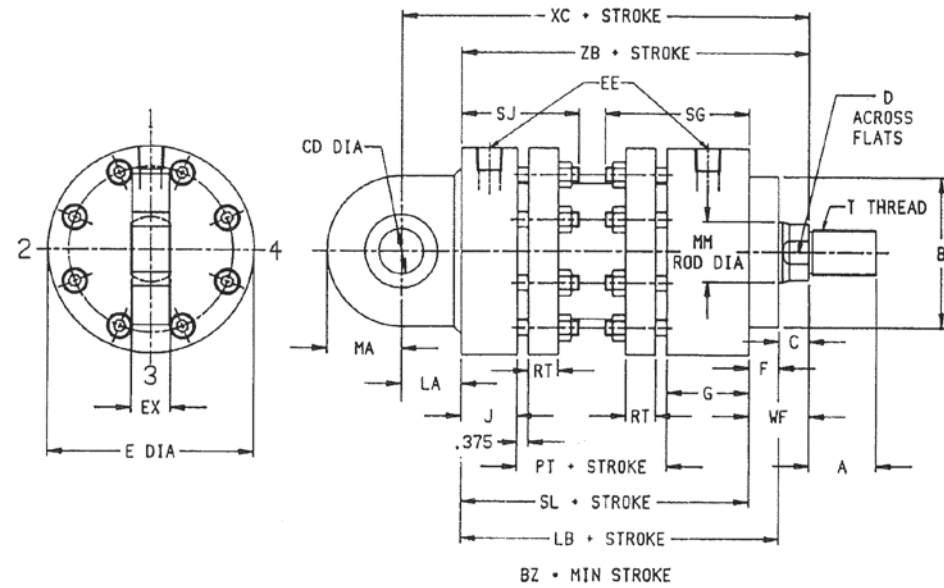
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **MP3**

BORE	ROD DIA. CODE	MM ROD DIA.	CYLINDER		T (THREAD)		
			A	D	SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
2.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
3.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
4.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
5.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
5.00	M	3.50	3.50	3.00	2.50-12	2.75-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
6.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
6.00	M	3.50	3.50	3.00	2.50-12	2.75-12	2.50-12
6.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
7.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
7.00	M	3.50	3.50	3.30	2.50-12	3.25-12	2.50-12
7.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
7.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
8.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
8.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
8.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
8.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
8.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
9.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
9.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
9.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
9.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
9.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
9.00	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
10.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
10.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
10.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
10.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
10.00	T	7.00	7.00	—	5.50-12	—	—
12.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
12.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
12.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
12.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
12.00	T	7.00	7.00	—	5.50-12	—	—
14.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
14.00	T	7.00	7.00	—	5.50-12	—	—
14.00	U	8.00	8.00	—	6.50-12	—	—
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
16.00	T	7.00	7.00	—	5.50-12	—	—
16.00	U	8.00	8.00	—	6.50-12	—	—

SERIES MT 2.00"-9.00" Bores MPU3 Spherical Bearing Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	CD +0.000 -0.001	E	EE		EX	F	G	J	LA	LB	MA	PT	RT
						SAE STRAIGHT THREAD	NPTF*									
2.00	3.25	1.38	0.81	0.750	4.12	#8 (1.750-16)	0.50	0.656	1.00	2.25	1.38	1.25	6.00	1.25	1.38	0.50
3.00	4.50	1.75	0.88	1.250	5.38	#12 (1.062-12)	0.75	1.093	1.12	2.62	1.75	1.75	7.25	2.00	1.75	0.75
4.00	5.00	2.38	1.00	1.500	6.88	#12 (1.062-12)	0.75	1.312	1.00	2.75	1.88	2.00	7.62	2.50	2.00	1.00
5.00	6.38	2.88	1.00	2.000	8.25	#12 (1.062-12)	0.75	1.750	1.00	3.00	2.12	2.50	8.62	3.25	2.50	1.25
6.00	7.38	3.25	1.00	2.250	9.62	#16 (1.312-12)	1.00	1.969	1.25	3.25	2.25	2.75	9.62	3.62	2.88	1.62
7.00	8.25	3.38	1.00	2.750	10.75	#16 (1.312-12)	1.00	2.406	1.25	3.25	2.25	3.00	9.75	4.38	3.00	1.75
8.00	9.75	3.25	1.12	3.000	12.38	#20 (1.625-12)	1.25	2.625	1.43	3.62	2.50	3.25	11.06	4.75	3.50	1.88
9.00	9.75	3.25	1.12	3.000	13.38	#20 (1.625-12)	1.25	2.625	1.43	3.62	2.50	3.25	11.31	4.75	3.75	2.00

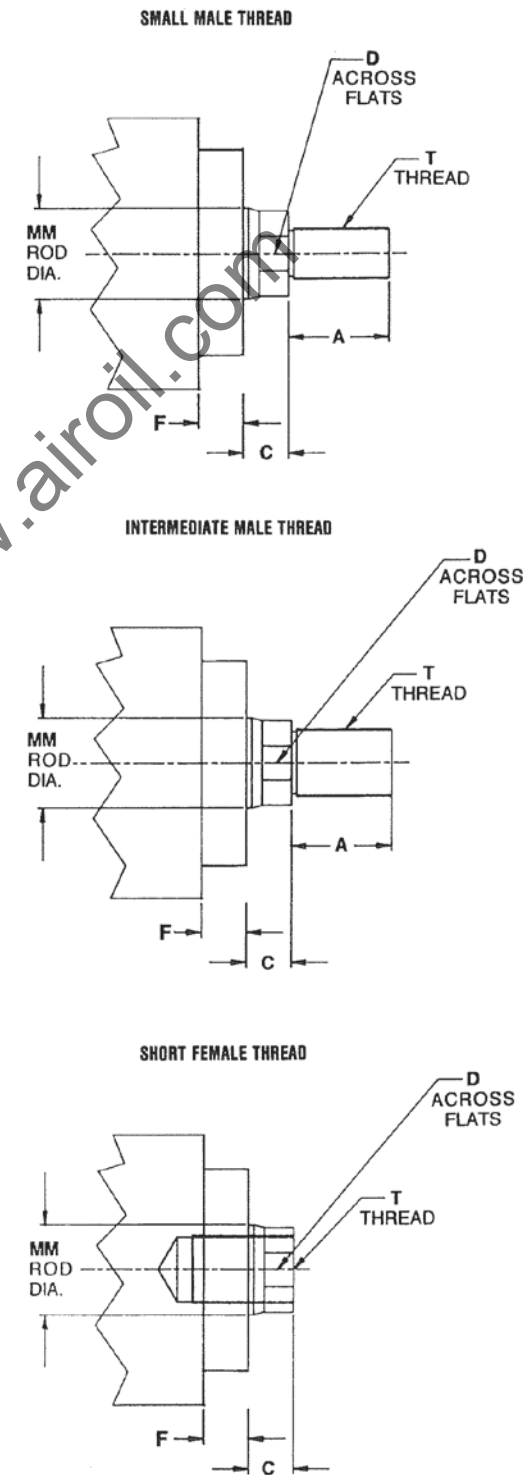
*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	SG	SJ	SL	WF	XC	ZB
2.00	3.47	2.59	5.00	1.81	8.06	6.81
3.00	4.22	3.34	6.12	2.00	9.88	8.12
4.00	4.78	3.91	6.62	2.00	10.62	8.62
5.00	5.41	4.53	7.62	2.00	12.12	9.62
6.00	6.19	5.19	8.38	2.25	13.38	10.62
7.00	6.69	5.69	8.50	2.25	13.75	10.75
8.00	6.81	5.69	9.62	2.56	15.43	12.19
9.00	6.81	5.69	9.88	2.56	15.69	12.43

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

NOTE: Spherical Bearing is rated for 2000 P.S.I. Dynamic Load.

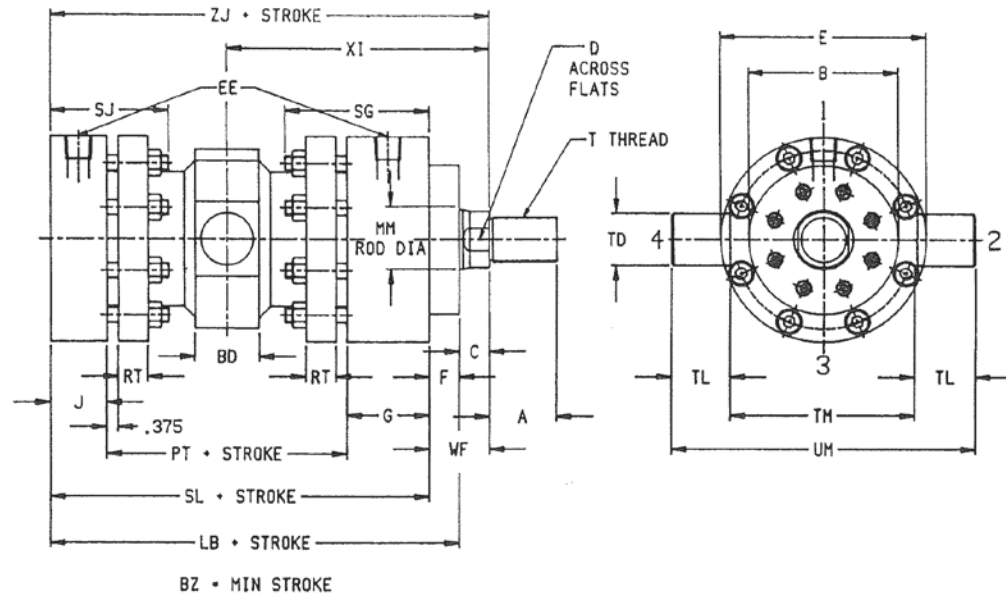
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter MPU3

BORE	CYLINDER		A	D	T (THREAD)		
	ROD DIA. CODE	MM ROD DIA.			SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
9.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12

SERIES MT 2.00"-16.00" Bores MT4 Intermediate Fixed Trunnion Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BD	BZ	C	E	EE		F	G	J	LB	PT	RT	SG	SJ	SL
						SAE STRAIGHT THREAD	NPTF*									
2.00	3.25	1.50	1.38	0.81	4.12	#8 (.750-16)	0.50	1.00	2.25	1.38	6.00	1.38	0.50	3.47	2.59	5.00
3.00	4.50	1.62	1.75	0.88	5.38	#12 (1.062-12)	0.75	1.12	2.62	1.75	7.25	1.75	0.75	4.22	3.34	6.12
4.00	5.00	2.12	2.38	1.00	6.88	#12 (1.062-12)	0.75	1.00	2.75	1.88	7.62	2.00	1.00	4.78	3.91	6.62
5.00	6.38	2.38	2.88	1.00	8.25	#12 (1.062-12)	0.75	1.00	3.00	2.12	8.62	2.50	1.25	5.41	4.53	7.62
6.00	7.38	2.38	3.25	1.00	9.62	#16 (1.312-12)	1.00	1.25	3.25	2.25	9.62	2.88	1.62	6.19	5.19	8.38
7.00	8.25	2.38	3.38	1.00	10.75	#16 (1.312-12)	1.00	1.25	3.25	2.25	9.75	3.00	1.75	6.69	5.69	8.50
8.00	9.75	2.88	3.25	1.12	12.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	11.06	3.50	1.88	6.81	5.69	9.62
9.00	9.75	2.88	3.25	1.12	13.38	#20 (1.625-12)	1.25	1.43	3.62	2.50	11.31	3.75	2.00	6.81	5.69	9.88
10.00	10.75	3.38	3.25	1.00	15.50	#24 (1.875-12)	1.50	1.43	4.25	3.12	13.56	4.75	2.38	7.91	6.78	12.12
12.00	10.75	4.88	3.25	1.12	18.75	#24 (1.875-12)	1.50	1.43	4.50	3.62	15.19	5.62	2.75	8.78	7.91	13.75
14.00	12.00	5.50	4.00	1.00	21.50	#32 (2.500-12)	2.00	2.00	5.00	4.25	17.00	5.75	3.25	9.66	8.91	15.00
16.00	12.00	5.50	3.00	2.25	23.62	#32 (2.500-12)	2.00	2.00	6.00	5.00	19.00	6.00	3.75	10.03	9.03	17.00

*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

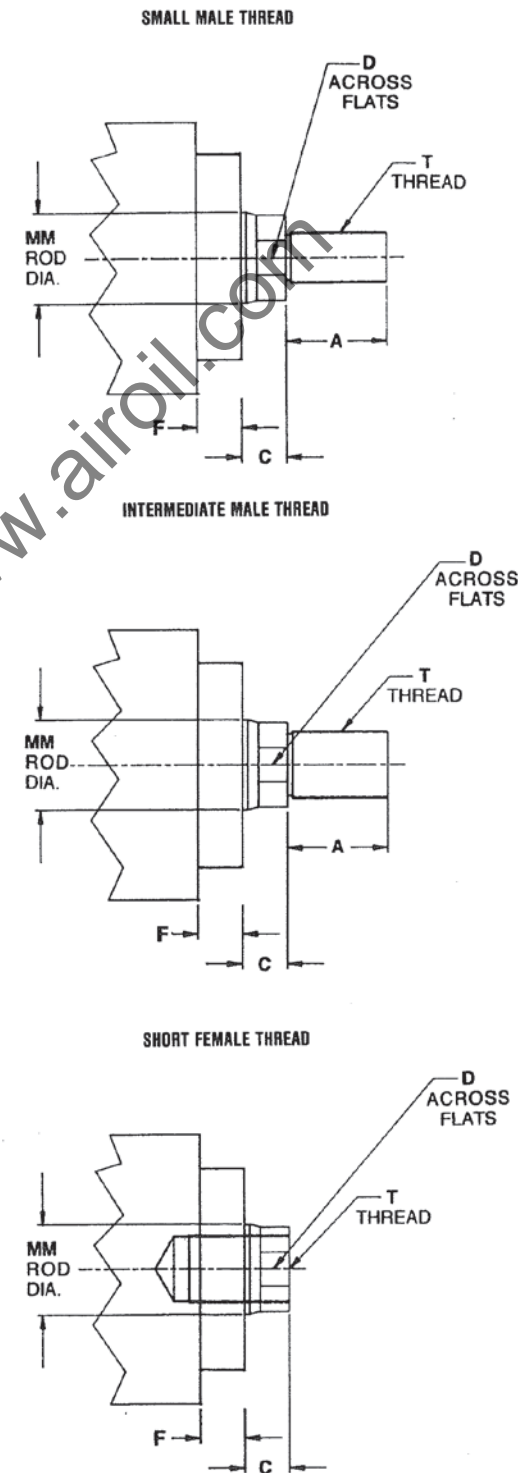
BORE	TD +.000 -.002	TL	TM	UM	WF	XI MIN.	ZJ
2.00	1.250	1.25	3.75	6.25	1.81	6.50	6.81
3.00	1.375	1.38	5.12	7.88	2.00	7.00	8.12
4.00	1.750	1.75	6.62	10.12	2.00	8.50	8.62
5.00	2.000	2.00	7.56	11.56	2.00	9.50	9.62
6.00	2.250	2.25	9.12	13.62	2.25	10.25	10.62
7.00	2.250	2.25	10.12	14.62	2.25	11.00	10.75
8.00	2.500	2.50	11.43	16.43	2.56	11.75	12.19
9.00	2.500	2.50	12.43	17.43	2.56	11.75	12.43
10.00	3.000	3.00	16.50	22.50	2.43	13.00	14.56
12.00	3.500	3.50	19.00	26.00	2.56	15.25	16.31
14.00	4.500	4.50	21.50	30.50	3.00	16.75	18.00
16.00	5.000	5.00	23.50	33.50	4.25	18.75	21.25

NOTE: Trunnion location (XI) must be specified when ordering.

NOTE: Align and mount pillow blocks to avoid bending moments in trunnions.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

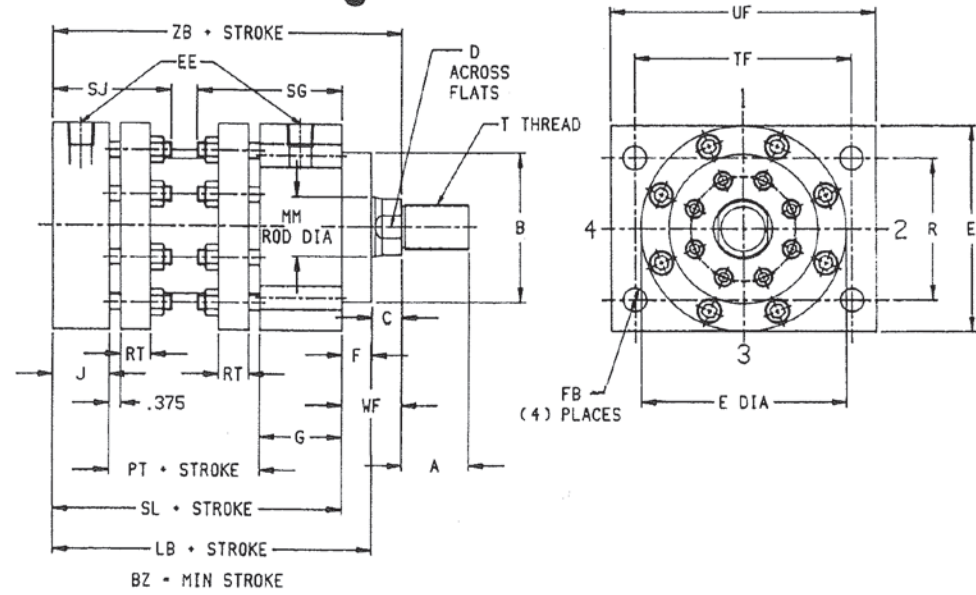
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **MT4**

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD)		
					SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
3.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
4.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	J	2.00	2.00	1.50	1.50-12	1.75-12	1.50-12
	K	2.50	2.25	1.69	1.88-12	2.25-12	1.88-12
5.00	L	3.00	3.00	2.06	1.88-12	2.25-12	1.88-12
	M	3.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
7.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
9.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
12.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
14.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—

SERIES MT 2.00"-16.00" Bores ME5 Head Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

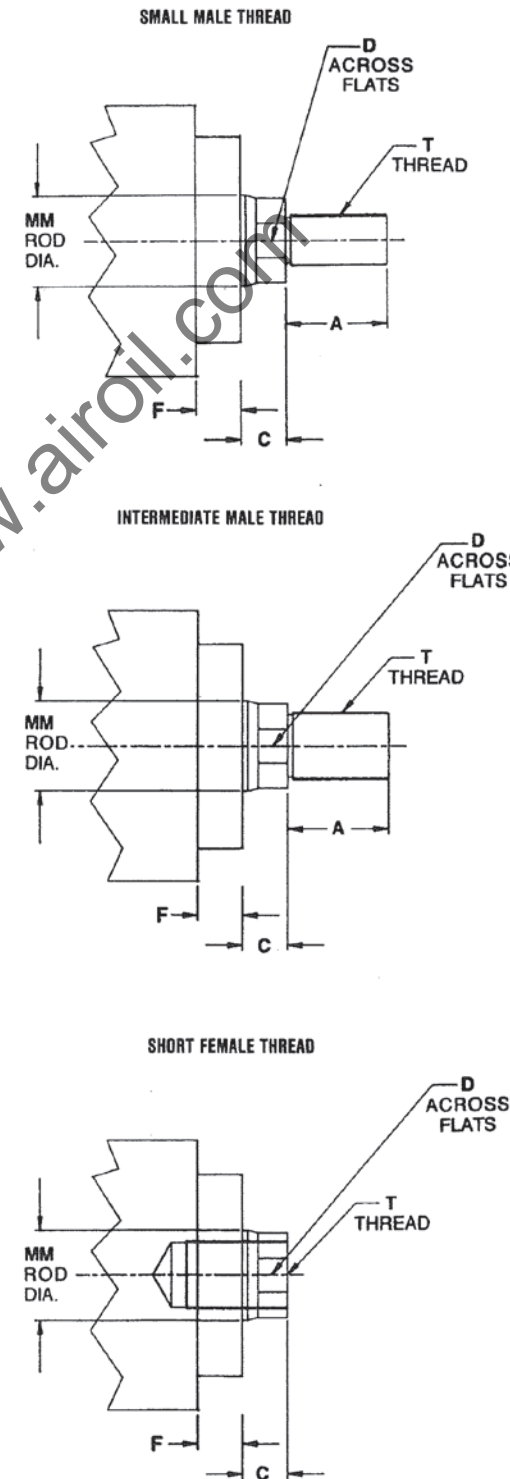
BORE	B	BZ	C	E	EE		F	FB	G	J	LB	PT	R	RT	SG
					SAE STRAIGHT THREAD	NPTF*									
2.00	3.25	1.38	0.81	4.12	#8 (.750-16)	0.50	1.00	0.41	2.25	1.38	6.00	1.38	2.50	0.50	3.47
3.00	4.50	1.75	0.88	5.38	#12 (1.062-12)	0.75	1.12	0.66	2.62	1.75	7.25	1.75	3.38	0.75	4.22
4.00	5.00	2.38	1.00	6.88	#12 (1.062-12)	0.75	1.00	0.78	2.75	1.88	7.62	2.00	4.75	1.00	4.78
5.00	6.38	2.88	1.00	8.25	#12 (1.062-12)	0.75	1.00	1.03	3.00	2.12	8.62	2.50	5.62	1.25	5.41
6.00	7.38	3.25	1.00	9.62	#16 (1.312-12)	1.00	1.25	1.28	3.25	2.25	9.62	2.88	5.88	1.62	6.19
7.00	8.25	3.38	1.00	10.75	#16 (1.312-12)	1.00	1.25	1.28	3.25	2.25	9.75	3.00	6.88	1.75	6.69
8.00	9.75	3.25	1.12	12.38	#20 (1.625-12)	1.25	1.43	1.53	3.62	2.50	11.06	3.50	8.50	1.88	6.81
9.00	9.75	3.25	1.12	13.38	#20 (1.625-12)	1.25	1.43	1.53	3.62	2.50	11.31	3.75	9.50	2.00	6.81
10.00	10.75	3.25	1.00	15.50	#24 (1.875-12)	1.50	1.43	1.78	4.25	3.12	13.56	4.75	11.50	2.38	7.91
12.00	10.75	3.25	1.12	18.75	#24 (1.875-12)	1.50	1.43	2.06	4.50	3.62	15.19	5.62	14.50	2.75	8.78
14.00	12.00	4.00	1.00	21.50	#32 (2.500-12)	2.00	2.00	2.06	5.00	4.25	17.00	5.75	16.00	3.25	9.66
16.00	12.00	3.00	2.25	23.62	#32 (2.500-12)	2.00	2.00	2.56	6.00	5.00	19.00	6.00	17.50	3.75	10.03

*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	SJ	SL	TF	UF	WF	ZB
2.00	2.59	5.00	4.25	5.12	1.81	6.81
3.00	3.34	6.12	5.75	7.12	2.00	8.12
4.00	3.91	6.62	7.25	8.88	2.00	8.62
5.00	4.53	7.62	8.50	10.25	2.00	9.62
6.00	5.19	8.38	10.25	13.25	2.25	10.62
7.00	5.69	8.50	11.25	14.25	2.25	10.75
8.00	5.69	9.62	12.50	15.25	2.56	12.19
9.00	5.69	9.88	13.50	16.25	2.56	12.43
10.00	6.78	12.12	15.50	19.00	2.43	14.56
12.00	7.91	13.75	17.50	21.00	2.56	16.31
14.00	8.91	15.00	20.00	24.00	3.00	18.00
16.00	9.03	17.00	22.00	25.50	4.25	21.25

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

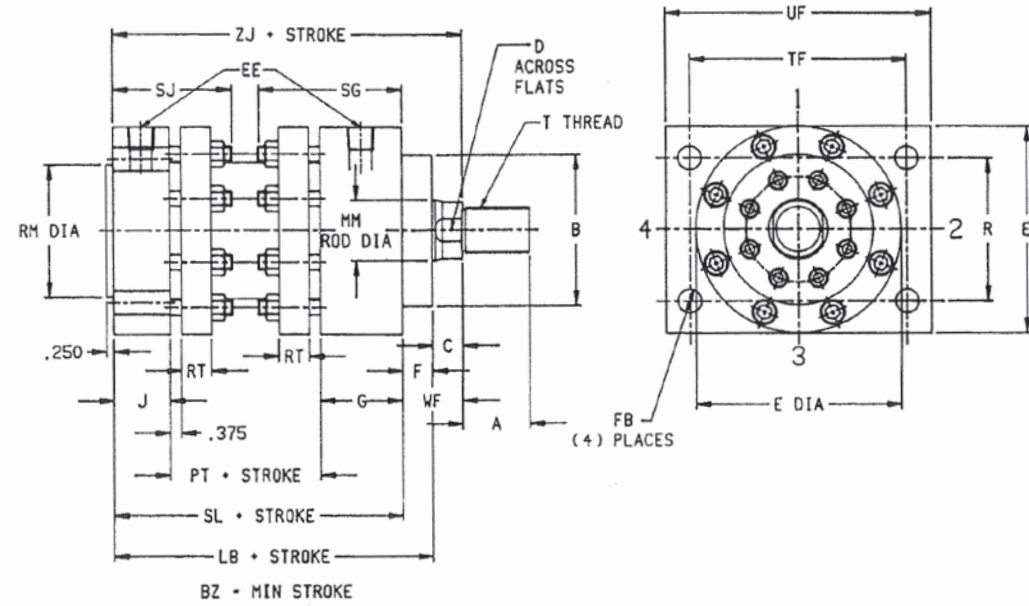
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **ME5**

BORE	ROD DIA. CODE	MM ROD DIA.	CYLINDER		T (THREAD)		
			A	D	SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.30	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12	
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.00	4.62	4.00-12	5.25-12	4.00-12
9.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.00	4.62	4.00-12	5.25-12	4.00-12
	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.00	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
12.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.00	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
14.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—

SERIES MT 2.00"-16.00" Bores ME6 Cap Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

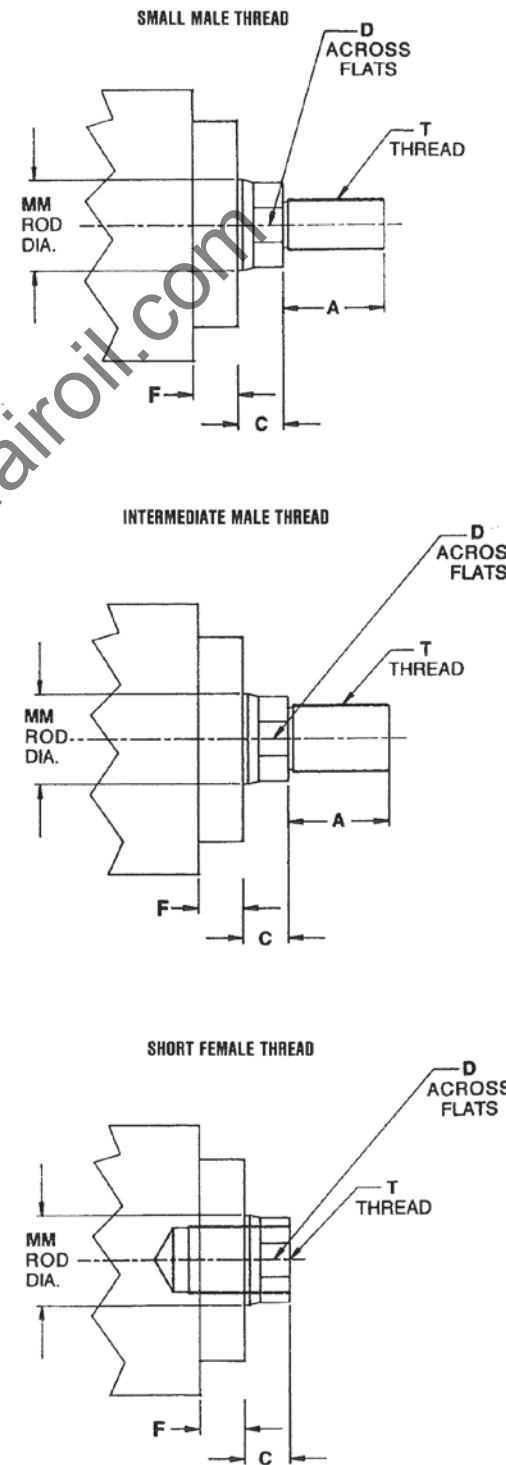
BORE	B	BZ	C	E	EE		F	FB	G	J	LB	PT	R	RM +0.000 -0.002	RT	SG
					SAE STRAIGHT THREAD	NPTF*										
2.00	3.25	1.38	0.81	4.12	#8 (1.062-12)	0.50	1.00	0.41	2.25	1.38	6.00	1.38	2.50	2.000	0.50	3.47
3.00	4.50	1.75	0.88	5.38	#12 (1.062-12)	0.75	1.12	0.66	2.62	1.75	7.25	1.75	3.38	3.625	0.75	4.22
4.00	5.00	2.38	1.00	6.88	#12 (1.062-12)	0.75	1.00	0.78	2.75	1.88	7.62	2.00	4.75	4.375	1.00	4.78
5.00	6.38	2.88	1.00	8.25	#12 (1.062-12)	0.75	1.00	1.03	3.00	2.12	8.62	2.50	5.62	5.000	1.25	5.41
6.00	7.38	3.25	1.00	9.62	#16 (1.312-12)	1.00	1.25	1.28	3.25	2.25	9.62	2.88	5.88	6.000	1.62	6.19
7.00	8.25	3.38	1.00	10.75	#16 (1.312-12)	1.00	1.25	1.28	3.25	2.25	9.75	3.00	6.88	6.000	1.75	6.69
8.00	9.75	3.25	1.12	12.38	#20 (1.625-12)	1.25	1.43	1.53	3.62	2.50	11.06	3.50	8.50	8.000	1.88	6.81
9.00	9.75	3.25	1.12	13.38	#20 (1.625-12)	1.25	1.43	1.53	3.62	2.50	11.31	3.75	9.50	9.000	2.00	6.81
10.00	10.75	3.25	1.00	15.50	#24 (1.875-12)	1.50	1.43	1.78	4.25	3.12	13.56	4.75	11.50	10.000	2.38	7.91
12.00	10.75	3.25	1.12	18.75	#24 (1.875-12)	1.50	1.43	2.06	4.50	3.62	15.19	5.62	14.50	12.000	2.75	8.78
14.00	12.00	4.00	1.00	21.50	#32 (2.500-12)	2.00	2.00	2.06	5.00	4.25	17.00	5.75	16.00	13.000	3.25	9.66
16.00	12.00	3.00	2.25	23.62	#32 (2.500-12)	2.00	2.00	2.56	6.00	5.00	19.00	6.00	17.50	14.250	3.75	10.08

*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	SJ	SL	TF	UF	WF	ZJ
2.00	2.59	5.00	4.25	5.12	1.81	6.81
3.00	3.34	6.12	5.75	7.12	2.00	8.12
4.00	3.91	6.62	7.25	8.88	2.00	8.62
5.00	4.53	7.62	8.50	10.25	2.00	9.62
6.00	5.19	8.38	10.25	13.25	2.25	10.62
7.00	5.69	8.50	11.25	14.25	2.25	10.75
8.00	5.69	9.62	12.50	15.25	2.56	12.19
9.00	5.69	9.88	13.50	16.25	2.56	12.43
10.00	6.78	12.12	15.50	19.00	2.43	14.56
12.00	7.91	13.75	17.50	21.00	2.56	16.31
14.00	8.91	15.00	20.00	24.00	3.00	18.00
16.00	9.03	17.00	22.00	25.50	4.25	21.25

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

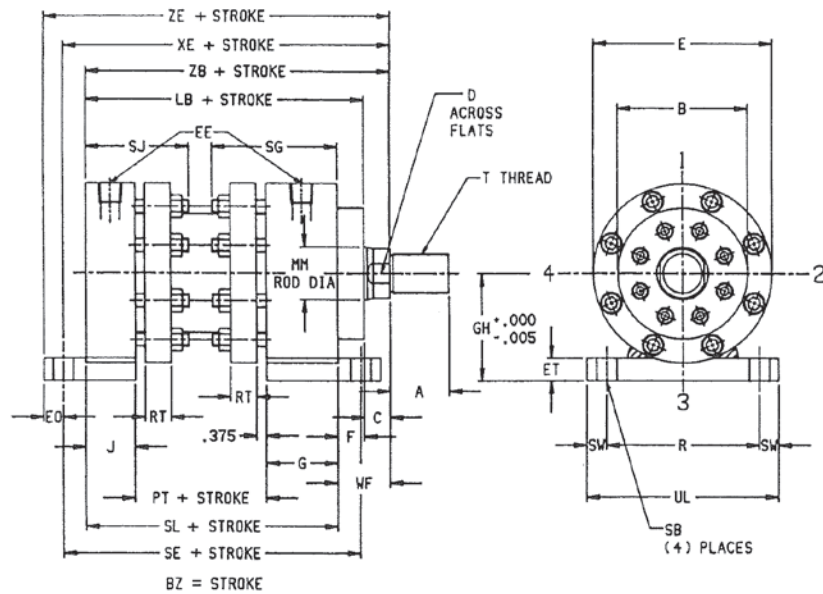
STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **ME6**

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD)		
					SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
9.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
12.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
	T	7.00	7.00	—	5.50-12	—	—
14.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
	T	7.00	7.00	—	5.50-12	—	—
	U	8.00	8.00	—	6.50-12	—	—

SERIES MT 2.00"-16.00" Bores MS7 End Lug Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	E	EE		EQ	ET	F	G	GH	J	LB	PT	R	RT	SB
					SAE STRAIGHT THREAD	NPTF*											
2.00	3.25	1.38	0.81	4.12	#8 (.750-16)	0.50	0.50	0.62	1.00	2.25	2.500	1.38	6.00	1.38	4.00	0.50	0.53
3.00	4.50	1.75	0.88	5.38	#12 (1.062-12)	0.75	0.62	0.75	1.12	2.62	3.250	1.75	7.25	1.75	4.62	0.75	0.66
4.00	5.00	2.38	1.00	6.88	#12 (1.062-12)	0.75	0.75	0.88	1.00	2.75	4.125	1.88	7.62	2.00	5.88	1.00	0.78
5.00	6.38	2.88	1.00	8.25	#12 (1.062-12)	0.75	0.88	1.00	1.00	3.00	4.875	2.12	8.62	2.50	6.75	1.25	0.91
6.00	7.38	3.25	1.00	9.62	#16 (1.312-12)	1.00	1.00	1.25	1.25	3.25	5.750	2.25	9.62	2.88	7.25	1.62	1.03
7.00	8.25	3.38	1.00	10.75	#16 (1.312-12)	1.00	1.00	1.25	1.25	3.25	6.375	2.25	9.75	3.00	8.25	1.75	1.03
8.00	9.75	3.25	1.12	12.38	#20 (1.625-12)	1.25	1.12	1.38	1.43	3.62	7.438	2.50	11.06	3.50	8.88	1.88	1.16
9.00	9.75	3.25	1.12	13.38	#20 (1.625-12)	1.25	1.12	1.38	1.43	3.62	7.938	2.50	11.31	3.75	9.88	2.00	1.16
10.00	10.75	3.25	1.00	15.50	#24 (1.875-12)	1.50	1.25	1.62	1.43	4.25	9.125	3.12	13.56	4.75	14.50	2.38	1.28
12.00	10.75	3.25	1.12	18.75	#24 (1.875-12)	1.50	1.50	1.88	1.43	4.50	11.000	3.62	15.19	5.62	17.00	2.75	1.53
14.00	12.00	4.00	1.00	21.50	#32 (2.500-12)	2.00	1.75	2.12	2.00	5.00	12.625	4.25	17.00	5.75	18.25	3.25	1.78
16.00	12.00	3.00	2.25	23.62	#32 (2.500-12)	2.00	2.00	2.38	2.00	6.00	14.000	5.00	19.00	6.00	22.00	3.75	2.06

*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

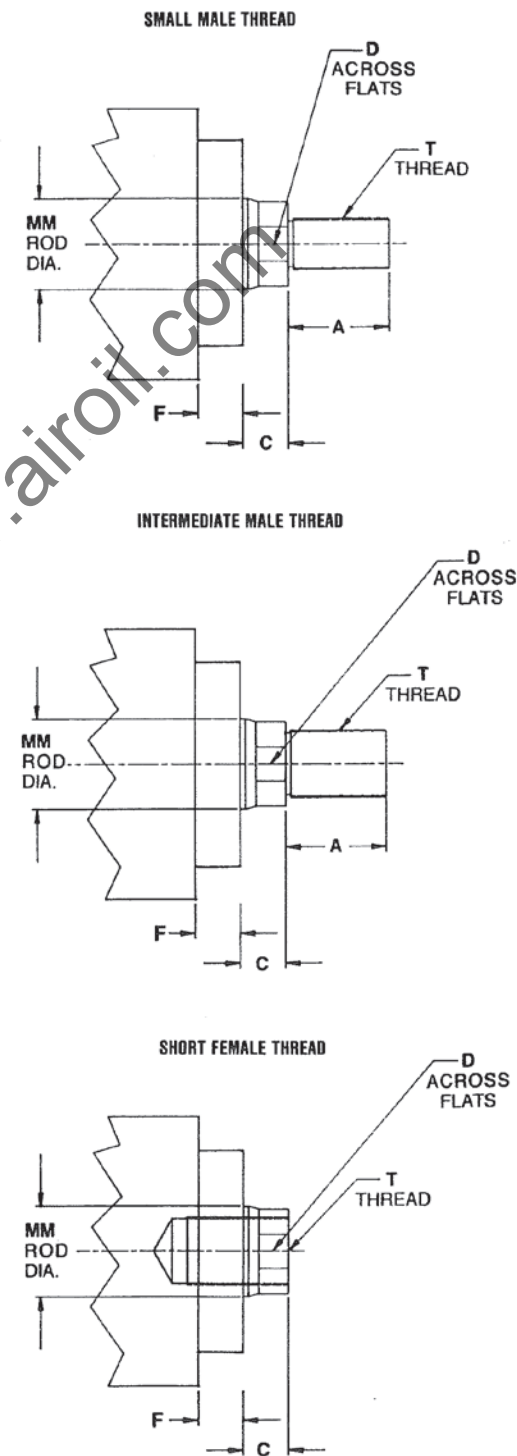
BORE	SE	SG	SJ	SL	SW	UL	WF	XE	ZB	ZE
2.00	6.75	3.47	2.59	5.00	0.50	5.00	1.81	7.69	6.81	8.19
3.00	7.88	4.22	3.34	6.12	0.62	5.88	2.00	9.00	8.12	9.62
4.00	8.38	4.78	3.91	6.62	0.75	7.38	2.00	9.50	8.62	10.25
5.00	9.62	5.41	4.53	7.62	0.88	8.50	2.00	10.62	9.62	11.50
6.00	10.88	6.19	5.19	8.38	1.69	10.62	2.25	11.88	10.62	12.88
7.00	11.50	6.69	5.69	8.50	1.69	11.62	2.25	12.25	10.75	13.25
8.00	12.62	6.81	5.69	9.62	2.19	13.25	2.56	13.69	12.19	14.81
9.00	12.88	6.81	5.69	9.88	2.19	14.25	2.56	13.93	12.43	15.06
10.00	15.62	7.91	6.78	12.12	1.25	17.00	2.43	16.19	14.56	17.43
12.00	17.25	8.78	7.91	13.75	1.62	20.25	2.56	18.19	16.31	19.69
14.00	19.00	9.66	8.91	15.00	2.12	22.50	3.00	20.00	18.00	21.75
16.00	21.00	10.03	9.03	17.00	2.00	26.00	4.25	23.25	21.25	25.25

CAUTION: Check for interference between rod attachment and mounting lug. Specify longer than standard "C" dimension if necessary.

NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES



Dimensions are Affected by the Rod Diameter **MS7**

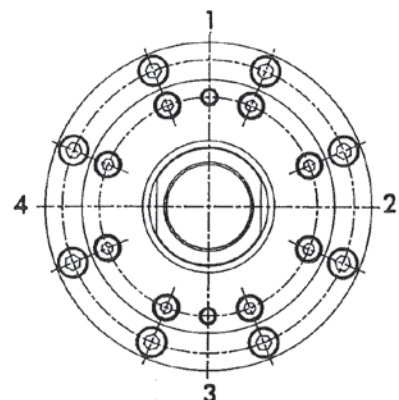
BORE	ROD DIA. CODE	MM ROD DIA.	CYLINDER		T (THREAD)		
			A	D	SM SMALL MALE	IM INTER-MEDIATE MALE	SF SHORT FEMALE
2.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16
2.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14
3.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
3.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12
4.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
4.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	J	2.00	2.25	1.69	1.50-12	1.75-12	1.50-12
5.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
5.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
5.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
6.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
6.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
6.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	K	2.50	3.00	2.06	1.88-12	2.25-12	1.88-12
7.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
7.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
7.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
7.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
7.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
8.00	L	3.00	3.50	2.62	2.25-12	2.75-12	2.25-12
8.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
8.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
8.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
8.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
8.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
8.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
9.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
9.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
9.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
9.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
9.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
9.00	Y	6.00	6.00	5.00	4.50-12	5.75-12	4.50-12
10.00	M	3.50	3.50	3.00	2.50-12	3.25-12	2.50-12
10.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
10.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
10.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
10.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
10.00	T	7.00	7.00	—	5.50-12	—	—
12.00	N	4.00	4.00	3.38	3.00-12	3.75-12	3.00-12
12.00	P	4.50	4.50	3.88	3.25-12	4.25-12	3.25-12
12.00	R	5.00	5.00	4.25	3.50-12	4.75-12	3.50-12
12.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
12.00	T	7.00	7.00	—	5.50-12	—	—
14.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
14.00	T	7.00	7.00	—	5.50-12	—	—
14.00	U	8.00	8.00	—	6.50-12	—	—
16.00	S	5.50	5.50	4.62	4.00-12	5.25-12	4.00-12
16.00	T	7.00	7.00	—	5.50-12	—	—
16.00	U	8.00	8.00	—	6.50-12	—	—

PORT LOCATION

Numbers 1, 2, 3 and 4 around end view of cylinder drawings are for describing optional pipe port locations. Position 1 is standard. In many cases ports can be positioned at 2, 3 or 4 by rotating the heads at assembly. In other cases where it is undesirable to rotate the heads because of corresponding rotation of cylinder mountings, additional ports can usually be placed at positions 2, 3 or 4. Orders or inquiries should state port locations for rod and cap end heads, if other than standard. When changing port locations, careful attention should be paid to clearance between pipes, cylinder mountings, and the heads of any mounting screws.

Standard ports will be supplied at Position 1. Orders should specify pipe port locations if other than standard. Optional ports and bossed ports are available. Refer to the charts below to select the appropriate port.

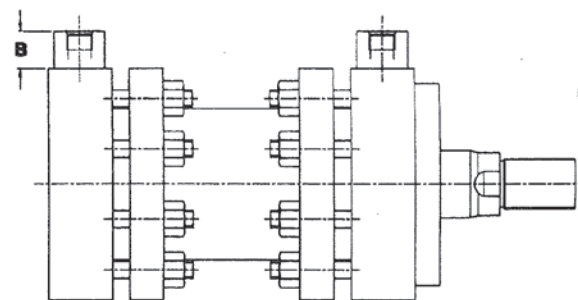
CAUTION: Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. **Fluid velocities in the supply line in excess of 15 feet per second are not recommended.**



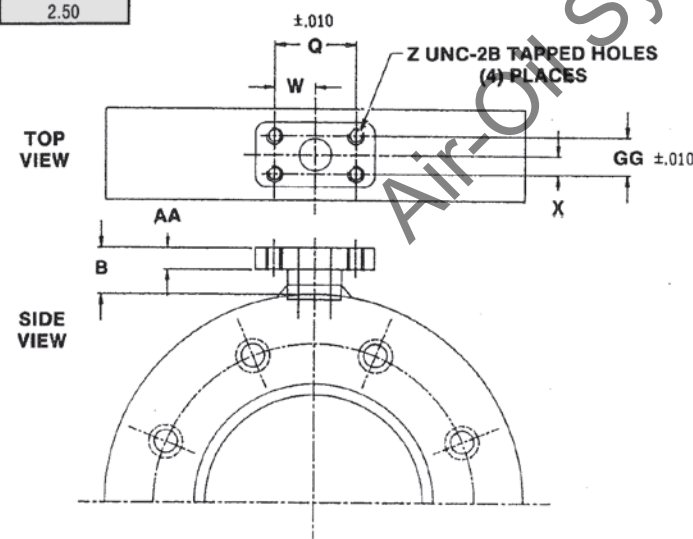
PORT SIZE

SERIES MT OPTIONAL PORTING

BORE	STANDARD SAE PORT	OVERSIZED BOSSSED SAE	DIM. B	STANDARD NPTF PORT	OVERSIZED BOSSSED PORT
2.00	#8 (.750-16)	#12 (1.062-12)	0.75	.50	.75
3.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
4.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
5.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
6.00	#16 (1.312-12)	#20 (1.625-12)	1.12	1.00	1.25
7.00	#16 (1.312-12)	#20 (1.625-12)	1.12	1.00	1.25
8.00	#20 (1.625-12)	#24 (1.875-12)	1.38	1.25	1.50
9.00	#20 (1.625-12)	#24 (1.875-12)	1.38	1.25	1.50
10.00	#24 (1.875-12)	#32 (2.500-12)	1.62	1.50	2.00
12.00	#24 (1.875-12)	#32 (2.500-12)	1.62	1.50	2.00
14.00	#32 (2.250-12)		1.62	2.00	2.50
16.00	#32 (2.250-12)		1.62	2.00	2.50



4-BOLT FLANGE PORTS



OPTIONAL SAE 4-BOLT FLANGE PORTS

BORE	PORT DIA.	GG	X	Q	W	AA	Z	B
2.00	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.00	.75	.88	.44	1.88	.94	.50	.375-16	1.06
4.00	.75	.88	.44	1.88	.94	.50	.375-16	1.06
5.00	.75	.88	.44	1.88	.94	.50	.375-16	1.06
6.00	1.00	1.03	.52	2.06	1.03	.56	.375-16	1.25
7.00	1.00	1.03	.52	2.06	1.03	.56	.375-16	1.25
8.00	1.25	1.19	.59	2.31	1.16	.62	.438-14	1.44
9.00	1.25	1.19	.59	2.31	1.16	.62	.438-14	1.44
10.00	1.50	1.41	.71	2.75	1.38	.81	.500-13	1.75
12.00	1.50	1.41	.71	2.75	1.38	.81	.500-13	1.75
14.00	2.00	1.69	.85	3.06	1.53	1.06	.500-13	2.00
16.00	2.00	1.69	.85	3.06	1.53	1.06	.500-13	2.00

HYDRAULIC FORCE DATA

The formula for determining the force produced by a cylinder is

$$F = A \times \text{PSI}$$

Force (lbs.) = Cylinder Piston Area (sq. in.) X Line Pressure (lbs./sq. in.)

Chart C1 shows the force produced by specific cylinder bore sizes at various pressures. Forces not listed on the chart can be calculated by using the formula $F = A \times \text{PSI}$. An example of this formula follows:

EXAMPLE: Determine the thrust of a 14.00" bore cylinder operating at 1250 p.s.i. hydraulic line pressure.
 $F = 153.94 \times 1250 \quad F = 192,425$

To select the proper bore size, first determine the force required for your particular application, then add a factor of five percent to allow for internal frictional losses.

Locate the total required force in Chart C1 in the column that matches your system's operating pressure. The bore size that produces the necessary total force at the desired operating pressure is the proper size for your application.

PRESSURE RATINGS

Chart C2 shows the pressure ratings for Hanna Series MT Hydraulic Cylinders.

*Ratings are based on the ultimate tensile strength of the weakest component and smallest rod size.

Chart C1 HYDRAULIC CYLINDER FORCE CHART*

Bore	Piston Area Sq. In.	PUSH STROKE Values are Pounds of Force						Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	
2.00	3.14	786	1571	2357	3142	4713	6285	.0136
3.00	7.07	1767	3535	5302	7070	10605	14140	.0306
4.00	12.56	3143	6285	9428	12560	18860	25140	.0544
5.00	19.63	4910	9820	14730	19640	29460	39280	.0860
6.00	28.27	7068	14140	21200	28270	42400	56540	.1224
7.00	38.48	9623	19240	28870	38490	57740	76980	.1666
8.00	50.26	12570	25140	37700	50270	75400	100500	.2176
9.00	63.62	15905	31810	47715	63620	95400	127240	.2754
10.00	78.54	19640	39270	58900	78540	117800	157100	.3393
12.00	113.10	28280	56550	84820	113100	169600	226200	.4886
14.00	153.94	38480	76970	115455	153940	230910	307880	.6664
16.00	201.06	50270	100530	150800	201060	301590	402120	.8686

Chart C1A PULL STROKE

Rod Dia.	Rod Area Sq. In.	To determine pull stroke thrust or consumption, deduct the value for the rod diameter from the corresponding cylinder bore in Chart C1.						Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	
1.00	.78	196	393	590	785	1175	1570	.0034
1.37	1.48	371	742	1113	1485	2230	2970	.0067
1.75	2.40	601	1202	1803	2405	3610	4810	.0104
2.00	3.14	786	1572	2357	3142	4715	6285	.0136
2.50	4.91	1225	2450	3682	4909	7350	9815	.0212
3.00	7.07	1767	3535	5302	7070	10605	14140	.0306
3.50	9.62	2405	4810	7216	9620	14435	19240	.0417
4.00	12.56	3142	6284	9426	12570	18850	25140	.0544
4.50	15.90	3976	7952	11930	15900	23860	31810	.0688
5.00	19.63	4909	9820	14730	19640	29450	39270	.0860
5.50	23.76	5940	11880	17820	23760	35640	47575	.1028
6.00	28.27	7068	14135	21200	28270	42400	56540	.1224
7.00	38.49	9623	19240	28870	38490	57740	76980	.1666
8.00	50.26	12565	25130	37695	50260	75390	100520	.2176

To obtain forces not given, multiply piston area times operating pressure.
 *Forces given do not allow for frictional or other power losses.
 1 U.S. Gallon = 231 Cubic Inches

Chart C2 HYDRAULIC CYLINDER RATING* (P.S.I.)

Bore	3:1 Factor of Safety	4:1 Factor of Safety
2.00	2650	2000
3.00	2650	2000
4.00	2650	2000
5.00	2650	2000
6.00	2650	2000
7.00	2650	2000
8.00	2650	2000
9.00	2650	2000
10.00	2650	2000
12.00	2650	2000
14.00	2650	2000
16.00	2250	1700

STROKE LIMITATION DATA

The rod diameter has to be capable of withstanding any compressive force developed by the cylinder working against the load. A piston rod diameter with adequate column strength to handle the compressive force of the application can be selected from the convenient pre-calculated chart below.

To use this chart find the force value, developed by the application, in the left column. Next, select the figure which resembles your application and then multiply "D" times the factor given in that figure. Finally, opposite the corresponding force value, find the value of "L" which is equal to, or greater than, the figure derived from factoring "D." Directly above is the rod diameter which is capable of withstanding the forces developed in the application.

EXAMPLE: Cylinder Bore = 10.00" Operating PSI = 2000
 Force Value is 157,100
 Application—Resembles Fig. 2 End Lug Mtg.
 Stroke = 80"
 "L" = 0.7 x 80; L = 56
 Correct Rod Diameter = 4.00"

The total force is 157,000 lbs., and the value of "L" is 56 inches in this application. The smallest diameter rod capable of handling this situation is 4.00 inches.

If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D."

NOTE: SEE APPLICATION FIGURES ON NEXT PAGE.

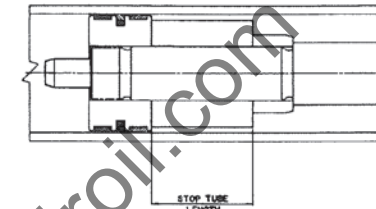
FORCE VALUE in pounds	VALUE OF "L" IN INCHES															
	PISTON ROD DIAMETER															
	1.00	1.38	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	7.00	8.00		
400	85															
600	70	132														
800	60	114	184													
1000	54	102	165	215												
1300	47	90	145	188												
1700	41	78	127	165	258											
2100	37	71	114	149	232											
2500	34	65	104	136	213	304										
3000	31	58	95	124	192	280	381									
4000	27	51	83	108	162	242	330	430								
5000	24	46	74	96	150	217	295	385								
6000	22	42	67	89	137	198	269	352	443							
8000	19	36	58	76	119	172	233	305	384	475						
10000	17	32	52	68	106	153	209	273	344	426	514					
12000	15	29	48	62	97	139	190	249	314	328	468	559	761			
16000	13	26	42	54	84	121	165	215	272	316	407	484	659	861		
20000		23	38	48	76	109	149	193	243	301	365	433	590	770		
30000		18	31	39	61	89	120	153	198	245	297	354	481	629		
40000			27	34	53	77	104	136	172	213	257	306	417	545		
50000			23	31	48	69	93	122	153	190	230	274	373	487		
60000			21	28	44	63	85	111	140	174	210	250	340	445		
80000				24	38	54	74	96	122	143	192	217	295	385		
100000					34	48	66	86	109	132	163	194	264	344		
120000						31	44	60	79	100	121	142	177	240	314	
140000							41	56	73	92	112	135	164	223	291	
160000							38	52	63	86	105	129	153	209	272	
200000								47	61	77	93	115	137	187	244	
250000								42	54	69	84	103	123	167	218	
300000														152	199	
350000															141	184
400000															131	172
500000															118	154

If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D."

STOP TUBE DATA

Long stroke cylinders can be subjected to a buckling action and excessive bearing wear due to the weight of the exposed rod. To reduce wear a stop tube is recommended.

All cylinders cushioned and non-cushioned are supplied with single piston construction. General construction of cylinder stop tube is illustrated below.



To determine if a stop tube is required, find the total value of "L" using the stroke limitation chart. Compare this value with the stop tube chart. If the value of "L" exceeds 40 inches, you can find the recommendation for stop tube length at the bottom of the chart.

EXAMPLE PROBLEM:
 Cylinder Model MS7-MT-NC-8-45-NSM-1A
 Pressure—1500 PSI
 End Lug Mount—Horizontal

From the description, the cylinder falls into Fig. 3. To determine the value of "L":

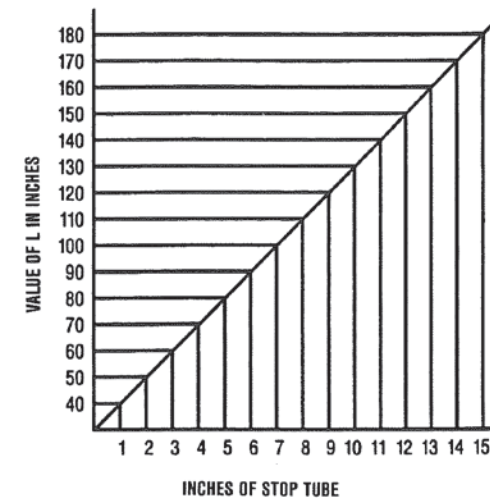
$$2 \times \text{Stroke} (2 \times 45) = 90$$

$$\text{Total Value of "L"} = 90$$

Looking this up on the chart, you'll find a recommended stop tube length of 6 inches.

The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and recheck column strength on stroke limitation chart.

STOP TUBE CHART

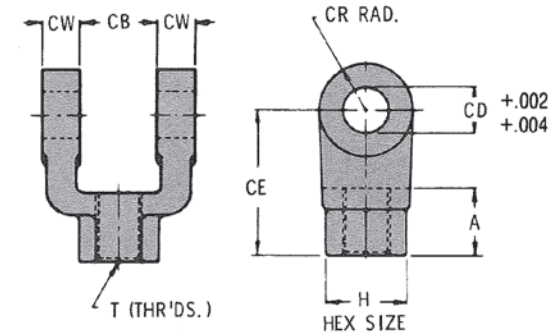


ROD END CONNECTION	Diagram
FIXED & WELL GUIDED	FIG. 1 $"L" = 0.5 \times D$
PIVOTED AND WELL GUIDED	FIG. 2 $"L" = 0.7 \times D$
SUPPORTED NOT WELL GUIDED	FIG. 3 $"L" = 2 \times D$
PIVOTED AND WELL GUIDED	FIG. 4 $"L" = 0.7 \times D$ FOR LONG STROKE SUPPORT HEAD HEAD NOT SUPPORTED $"L" = D$
	FIG. 5 $"L" = 0.7 \times D$
	FIG. 6 $"L" = D$
	FIG. 7 $"L" = D$
	FIG. 8 $"L" = D$

These are standard accessories matched to bore size and piston rod code. The Clevis Bracket (Item MB) fits the cap end of Model MP1. The Bracket (Item B) fits the piston Rod Clevis with the same number (i.e. B-7 Bracket fits V-7 Rod Clevis). The Clevis Pin (Item PC) is furnished with Model MP1 and fits the Clevis Bracket (Item MB). Specify if additional pins are required. If you require accessories other than standard for that bore size or piston rod, specify the item number on your order.

***CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

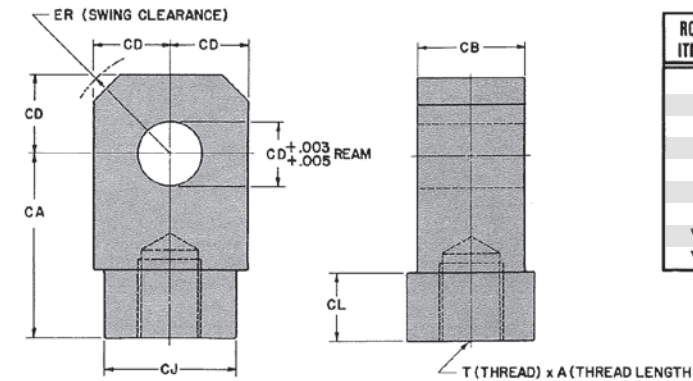
Rod Clevis



Use with Item B Brackets and Item P Pin.

ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-2	F	1.12	1.25	.75	2.38	.88	.62	1.25	.75-16	14,000
V-3	G	1.62	1.50	1.00	3.12	1.12	.75	1.75	1.00-14	22,500
V-4	H	2.00	2.00	1.37	4.12	1.62	1.00	2.00	1.25-12	41,250
V-5	J	2.25	2.50	1.75	4.50	2.00	1.25	2.75	1.50-12	57,000
V-6	K	3.00	2.50	2.00	5.50	2.25	1.25	3.00	1.88-12	75,000
V-7	L	3.50	3.00	2.50	6.50	2.88	1.50	3.50	2.25-12	112,500
V-8	M	3.50	3.00	3.00	6.75	3.12	1.50	3.88	2.50-12	135,000
V-10	P	4.50	4.00	3.50	8.50	3.88	2.00	5.00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4.38	2.25	6.19	4.00-12	270,000

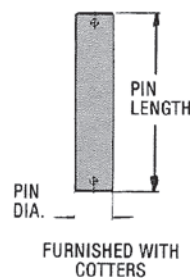
Rod Eye



ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-2	F	1.12	2.06	1.25	.75	-	-	1.12	.75-16	12,500
Y-3	G	1.62	2.81	1.50	1.00	-	-	1.44	1.00-14	20,250
Y-4	H	2.00	3.44	2.00	1.37	-	-	2.00	1.25-12	37,000
Y-5	J	2.25	4.00	2.50	1.75	-	-	2.50	1.50-12	59,000
Y-6	K	3.00	5.00	2.50	2.00	3.25	2.50	2.88	1.88-12	67,500
Y-7	L	3.50	5.81	3.00	2.50	4.00	2.81	3.56	2.25-12	101,250
Y-8	M	3.50	6.12	3.00	3.00	5.00	2.50	4.25	2.50-12	121,500
Y-10	P	4.50	7.62	4.00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5.50	9.12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

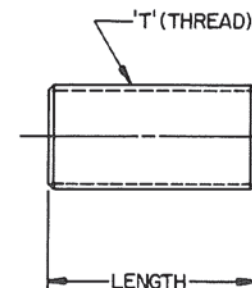
Pin

Use with Item V Rod Clevis, Item Y Rod Eye and Item B Brackets.



PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P2	3.09	.75	13,800
P3	3.60	1.00	24,500
P4	4.66	1.37	46,500
P5	5.66	1.75	75,150
P6	5.72	2.00	98,150
P7	6.94	2.50	153,400
P8	7.19	3.00	220,900
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

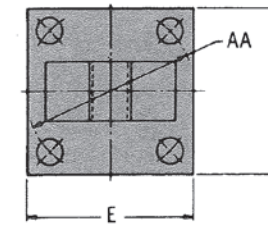
Piston Rod Stud



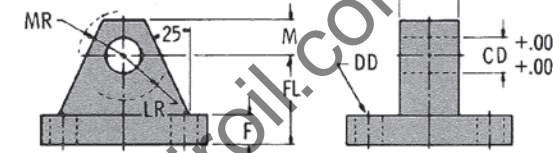
ITEM NO.	T	LENGTH
Stud 2	.75-16	2.25
Stud 3	1.00-14	3.25
Stud 4	1.25-12	4.00
Stud 5	1.50-12	4.50

Brackets

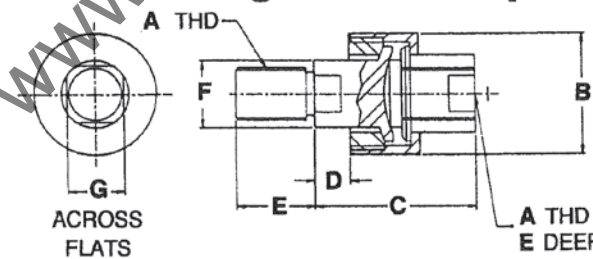
Use with Item V Rod Clevis and Item P Pin.



BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
B-2	3.60	1.25	.750	.56	.88	3.50	.62	1.88	.88	.75	.88	6,300
B-3	4.60	1.50	1.000	.69	1.38	4.50	.75	2.25	1.25	1.00	1.25	10,000
B-4	5.40	2.00	1.375	.69	1.75	5.00	.88	3.00	1.75	1.38	1.75	19,250
B-5	7.00	2.50	1.750	.94	2.25	6.50	.88	3.12	2.12	1.75	2.12	21,200
B-6	8.10	2.50	2.000	1.06	2.56	7.50	1.00	3.50	2.38	2.00	2.38	24,500
B-7	9.30	3.00	2.500	1.19	3.12	8.50	1.00	4.00	2.94	2.50	2.94	25,000
B-8	10.60	3.00	3.000	1.31	3.25	9.50	1.00	4.25	3.19	2.75	3.19	22,500
B-10	13.60	4.00	3.500	1.81		12.62	1.69	7.25	3.62	3.50	3.62	58,500
B-12	16.19	4.50	4.000	2.06		14.88	1.94	7.75	4.12	4.00	4.12	73,250

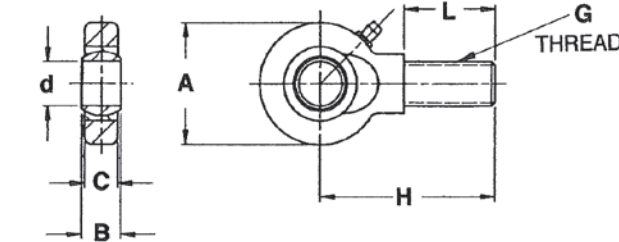


Linear Alignment Coupler



PART NO.	A	B	C	D	E	F	G	H	MAX. PULL LOAD
S-2	.750-16	1.75	2.31	0.50	1.12	0.94	0.81	1.12	8,750
S-3	1.000-14	2.50	2.94	0.53	1.62	1.34	1.16	1.62	16,125
S-4	1.250-12	2.50	2.94	0.53	1.62	1.34	1.16	1.62	19,600
S-5	1.500-12	3.25	4.38	0.88	2.25	1.94	1.75	2.38	34,000
S-6	1.875-12	3.75	5.62	1.00	3.00	2.94	-	-	41,250
S-7	2.250-12	6.75	6.38	1.00	3.50	2.75	2.38	2.88	99,250

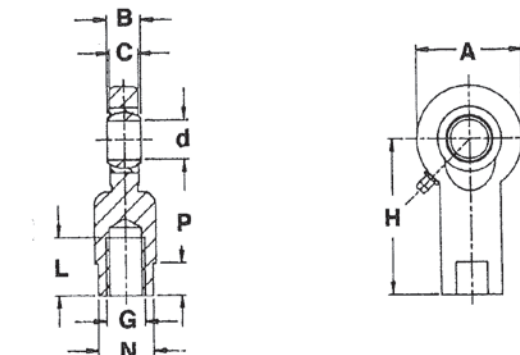
Universal Spherical Rod Eyes



Male

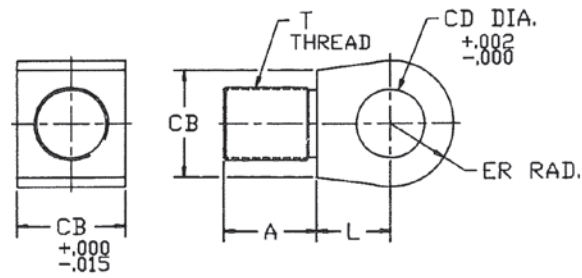
PART NO.	d	B	H	G	L	A	C	LBS. CAPACITY
UMY-12	0.75	0.66	3.00	.750-16	1.56	2.06	0.56	7500
UMY-20	1.25	1.09	4.56	1.250-12	2.56	3.31	0.94	20700
UMY-24	1.50	1.31	5.41	1.500-12	3.06	4.00	1.12	29800
UMY-28	1.75	1.53	6.31	1.750-12	3.56	4.62	1.31	40800
UMY-32	2.00	1.75	7.19	2.000-12	4.06	5.25	1.50	52800
UMY-36	2.25	1.97	8.12	2.250-12	4.50	5.88	1.69	66800
UMY-40	2.50	2.19	9.00	2.500-12	5.00	6.50	1.88	82800

Female



PART NO.	d	B	H	G	L	A	N	C	P	LBS. CAPACITY
UFY-12	0.75	0.66	3.00	.750-16	1.12	2.06	1.19	0.56	0.62	7500
UFY-20	1.25	1.09	4.56	1.250-12	1.81	3.31	1.88	0.94	0.75	20700
UFY-24	1.50	1.31	5.41	1.500-12	2.12	4.00	2.31	1.12	1.00	29800
UFY-28	1.75	1.53	6.31	1.750-12	2.44	4.62	2.75	1.31	1.19	40800
UFY-32	2.00	1.75	7.19	2.000-12	2.75	5.25	3.12	1.50	1.19	52800
UFY-36	2.25	1.97	8.12	2.250-12	3.00	5.88	3.38	1.69	1.38	66800
UFY-40	2.50	2.19	9.00	2.500-12	3.25	6.50	3.69	1.88	1.38	82800

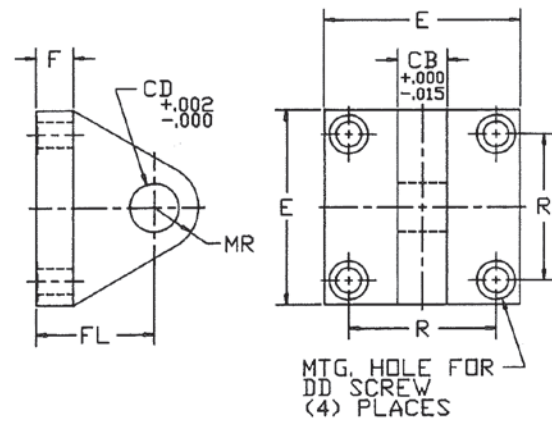
Male Rod Eye



ROD EYE ITEM NO.	A	CB	CD	ER	T	L	*LBS. CAPACITY
MY-2	.88	1.25	.752	.62	.75-16	.88	5,000
MY-3	1.25	1.50	1.252	1.12	1.00-14	1.38	9,300
MY-4	1.62	2.00	1.377	1.25	1.25-12	1.50	14,900
MY-5	1.88	2.25	1.502	1.38	1.50-12	1.62	22,250
MY-6	2.38	2.75	1.752	1.62	1.88-12	1.88	36,000
MY-8	2.88	3.25	2.002	1.88	2.25-12	2.12	53,200
MY-10	3.38	3.75	2.502	2.38	2.50-12	2.62	66,700
MY-12	4.00	4.50	3.002	2.88	3.00-12	3.12	97,300
MY-14	5.50	6.00	3.502	3.38	4.00-12	3.62	176,000
MY-16	6.50	7.50	4.252	4.00	5.00-12	4.25	280,000

Clevis Brackets

Use with MP1 Mount.

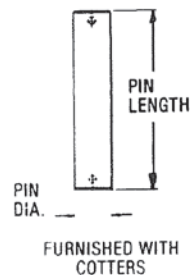


BRACKET ITEM NO.	CB	CD	DD	E	F	FL	MR	R	*LBS. CAPACITY
MB-2	1.00	.752	.38	3.00	.56	1.75	.62	2.25	7,350
MB-3	1.25	1.252	.62	5.00	.94	3.00	1.12	3.75	18,562
MB-4	1.25	1.377	.75	6.00	1.19	3.88	1.25	4.50	21,000
MB-5	1.25	1.502	1.00	7.00	1.44	4.62	1.38	5.00	23,625
MB-6	1.50	1.752	1.25	8.25	1.69	5.62	1.62	6.00	33,525
MB-8	3.00	2.002	1.50	10.00	1.94	6.88	1.88	7.25	79,200
MB-10	3.50	2.502	1.75	13.25	2.19	8.75	2.38	10.00	118,650
MB-12	4.50	3.002	2.00	15.75	2.44	10.25	2.88	12.00	186,300
MB-14	5.00	3.502	2.00	18.00	2.44	11.25	3.38	14.25	231,707
MB-16	6.00	4.252	2.50	20.50	2.94	12.50	4.00	16.00	354,387

Clevis Pin

Use with Item MY Rod Eye and Item MB Clevis Bracket. Included with MP1 Mount.

PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
PC-2	3.25	.750	13,800
PC-3	3.75	1.250	38,350
PC-4	4.00	1.375	46,500
PC-5	4.75	1.500	55,200
PC-6	5.50	1.750	75,150
PC-8	7.00	2.000	98,150
PC-10	8.00	2.500	153,400
PC-12	10.50	3.000	220,900
PC-14	11.50	3.500	300,650
PC-16	13.50	4.250	443,000



* CAUTION:

Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load for that accessory.

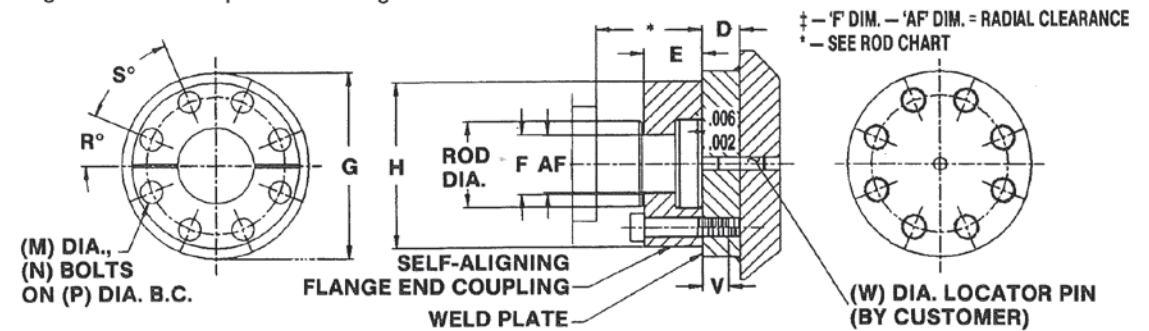
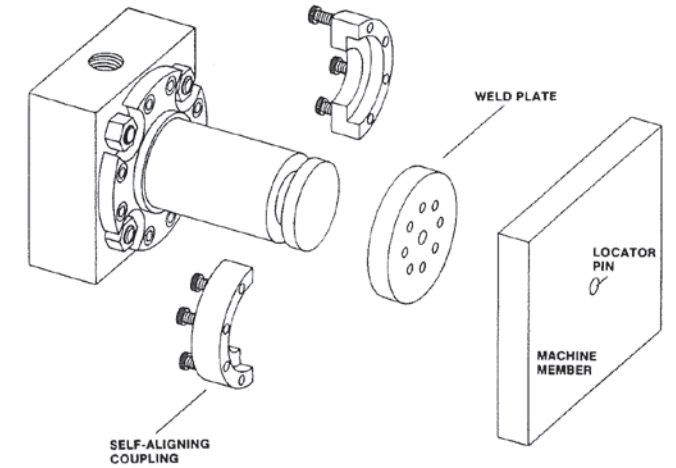
Self-Aligning Rod End Coupling

Hanna's Self-Aligning Rod End Coupling permits fast, easy assembly, disassembly, installation and servicing. Precision-machined, two-piece steel construction provides close radial alignment between piston rod end and machine member.

Allowing for radial movement increases seal and bearing life within the cylinder by eliminating much of the side load. High-tensile alloy steel, socket head cap screws and all-steel construction are designed to take full cylinder load with a factor of safety.

The Self-Aligning Rod End Coupling is used in conjunction with Hanna's RC rod end.

A Weld Plate is an added accessory for use with the Self-Aligning Rod End Coupling. It eliminates lay-out, drilling and tapping each hole to match the coupling on your machine. The hole in the center of the Weld Plate is accurately drilled for a locating pin for fast, close positioning to the machine prior to welding.

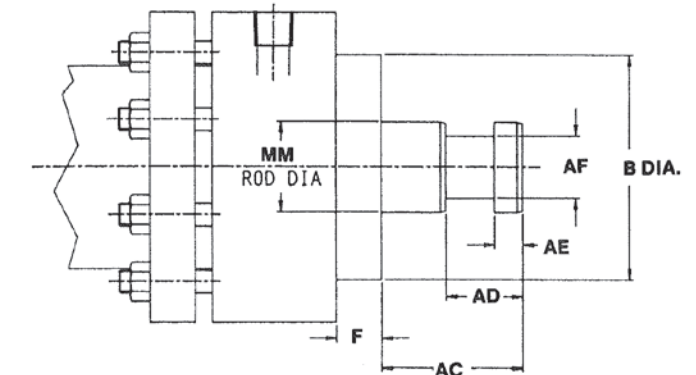


COUPLING NO.	ROD DIA. MM	AF ±	E	F ±	H	M	N	P	R	S	V	WELD PLATE NO.	D	G	W PIN DIA.	BOLT TORQ. FT. LB.
CP-100	1.00	.688	.62	.75	2.00	.250-20	6	1.50	30	60	.375	WP-100	.500	2.50	.25	13
CP-138	1.38	.875	.69	.938	2.50	.312-18	6	2.00	30	60	.562	WP-138	.625	3.00	.25	25
CP-175	1.75	1.12	.88	1.19	3.00	.375-16	8	2.38	22.5	45	.625	WP-175	.750	3.50	.25	45
CP-200	2.00	1.38	1.25	1.44	3.50	.375-16	12	2.69	15	30	.750	WP-200	.875	4.00	.38	45
CP-250	2.50	1.75	1.38	1.88	4.25	.500-13	8	3.44	22.5	45	.875	WP-250	1.00	5.00	.38	80
CP-300	3.00	2.25	1.88	2.38	5.00	.500-13	12	4.00	15	30	.875	WP-300	1.00	5.50	.38	80
CP-350	3.50	2.50	2.00	2.62	5.88	.625-11	12	4.69	15	30	1.00	WP-350	1.12	6.50	.38	200
CP-400	4.00	3.00	2.00	3.12	6.38	.625-11	12	5.19	15	30	1.00	WP-400	1.12	7.00	.38	200
CP-450	4.50	3.50	2.38	3.62	6.88	.750-10	8	5.69	22.5	45	1.12	WP-450	1.25	7.50	.38	350
CP-500	5.00	3.88	2.50	4.00	7.38	.625-11	12	6.19	15	30	1.00	WP-500	1.38	8.00	.38	200
CP-550	5.50	4.38	3.12	4.50	8.25	.750-10	12	6.88	15	30	1.38	WP-550	1.50	9.00	.38	350

NOTE: FOR LARGER COUPLING SIZES, CONSULT FACTORY

RC ROD END DIMENSIONS

ROD STYLE	ROD CODE	ROD DIA MM	AC	AD	AE	AF DIA
RC-100	F	1.00	1.62	.938	.375	.688
RC-138	G	1.38	2.25	1.06	.375	.875
RC-175	H	1.75	2.75	1.31	.500	1.12
RC-200	J	2.00	3.12	1.69	.625	1.38
RC-250	K	2.50	4.00	1.94	.750	1.75
RC-300	L	3.00	4.50	2.44	.875	2.25
RC-350	M	3.50	4.50	2.69	1.00	2.50
RC-400	N	4.00	5.00	2.69	1.00	3.00
RC-450	P	4.50	5.50	3.19	1.50	3.50
RC-500	R	5.00	6.00	3.19	1.50	3.88
RC-550	S	5.50	6.50	3.94	1.88	4.38



ELECTRONIC & ELECTRICAL CONTROLS

Proximity Switches

Hanna offers GO Model 75 and Model 77 proximity switches for mounting on Series MT cylinders through 8.00" bores.

The GO switch uses three magnets to move a common terminal between two contacts. The primary magnet is held in the retracted position, with one of its magnetic poles attracted to the unlike pole of the center magnet. At the same time, the bias magnet is being repelled by the like pole of the center magnet. In this mode (Figure 1), the rod connected to the primary magnet keeps the common terminal in the Normally Closed (N/C) contact position.

When a ferrous actuator enters the sensing area of the switch (Figure 2), the magnetic attraction of the primary magnet to the center magnet is weakened. The primary magnet moves toward the actuator, pulling the connecting rod forward and moving the common terminal to the Normally Open (N/O) contact position.

SPECIFICATIONS

Size—(Model 75): 5/8" dia. x 4-5/16" long, with 5/8"-18 NF x 2-13/16" threads.

Size—(Model 77): 3/4" dia. x 5-13/16" long, with 3/4"-16 UNF x 2-7/8" threads.

Sensing Distance: 0.100" end sensing.

Differential: Approximately .040".

Response Time: 8 milliseconds.

Temperature Rating: -40° F to +221° F.

Contacts: Single Pole, Double Throw, Form C Silver cadmium oxide, gold flashed.

Rating: 2 amp @ 240 VAC, 50 mA @ 24VDC (CSA only). 250 VDC @ .5 amp resistive (UL only).

Housing: Stainless steel.

Conduit Outlet: 1/2"—14 NPT. One location.

Repeatability: 0.002" typical.

ORDERING INFORMATION

GO Models 75 and 77 Proximity Switches are available on Hanna's Series MT Mill-Type Hydraulic Cylinders 2.00" through 8.00" bores. Consult factory for availability and mounting on bore sizes over 8.00".

Switches will be mounted at the factory according to customer specified locations. Specify mounting position of switches and pipe port location, referring to numbered positions on end view of cylinder as shown.

Position location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End. Position 5 is at back face of Blind Head.

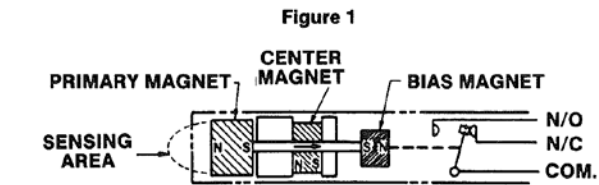
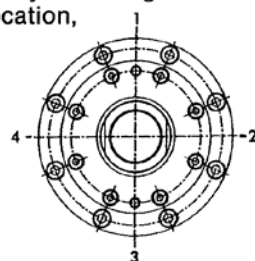


Figure 1 Unoperated

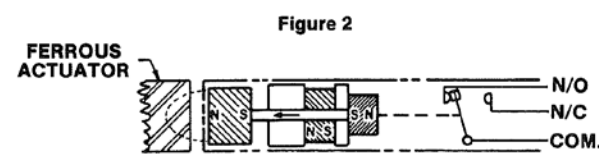
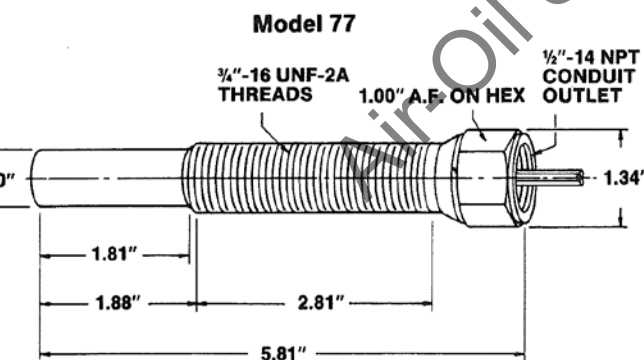
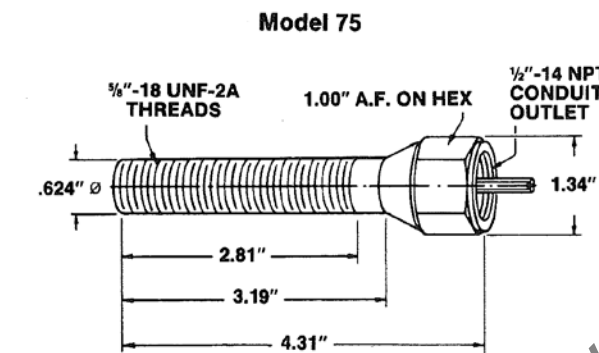
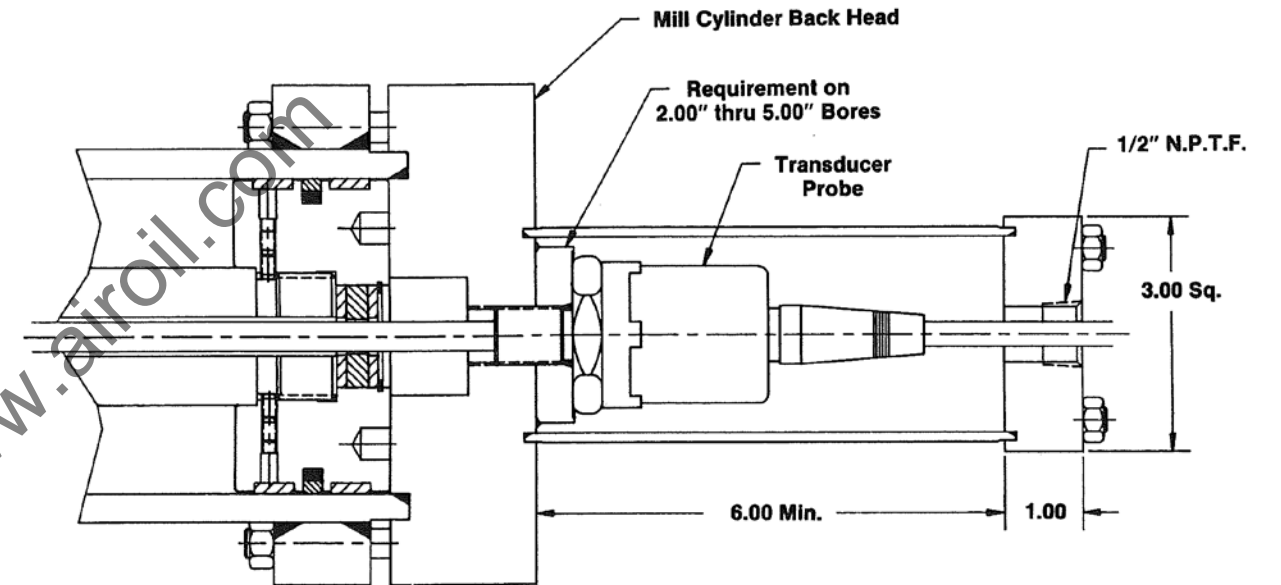


Figure 2 Operated



Electronic Feedback Device



Hanna's Electronic Feedback Device is ideal for a wide range of mill-type cylinder applications, including edge guiding on coil processing equipment, screwdown cylinder roll positioning, forming and bending of precise metal shapes, rapid acceleration and deceleration of large masses, and other applications where precise control is required. Positional accuracy of ±.001 and repeatability of ±.001 are easily obtained in digital systems. Analog responses on positions less than .010 are common.

Standard mountings for Series MT cylinders equipped with the Electronic Feedback Device are MT4 Intermediate Fixed Trunnion, ME5 Head Flange and MS7 End Lugs. MT cylinders with mounting styles MP1 Fixed Double Ear Clevis, MP3 Fixed Single Ear Clevis and MPU3 Spherical Bearing Mount can be custom modified to accept the feedback device. Please consult Factory.

The Electronic Feedback Device is available on all bore sizes from 2.00" through 16.00". Hanna can provide Series MT cylinders with the device installed as a complete package. We can also supply MT cylinders fully prepared to accept customer-installed devices.

INSTALLATION, OPERATION AND MAINTENANCE DATA

INSTALLATION:

The pipe ports of cylinders are sealed with plastic plugs. The plugs protect the precision internal parts by sealing out damaging dirt and grit. Do not remove port seals until ready to connect piping. To protect cylinders, clean all pipes and pipe fittings of dirt, scale, and thread chips. A filter is recommended to keep the operating fluid free of foreign matter.

Accurate mounting and alignment are essential to proper cylinder performance. By eliminating side loading, packing and bearing life will be increased. Mounting surfaces should be straight, bearings for pin and trunnion mounting must be in line.

Dirt or abrasive matter adhering to the piston rod may cause excessive wear to the piston rod and gland. For best results, protect the cylinder from such dirt. A piston rod protective shield is ideal for this purpose.

OPERATION:

Needle valves in cylinder head and cap of adjustable cushioned cylinders permit regulation of cushioning effect. Adjust needle valve with an Allen wrench, rotating clockwise to increase cushioning and counter-clockwise to decrease cushioning effect. Cushion adjustment needles require only about one to one and a half turn adjustment. Speed control valves are essential for obtaining the best cushioning operation. A proper balance of cushion needle and flow control valve adjustment should result in a smooth stop with no bouncing.

MAINTENANCE:

Parts which may need replacement in the course of normal use are the rod wiper and the packings for the piston rod.

The need for replacement of the piston rod packing will become evident through the escaping of fluid around the gland.

To replace rod wiper or rod packings, remove the gland from the cylinder. Remove worn rod wiper and rod packing. To reassemble, slip new rod wiper and rod packing into grooves. Care should be exercised not to nick the lips of the packings. Be sure to retorque gland screws to the specified torque for the cylinder. (See torque chart below.)

It is recommended that new "O" rings be installed each time the cylinder is disassembled for maintenance. This applies to tube and gland "O" rings. The cushion needle valve "O" rings should also be replaced if these parts are disassembled. When reassembling, be sure to apply proper bolt torque. (See torque chart below.)

If the cushion action of the cylinder fails, check to determine if the cushion sleeve has been worn on its outside diameter, and if foreign particles have become lodged between the face of the sleeve and the cylinder head bore.

If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned correctly with the load it is pushing or pulling. 4. That the piston packings or the piston rod packings are not worn, allowing pressure to escape.

Replacement parts can be furnished quickly if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number, as shown. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

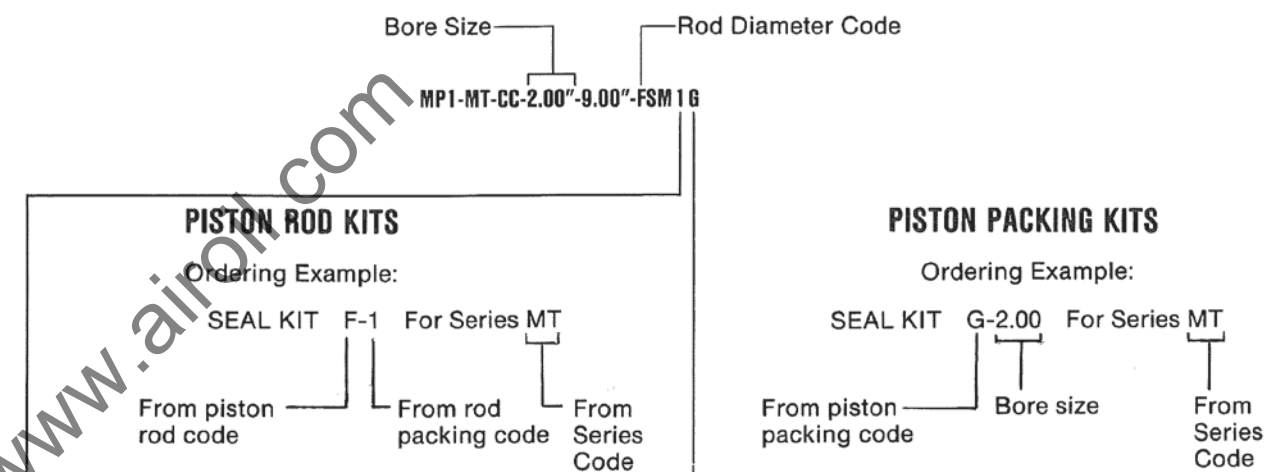
FASTENER TORQUES

BORE	HEAD BOLT TORQUE		GLAND SCREW TORQUE	
	BOLT SIZE	TORQUE	SCREW SIZE	TORQUE
2.00	.312-18	25 ft-lbs.	.312-18	25 ft-lbs.
3.00	.312-18	25	.312-18	25
4.00	.375-16	45	.375-16	45
5.00	.500-13	100	.437-14	60
6.00	.625-11	200	.500-13	100
7.00	.625-11	200	.500-13	100
8.00	.625-11	200	.625-11	200
9.00	.625-11	200	.625-11	200
10.00	.750-10	350	.625-11	200
12.00	.875-9	575	.625-11	200
14.00	.875-9	575	.750-10	350
16.00	1.000-8	950	.750-10	350

SEAL KITS

All cylinders are fully field identifiable, including packing option codes.

NAMEPLATE CODE EXAMPLE



Order by Piston Rod Packing Code, Rod Diameter Code, and Cylinder Series Code from nameplate as outlined.

- 1 (STANDARD)
Temperature Range -20°F to +200°F
Buna-N O-Rings, Polyurethane Rod Packing and Polyurethane Wiper.
- 3 (OPTIONAL)
Temperature Range -20°F to +400°F
Viton O-Rings, Viton Rod Packing, Viton Wiper.

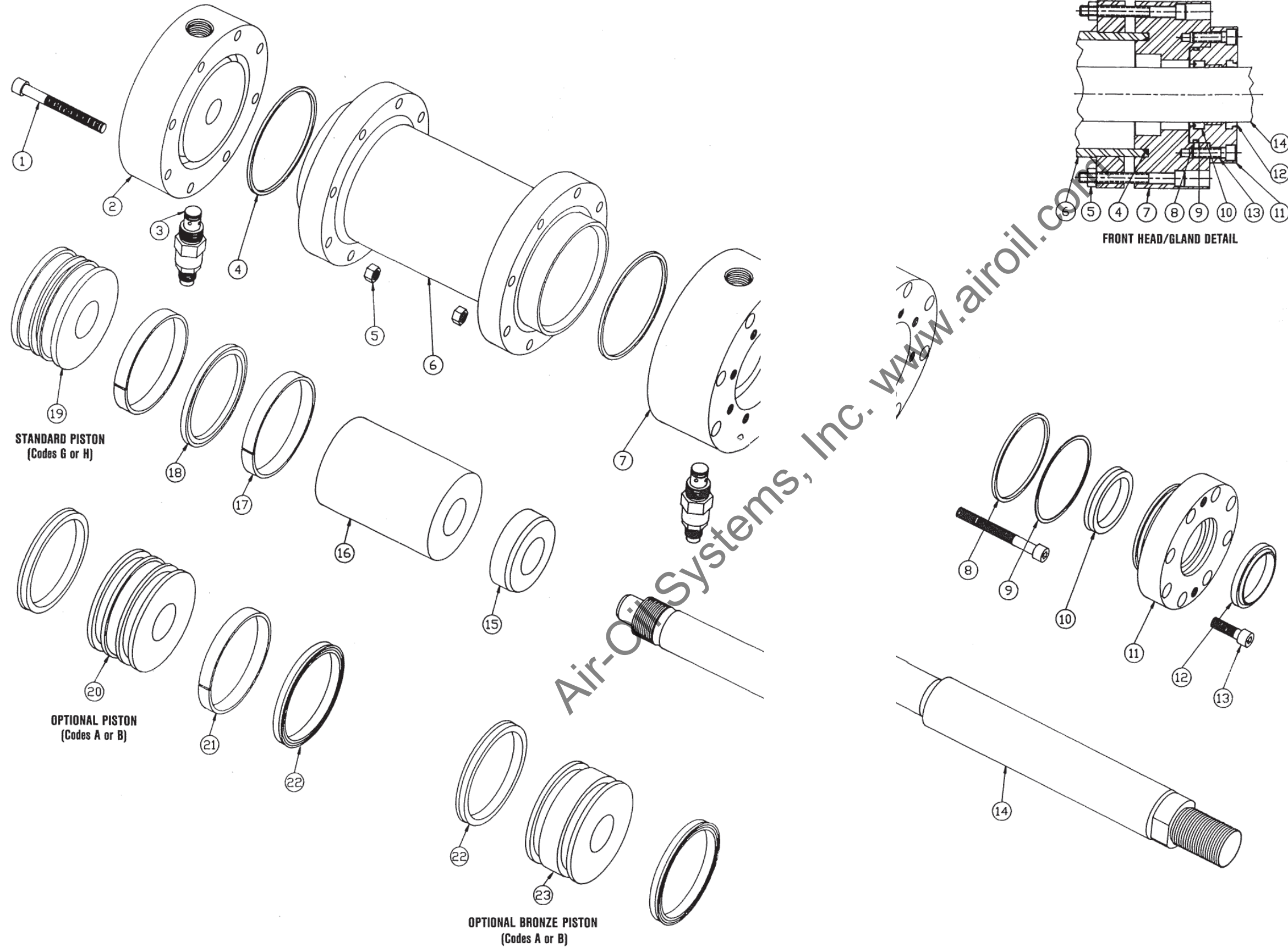
Order by Piston Packing Code, Bore Size, and Cylinder Series Code from nameplate as outlined.

- A Temperature Range -20°F to +200°F
Polyurethane U-Cup Seal with Buna Expander, Wear Strip, Buna Tube Seals.
- B Temperature Range -20°F to +400°F
Viton U-Cup Seal with Viton Expander, Wear Strip, Viton Tube Seals.
- G Temperature Range -20°F to +200°F
Piston Wear Strip(s), Filled Teflon seal w/Buna-N Expander, Buna-N Tube Seals.
- H Temperature Range -20°F to +400°F
Piston Wear Strip(s), Filled Teflon Seal w/Viton Expander, Viton Tube Seals.

CYLINDER WEIGHTS

BORE	BASE WEIGHT AT ZERO STROKE	BODY WEIGHT PER INCH OF STROKE	ROD SIZE	ROD WEIGHT PER INCH OF STROKE
2.00	18 lbs.	.50 lbs.	1.00	.22 lbs.
3.00	41	.72	1.38	.42
4.00	70	1.20	1.75	.68
5.00	124	1.88	2.00	.89
6.00	178	2.12	2.50	1.39
7.00	226	3.33	3.00	2.00
8.00	333	3.77	3.50	2.72
9.00	397	4.22	4.00	3.56
10.00	648	4.67	4.50	4.50
12.00	1062	11.56	5.00	5.56
14.00	1575	13.34	5.50	6.72
16.00	2188	15.11	6.00	8.00
			7.00	10.89
			8.00	14.22

PARTS LIST

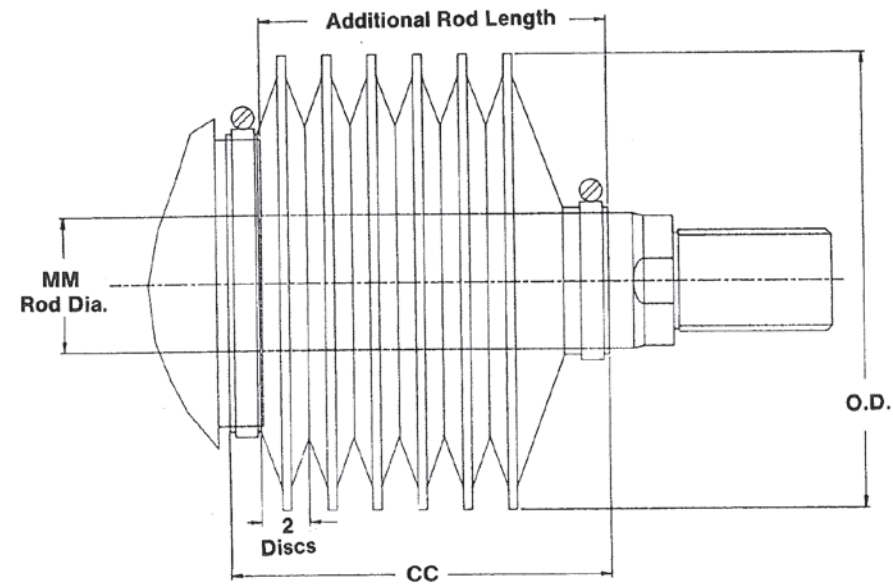


When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

PART NO.	NO. REQ'D.	DESCRIPTION
1	**	Cap Screw
2	1	Back Head
3	2	Cushion Valve
4*	2	O-Ring
5	**	Nut
6	1	Tube
7	1	Front Head
8*	1	O-Ring
9*	1	Back Up
10*	1	Rod Packing
11	1	Gland
12*	1	Rod Wiper
13	**	Gland Screw
14	1	Piston Rod
15	1	Cushion Sleeve
16	1	Stop Tube
17*	**	Piston Wear Ring
18*	1	Filled Teflon Seal with Buna Expander
19	1	Piston
20	1	Piston***
21*	1	Piston Wear Ring
22*	2	Piston Packing
23	1	Bronze Piston***

* Recommended Spare Parts
 ** As Required
 *** Optional Parts

Rod Boots



BORE	MM ROD DIA.	O.D.	BF	BORE	MM ROD DIA.	O.D.	BF	BORE	MM ROD DIA.	O.D.	BF
2.00	1.00	4.75	1.25	7.00	2.50	10.00	3.06	10.00	3.50	12.00	3.56
	1.38	5.25	1.38		3.00	10.00	2.81		4.00	12.00	3.25
3.00	1.38	5.25	1.38	8.00	3.50	10.00	2.56	12.00	4.50	12.00	3.00
	1.75	5.50	1.31		4.00	10.50	2.50		5.00	12.00	2.88
	2.00	6.00	1.31		4.50	11.00	2.50		5.50	12.00	2.50
4.00	1.75	6.00	1.56	9.00	5.00	11.00	2.38	14.00	7.00	13.25	2.50
	2.00	6.00	1.31		3.00	11.00	3.31		4.00	12.00	3.25
	2.50	6.50	1.31		3.50	11.00	3.06		4.50	12.00	3.00
5.00	2.00	7.00	1.81	16.00	4.00	11.00	2.75	16.00	5.00	12.00	2.88
	2.50	7.00	1.56		4.50	11.00	2.50		5.50	12.00	2.50
	3.00	7.00	1.31		5.00	11.25	2.50		7.00	13.25	2.50
	3.50	7.50	1.31		5.50	11.75	2.50		8.00	14.25	3.00
6.00	2.50	9.00	2.56	16.00	6.00	11.75	2.25	16.00	5.50	14.25	3.62
	3.00	9.00	2.31		4.00	11.00	2.75		7.00	14.25	3.00
	3.50	9.00	2.06		4.50	11.00	2.50		8.00	14.25	2.50
	4.00	10.50	2.50		5.00	11.25	2.50		7.00	14.25	3.00
						5.50	11.75		2.50	8.00	14.25

ROD BOOT CALCULATIONS

Number of Discs = (2 x Total Stroke) ÷ BF (Raise result to next even whole number.)

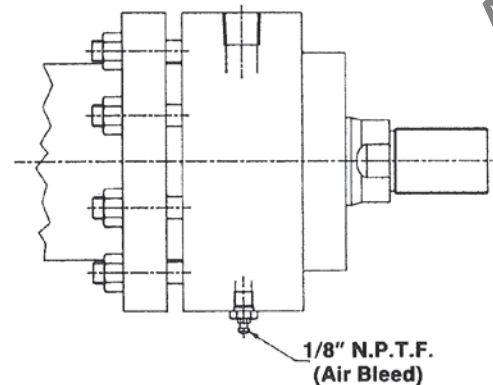
CC (Length of Boot) = Number of Discs x .050 + 1.50. (Raise result to nearest 1/8 inch.)

Additional Rod Length to accommodate Boot = CC - .75 Dim.

Air Bleeds

Air bleeds provide a means to remove all trapped air from hydraulic systems.

NOTE: Specify port position for bleed.



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MOUNTING STYLE

- Fixed Double Ear Clevis MP1
- Fixed Single Ear Clevis MP3
- Spherical Bearing MPU3
- Intermediate Fixed Trunnion MT4
- Head Flange ME5
- Cap Flange ME6
- End Lugs MS7

Double Rod End D
(Specify only if required)

SERIES

- MTI Type Hydraulic (Heavy Duty) MT

CUSHION

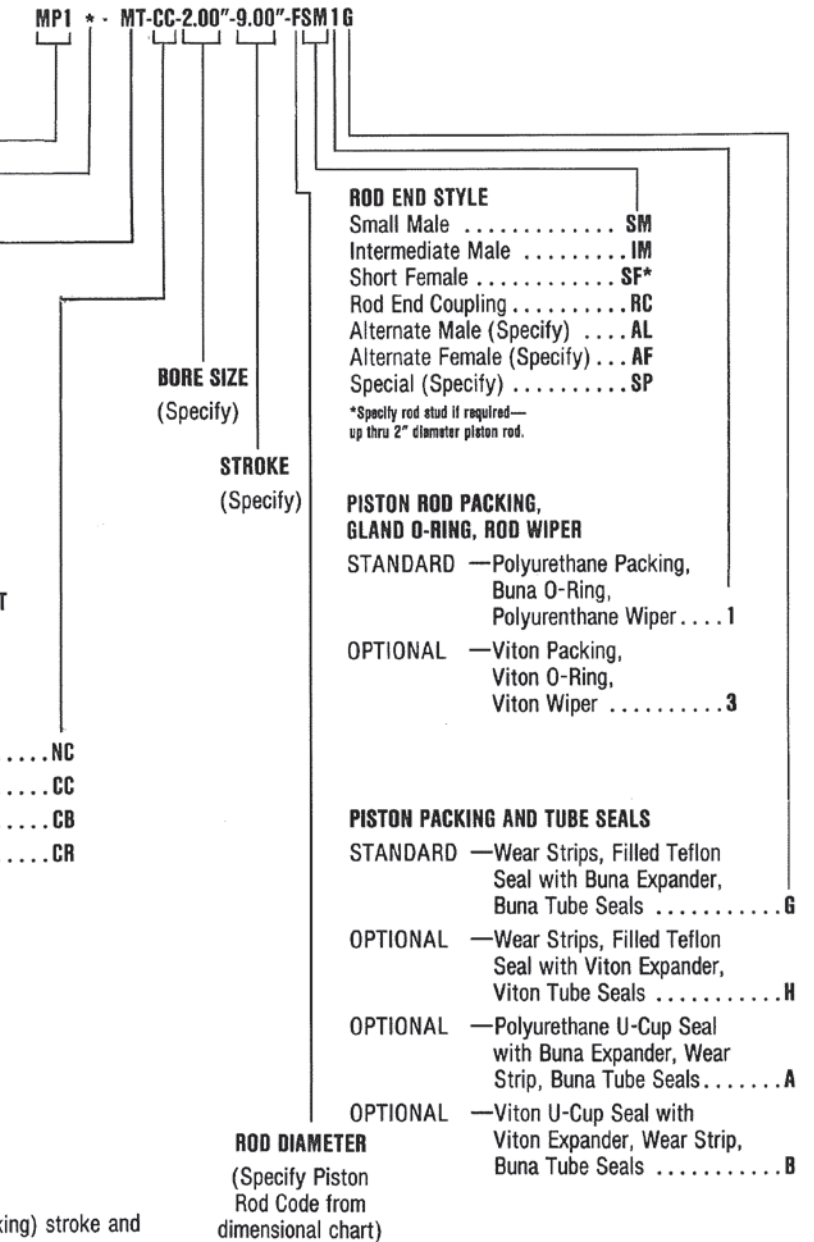
- Non-Cushion NC
- Cushion, Both Ends CC
- Cushion, Cap End Only CB
- Cushion, Head End Only CR

OPTIONS (Specify only if required)

- Bronze Piston
- Bronze Rod Bearing
- Bronze Rod Scraper
- Metric Sizing

When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

NPTF ports will be furnished as standard unless SAE straight thread ports are specified.



ROD END STYLE

- Small Male SM
- Intermediate Male IM
- Short Female SF*
- Rod End Coupling RC
- Alternate Male (Specify) AL
- Alternate Female (Specify) ... AF
- Special (Specify) SP

*Specify rod stud if required—up thru 2" diameter piston rod.

PISTON ROD PACKING, GLAND O-RING, ROD WIPER

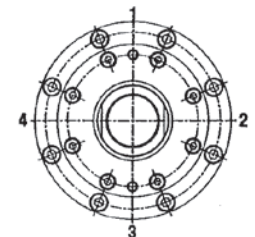
- STANDARD —Polyurethane Packing, Buna O-Ring, Polyurethane Wiper 1
- OPTIONAL —Viton Packing, Viton O-Ring, Viton Wiper 3

PISTON PACKING AND TUBE SEALS

- STANDARD —Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals 6
- OPTIONAL —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals H
- OPTIONAL —Polyurethane U-Cup Seal with Buna Expander, Wear Strip, Buna Tube Seals A
- OPTIONAL —Viton U-Cup Seal with Viton Expander, Wear Strip, Buna Tube Seals B

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

NOTE: Cushion needles furnished with viton seals.



Port location: if other than position 1, must be specified. Mounting accessories must be specified if required.

Air-Oil Systems, Inc. www.airoil.com



Series RT Hydraulic Rotating Cylinders

- Continuous 500 RPM Capability
- 1,500 PSI Pressure Rating
- Flush and Flange Mountings
- Exclusive Coupling Sealing System
- Nitrotec-Hardened Coupling Housing and Stem
- 4.5" – 16.00" Standard Bore Sizes

Series RT Heavy-Duty Hydraulic Rotating Cylinders

Hanna's rugged, heavy-duty hydraulic rotating cylinders provide optimum performance wherever rotation and linear actuation interface. Applications include recoilers, uncoilers, tension reels, transfer line spindles, and power chucking on machine tools.

The coupling is supported by two anti-friction bearings, enabling the cylinder to maintain 500 RPM. Mirror-finished, Nitrotec-treated coupling housing and Nitrotec-treated stem provide extra-hardened surfaces for longer seal life, and corrosion protection with high water based fluids.

In addition to the axial support and stability of the coupling, the large diameter permits the use of either a probe indicator to actuate travel limit devices; or Hanna's optional Electronic Feedback device for the ultimate in safety and product yield. The design latitude thus offered expands the inherent capabilities of Series RT rotating cylinders.

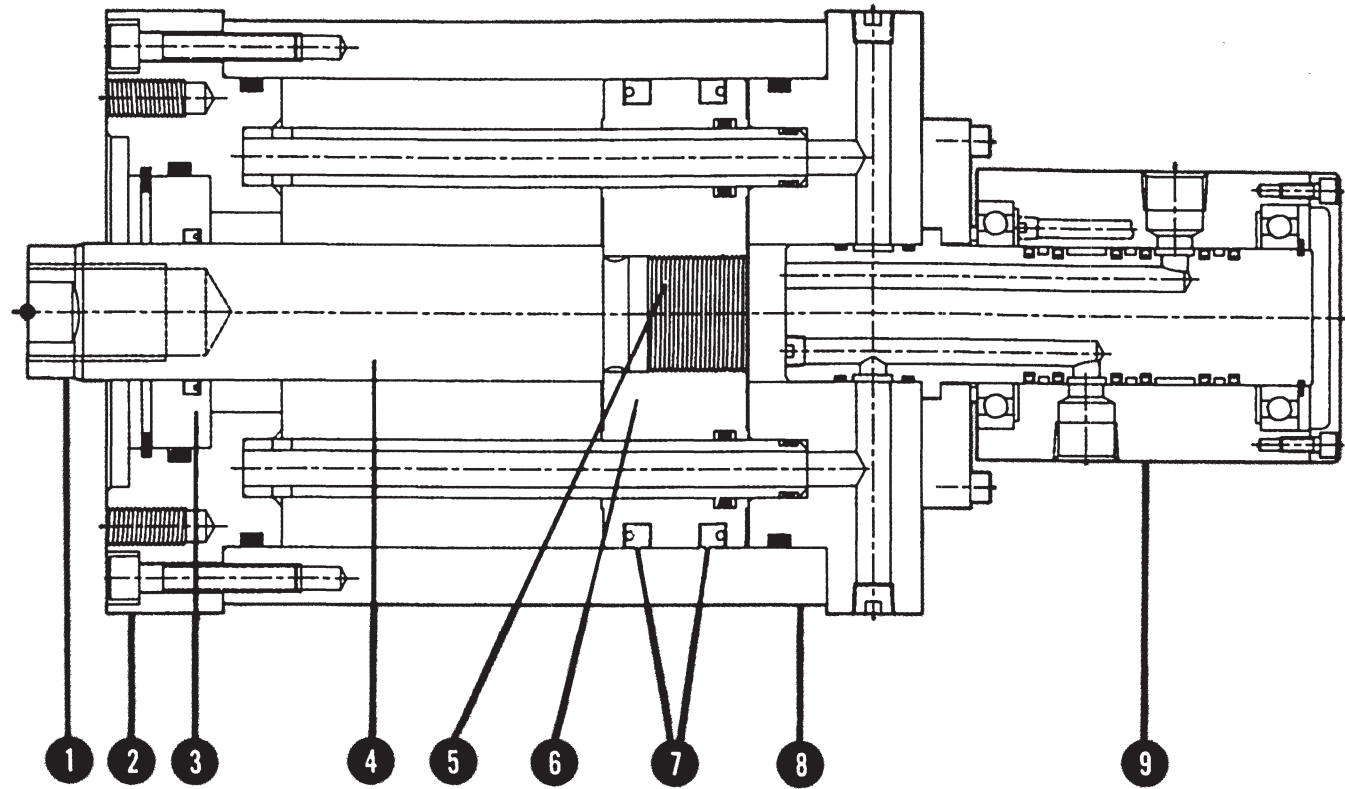
Available flush or flange mounted, Hanna's Series RT cylinders offer hydraulic p.s.i. ratings up to 1500. Standard bore sizes are 4.50" through 16.00". Hanna can also meet special requirements for larger bore sizes, higher RPM or greater pressures. Please consult the factory.

HYDRAULIC PRESSURE AND RPM LIMITS

BORE SIZE	20 GPM COUPLING		45 GPM COUPLING	
	P.S.I.	R.P.M.	P.S.I.	R.P.M.
4.50	1500	500	—	—
6.00	1500	500	—	—
8.00	1500	500	1500	350
10.00	1500	500	1500	350
12.00	1500	500	1500	350
14.00	1000	500	1000	350
16.00	1000	500	1000	350

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Series RT Cylinder Features

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity.

2. Heads

Steel heads are precision-machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

3. Rod Bearing Cartridge

Tapped for quick and easy removal.

4. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failures. All rod sizes are hard chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to an 8-micro-inch finish.

5. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

6. Piston

One-piece piston is made of high impact ductile iron, threaded to the piston rod.

7. Piston Sealing System

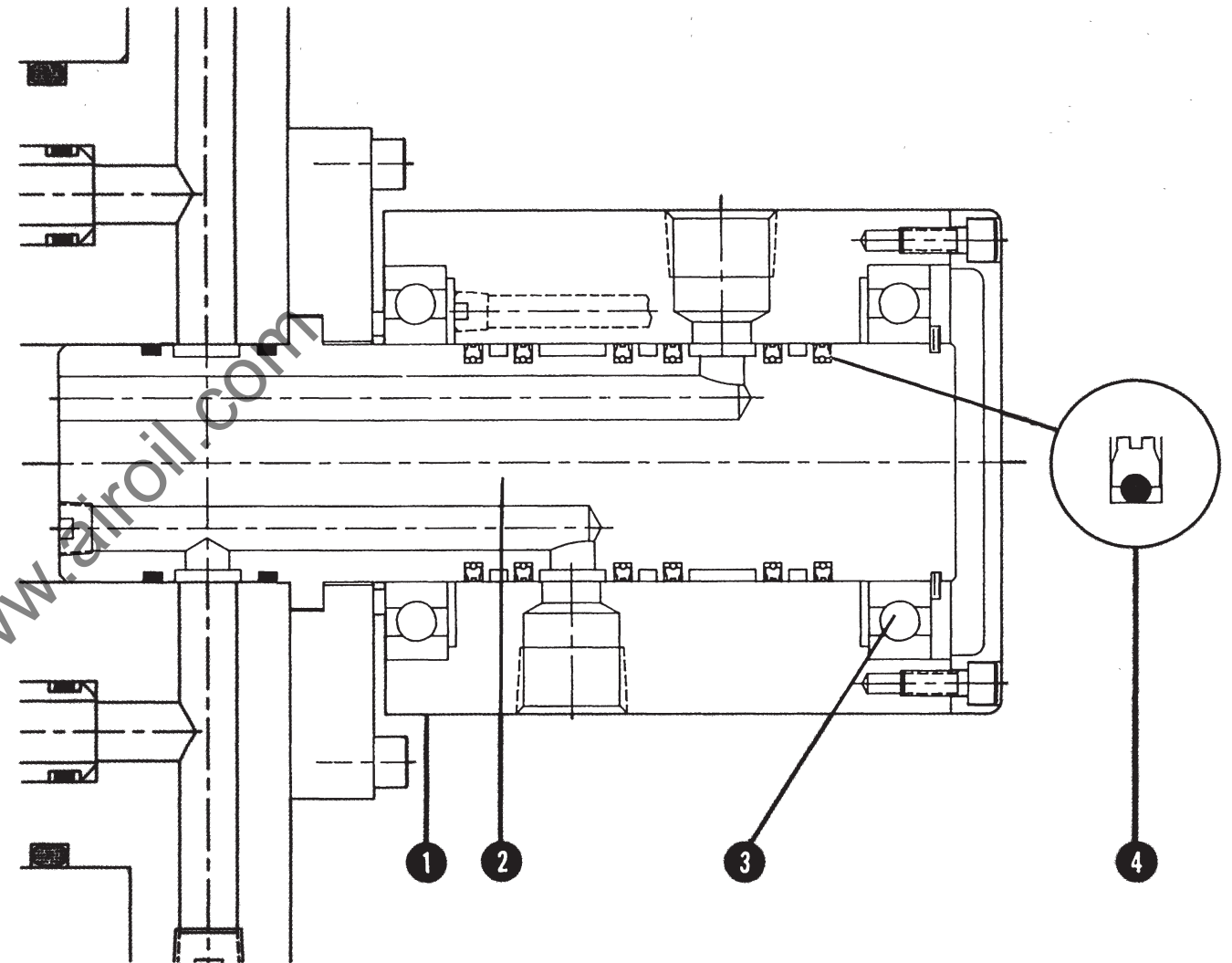
Self-regulating, wear-compensating, pressure-energized polyurethane seal assures zero by-pass. For higher temperature service, or for use with fire-resistant or high water-based fluids, Viton seals are an available option.

8. Tubing

Steel tubing is precision-honed to a 16 micro-inch finish for close tolerance between piston seal and tube wall, thus extending seal life.

9. Coupling

Series RT standard 20 GPM coupling is rated at 500 RPM. Optional 45 GPM coupling with a 350 RPM rating is available for cylinders with 8.00" and larger bore sizes. Both couplings bolt on, and are easily removed from the outside.



Series RT Coupling Features

1. Nitrotec-Treated Coupling Housing

Nitrotec treatment of Series RT coupling housings provides specific characteristics that enhance cylinder performance and assure long service life. An advanced heat treating method, the Nitrotec process converts the first few thousandths of an inch of the housing's interior surface depth to an iron nitride, non-metallic layer, which has a hardness of approximately 60 Rc. In the process, the surface also becomes microporous.

This extremely hard microporous surface layer enables the coupling housing to exhibit three important engineering characteristics:

- (1) Wear resistance superior to conventional heat treatment.
- (2) Oil retention for operating lubricity comparable to non-ferrous sintered bearings.
- (3) Excellent corrosion resistance.

Prior to the Nitrotec treatment, the interior surface layer is precision honed for exacting size control. The combination of the Nitrotec process and the precision honing provides the optimum surface for extended seal life, and corrosion resistance when high water based fluids are used.

2. Nitrotec-Treated Coupling Stem

As is the case with the housing, the coupling stem is also hardened via the Nitrotec process, assuring long life and maximum corrosion protection.

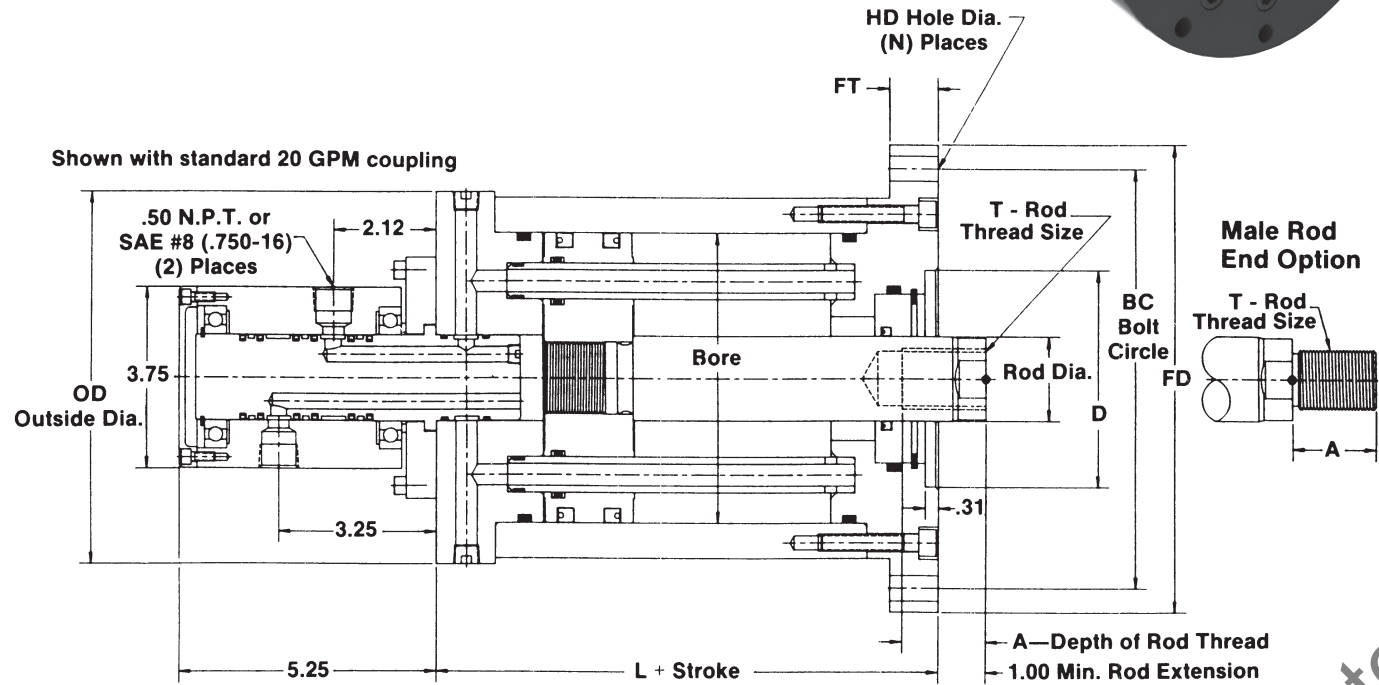
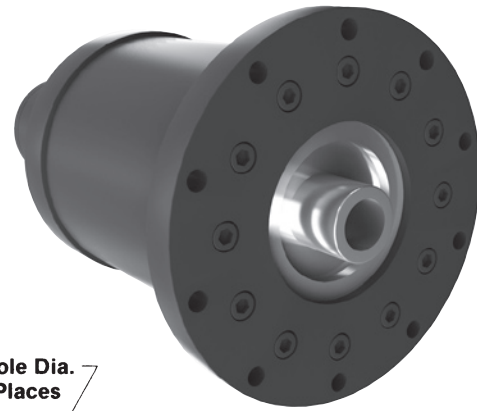
3. Dual Bearing Coupling Construction

Each end of the coupling housing is supported on the stem by a permanently-lubricated, anti-friction, factory-sealed bearing. The dual bearing construction makes the entire unit extra rugged, assuring rigidity and stability under the most difficult operating conditions. This rigidity and stability further extend seal life.

4. Exclusive Coupling Sealing System

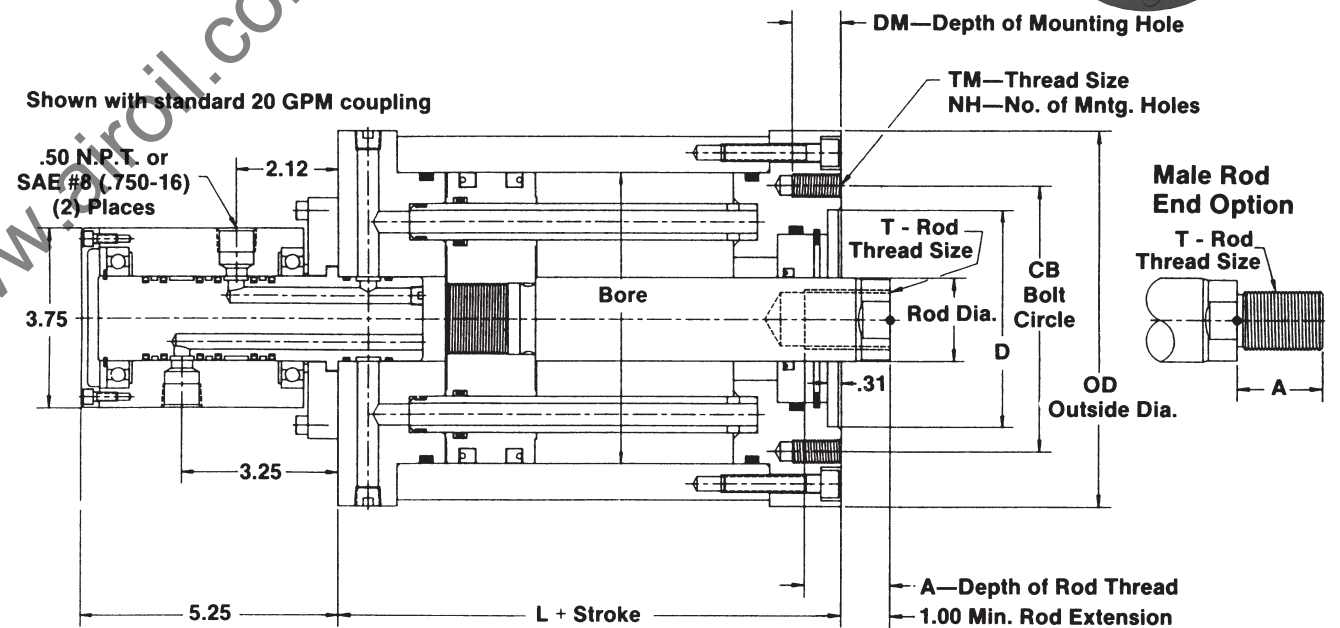
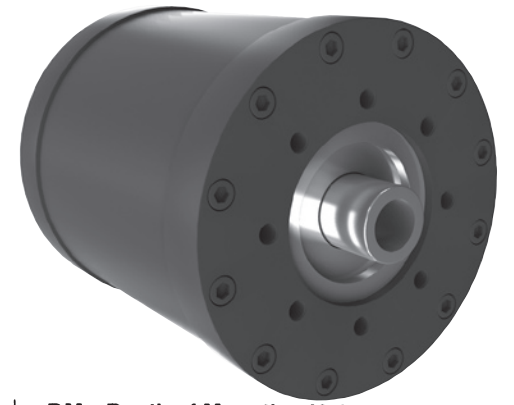
Hanna's exclusive mechanically-energized, carbon-graphite filled Teflon coupling seals provide maximum sealing efficiency. Engineered specifically for high RPM applications, they minimize friction, thereby eliminating the heat build-up that causes excessive wear in a rotating cylinder coupling. The result: long service life! The seals are compatible with most all hydraulic fluids, including fire resistant and high water based fluids.

MF3 Flange Mount



NOTE: .25 NPT (or #4 [.438-20] SAE) coupling drain port not shown. Must be piped back unrestricted.

MR2 Flush Mount



NOTE: .25 NPT (or #4 [.438-20] SAE) coupling drain port not shown. Must be piped back unrestricted.

DIMENSIONS

CYLINDER			A	D +.001 -.000	L	T (THREAD)		OD	BC	N	HD	FD	FT
BORE	ROD DIA. CODE	ROD DIA.				SMALL MALE SM	SHORT FEMALE SF						
4.50	I	1.25	1.25	3.000	5.69	88-14	88-14	6.12	7.00	5	53	8.00	1.00
	H	1.75	1.75	4.002	5.69	1.25-12	1.25-12	6.12	7.00	5	53	8.00	1.00
6.00	H	1.75	1.75	4.500	6.31	1.25-12	1.25-12	7.75	8.75	8	53	9.75	1.00
	K	2.50	2.50	5.502	6.31	1.88-12	1.88-12	7.75	8.75	8	53	9.75	1.00
8.00	J	2.00	2.00	5.000	6.56	1.50-12	1.50-12	9.88	11.50	6	78	13.12	1.25
	L	3.00	3.00	6.002	6.56	2.25-12	2.25-12	9.88	11.50	6	78	13.12	1.25
10.00	K	2.50	2.50	6.000	6.68	1.75-12	1.75-12	11.88	13.50	10	78	15.62	1.38
	M	3.50	3.50	8.002	6.68	2.50-12	2.50-12	11.88	13.50	10	78	15.62	1.38
12.00	M	3.50	3.50	7.500	6.94	2.00-12	2.00-12	14.19	16.25	10	91	18.00	1.50
	P	4.50	4.50	10.002	6.94	3.00-12	3.00-12	14.19	16.25	10	91	18.00	1.50
14.00	N	4.00	4.00	9.000	7.69	2.50-12	2.50-12	16.25	18.25	12	91	20.00	1.50
	R	5.00	5.00	10.002	7.69	3.50-12	3.50-12	16.25	18.25	12	91	20.00	1.50
16.00	N	4.00	4.00	10.000	10.00	2.50-12	2.50-12	18.62	20.88	12	106	23.00	1.50
	R	5.00	5.00	10.002	10.00	3.50-12	3.50-12	18.62	20.88	12	106	23.00	1.50

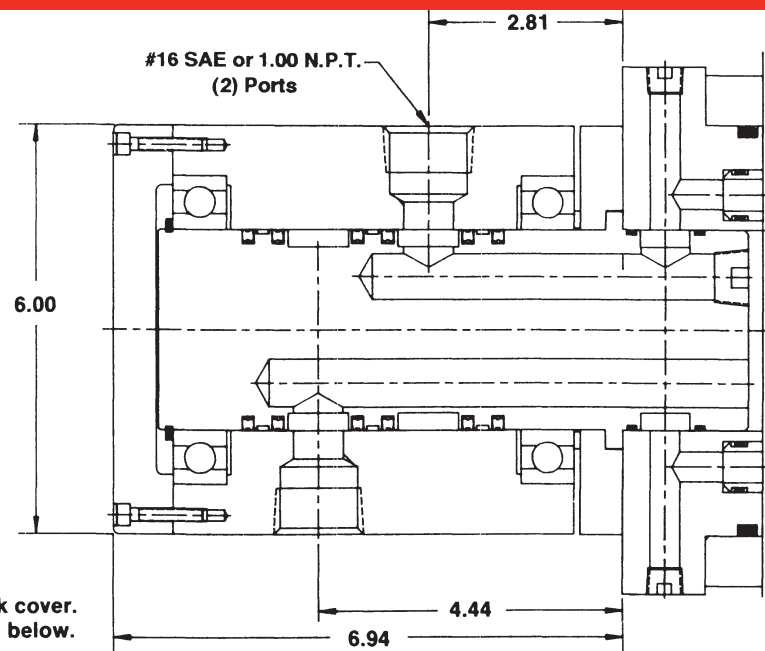
DIMENSIONS

CYLINDER			A	D +.001 -.000	L	T (THREAD)		OD	CB	DM	NH	TM
BORE	ROD DIA. CODE	ROD DIA.				SMALL MALE SM	SHORT FEMALE SF					
4.50	I	1.25	1.25	3.000	5.69	88-14	88-14	6.12	3.75	1.00	4	50-13
	H	1.75	1.75	4.002	5.69	1.25-12	1.25-12	6.12	5.00	.75	5	50-13
6.00	H	1.75	1.75	4.500	6.31	1.25-12	1.25-12	7.75	5.50	1.00	8	50-13
	K	2.50	2.50	5.502	6.31	1.88-12	1.88-12	7.75	6.50	.75	8	50-13
8.00	J	2.00	2.00	5.000	6.56	1.50-12	1.50-12	9.88	6.50	1.00	8	62-11
	L	3.00	3.00	6.002	6.56	2.25-12	2.25-12	9.88	8.00	1.00	6	75-10
10.00	K	2.50	2.50	6.000	6.68	1.75-12	1.75-12	11.88	8.50	1.12	8	75-10
	M	3.50	3.50	8.002	6.68	2.50-12	2.50-12	11.88	9.50	1.00	10	.75-10
12.00	M	3.50	3.50	7.500	6.94	2.00-12	2.00-12	14.19	10.50	1.25	10	75-10
	P	4.50	4.50	10.002	6.94	3.00-12	3.00-12	14.19	11.50	1.12	10	.88-9
14.00	N	4.00	4.00	9.000	7.69	2.50-12	2.50-12	16.25	12.50	1.25	15	75-10
	R	5.00	5.00	10.002	7.69	3.50-12	3.50-12	16.25	12.00	1.12	12	.88-9
16.00	N	4.00	4.00	10.000	10.00	2.50-12	2.50-12	18.62	14.50	2.00	16	1.25-7
	R	5.00	5.00	10.002	10.00	3.50-12	3.50-12	18.62	13.00	1.50	12	1.00-8

45 GPM Coupling

Hanna offers a 45 GPM coupling as an option for Series RT rotating cylinders with 8.00" and larger bore sizes.

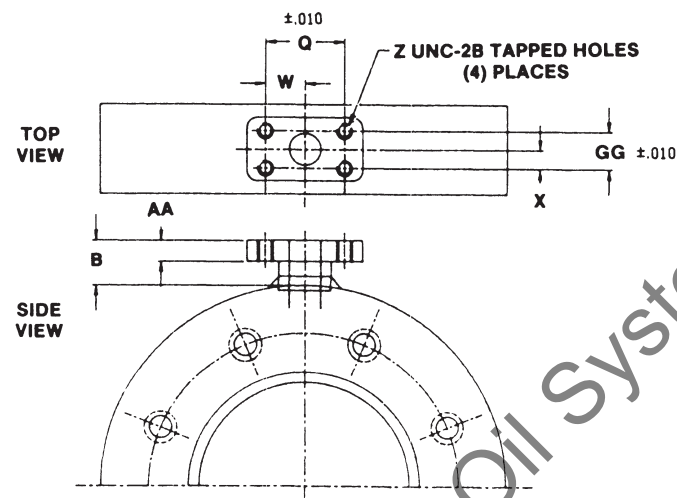
The unit has a 45 GPM flow rate at 15 feet per second velocity, and 350 RPM. Maximum hydraulic pressure rating is 1500 P.S.I. Higher pressures and RPM are available as specials. Please consult the factory. Tell-tale sensor and Electronic Feedback device options are also available. See Page 227.



Shown with standard back cover. Slotted back cover shown below.

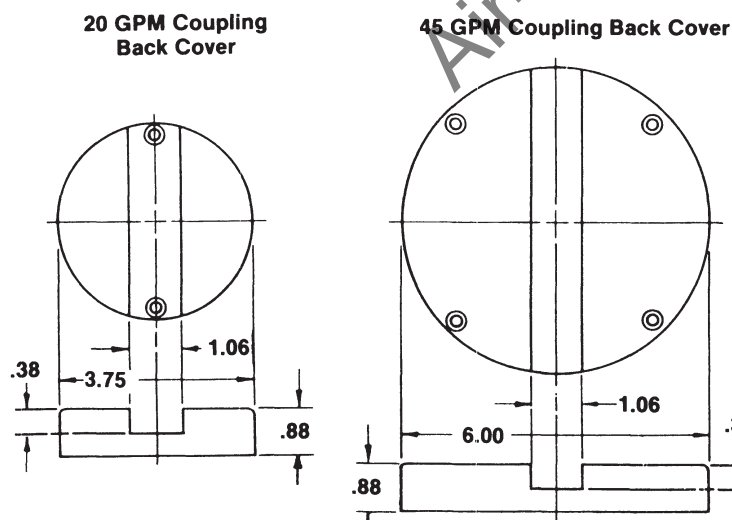
SAE 4-Bolt Flange Ports

COUPLING SIZE	PORT DIA.	GG	X	Q	W	AA	Z	B
20 GPM	50	69	34	1.50	75	50	312-18	1.25
	75	88	44	1.88	94	50	375-16	1.06
45 GPM	1.00	1.03	52	2.06	1.03	56	375-16	1.25
	1.25	1.19	59	2.31	1.16	62	438-14	1.44



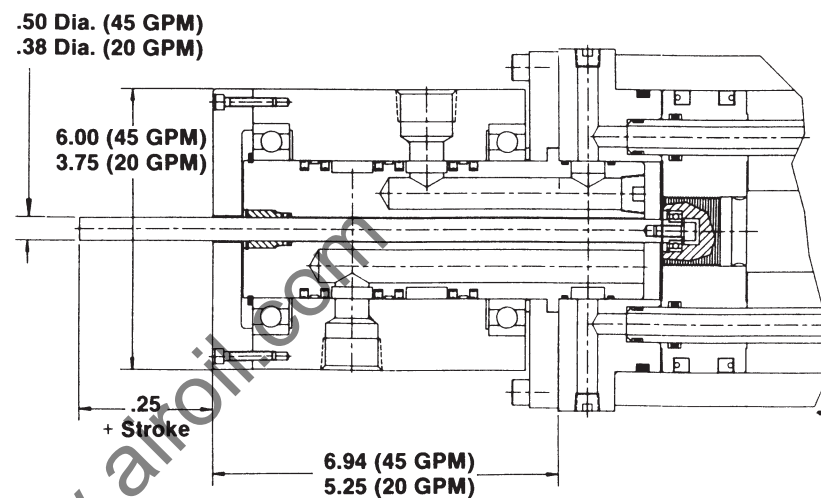
Slotted Coupling Back Covers

Both 20 GPM and 45 GPM couplings are available with a slotted back plate to accommodate a stabilizer bar.

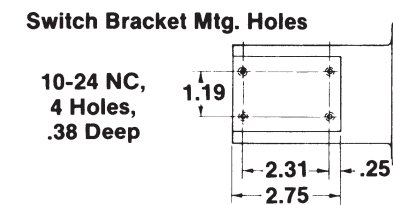


Series RT Hydraulic Rotating Cylinders

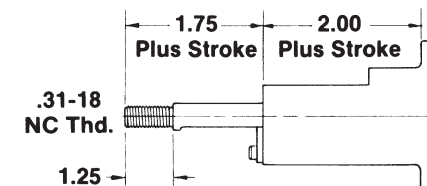
This mechanical position indicator is an option available on both 20 GPM and 45 GPM couplings.



Rotating Cylinder with Tell-Tale Sensor



Tell-Tale Sensor



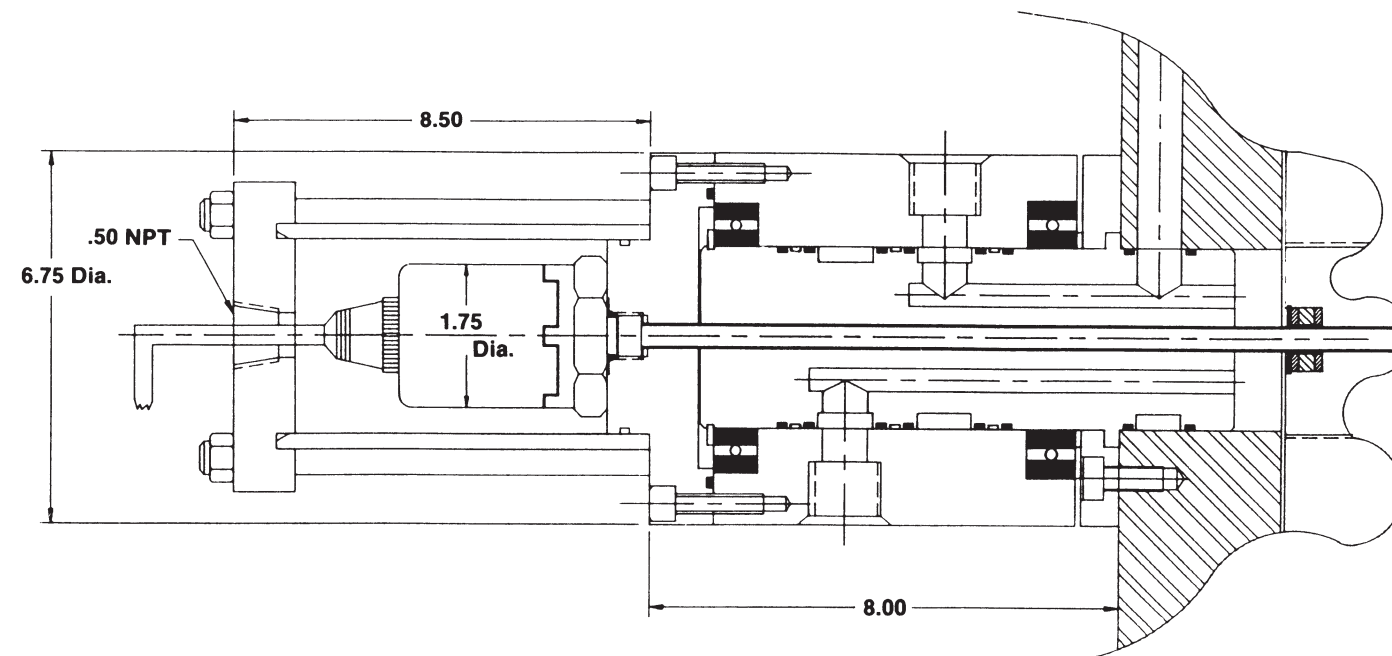
Non-Rotating Tell-Tale Sensor

Note: Trip rod end configurations other than shown will be quoted on request.

Electronic Feedback Device

Series RT Rotating Cylinders with the 45 GPM coupling are available equipped with Hanna's Electronic Feedback device. With this unit, precise size control can be maintained on the mandrel of a recoiling or uncoiling machine,

thus providing an additional safety factor, as well as increased product yield. The Electronic Feedback device provides positional accuracy of $\pm .001$ in digital systems; analog responses on positions less than .010 are common.



Series RT Hydraulic Rotating Cylinders

CYLINDER THRUST FORCE

Cylinder Thrust Force in Pounds for Various Line Pressures								Consumption Per Inch of Stroke in One Direction		
Cylinder Bore Inches	Piston Area Sq. In.	Pressures of Operating Medium—Air or Hydraulic						Oil* Gallons Displaced	Pressure Air Cubic Ft Displaced	Free Air Cubic Ft at 80 PSI
		50 PSI	80 PSI	100 PSI	250 PSI	500 PSI	1,000 PSI			
4.50	15.904	795	1,272	1,590	3,976	7,952	15,904	0688	0092	0593
6.00	28.274	1,414	2,262	2,827	7,071	14,137	28,274	1224	0164	1056
8.00	50.265	2,513	4,021	5,027	12,566	25,133	50,265	2176	0291	1873
10.00	78.540	3,927	6,283	7,854	19,635	39,270	78,540	3400	0455	2928
12.00	113.100	5,655	9,048	11,310	28,275	56,550	113,100	4896	0656	4226
14.00	153.940	7,697	12,315	15,394	38,485	76,970	153,940	6664	0891	5740
16.00	201.060	10,053	16,085	20,106	50,265	100,530	201,060	8704	1163	7492

*GPM = gallons per inch times inches per minute

ROD DIAMETER THRUST FORCE

Rod Diameter Thrust Force in Pounds for Various Line Pressures								Consumption Per Inch of Stroke in One Direction		
Piston Rod Bore Inches	Piston Area Sq. In.	Pressures of Operating Medium—Air or Hydraulic						Oil* Gallons Displaced	Pressure Air Cubic Ft Displaced	Free Air Cubic Ft at 80 PSI
		50 PSI	80 PSI	100 PSI	250 PSI	500 PSI	1,000 PSI			
1.25	1.227	61	98	122	306	610	1,227	0053	0007	0043
1.75	2.405	120	192	241	601	1,203	2,405	0104	0014	0090
2.00	3.142	157	251	314	786	1,571	3,142	0136	0019	0122
2.50	4.909	245	392	491	1,225	2,450	4,900	0213	0021	0183
3.00	7.069	353	566	707	1,767	3,535	7,069	0306	0041	0264
3.50	9.621	481	770	962	2,405	4,811	9,621	0417	0056	0358
4.00	12.566	628	1,005	1,257	3,142	6,283	12,566	0544	0073	0468
4.25	14.186	709	1,134	1,418	3,546	7,093	14,186	0614	0082	0508
4.50	15.904	795	1,272	1,590	3,976	7,952	15,904	0688	0092	0593
5.00	19.635	982	1,571	1,964	4,909	9,818	19,635	0850	0114	0722
5.50	23.758	1,188	1,901	2,376	5,940	11,879	23,758	1028	0137	0861

OIL FLOW

S = Standard weight pipe. X = Extra strong. XX = Double extra strong. Butt Welded Steel Clean Pipe				Oil Flow in Gallons Per Minute and Friction Pressure Drop in Pounds Per Square Inch Per Foot Length of Pipe						Equivalent Length of Straight Pipe in Feet for Various Fittings		
Pipe Size	Bursting Pressure PSI	Internal Diameter Inches	Internal Area Sq. In.	Velocity = 10 Ft Per Sec		Velocity = 20 Ft Per Sec		Velocity = 30 Ft Per Sec		Pipe Size	Elbow	Tee
				Gals Per Minute	Pressure Drop in PSI	Gals Per Minute	Pressure Drop in PSI	Gals Per Minute	Pressure Drop in PSI			
3/8S	10,754	493	191	5.98	1.19	11.96	3.71	17.94	7.31	3/8	1.3	3.0
1/2S	10,784	.622	.304	9.48	.82	18.96	2.75	28.44	5.36	1/2	1.5	3.3
3/4X	11,728	742	.433	13.52	.69	27.04	2.15	40.56	4.15			
3/4S	8,608	824	533	16.78	.59	33.56	1.80	50.34	3.44	3/4	2.2	4.6
1-1/4XX	18,408	896	630	19.66	.54	39.32	1.64	58.98	3.13			
1X	10,888	957	719	22.42	.49	44.84	1.54	67.26	2.93			
1S	8,088	1,049	864	27.18	.43	54.36	1.40	81.54	2.67	1	2.8	5.7
1-1/2XX	16,840	1,100	950	29.62	.41	59.24	1.34	88.86	2.44			
1-1/4X	9,200	1,278	1,283	40.30	.33	80.60	1.07	120.90	2.00			
1-1/4S	6,744	1,380	1,495	46.96	.31	93.92	.91	140.88	1.76	1-1/4	3.7	7.8

(P λ) = Pressure drops have been derived from the rational formula — $P \lambda = \frac{323f SLV^2}{d}$

(G P M) = Gallons per minute have been derived from the rational formula — $G = 431 \sqrt{\frac{P \lambda d^5}{fSL}}$

(f) = Friction factors from "Piping Handbook," 4th Ed., Fig. 15a $\frac{d \sqrt{vs}}{Z}$

STORAGE:

Cylinders in storage should always be fully protected against the elements or other adverse conditions.

INSTALLATION:

The pipe ports of cylinders are sealed with plastic plugs. The plugs protect the precision internal parts by sealing out damaging dirt and grit. Do not remove port seals until ready to connect piping. To protect cylinders, clean all pipes and pipe fittings of dirt, scale, and thread chips. A filter is recommended to keep the operating fluid free of foreign matter.

Accurate mounting and alignment are essential to proper cylinder performance. By eliminating side loading, packing and bearing life will be increased.

MAINTENANCE:

Precision construction of Hanna cylinders minimizes wear as a maintenance problem. Parts which may need replacement in the course of normal use are the packings for the piston and piston rod, guide pin seals and coupling seals.

To replace rod seal, remove front head from tube. Remove gland retaining ring and push the gland out from tube end. Remove old rod seal and gland O-ring, and carefully clean both grooves. To reassemble, slip new rod packing into groove, exercising care not to nick the lips of the packing. Install gland and retaining ring, then replace front head and retorque per the **Fastener Torque** table as shown on this page.

To replace piston seals and guide pin O-rings, remove front head and piston rod assembly. Remove old packings and carefully clean grooves. Install new seals. Place guide pins into back head. Carefully replace ram assembly into tube, lining up guide pins. Exercise care not to damage packing lips. Replace front head, and retorque per the **Fastener Torque** table.

To replace coupling seals, remove coupling cap and bearing retaining ring. Remove coupling housing, then remove retainer cap screws. Slide coupling shaft out of back head, and remove old seals. Clean all grooves and replace shaft O-rings. Then replace shaft into back head, and secure with retainer and cap screws. Retorque per **Fastener Torque** table.

For cylinders with old style seals, replace O-rings and back-up washers, then replace housing, retaining ring and coupling cap. Torque per **Fastener Torque** table.

For cylinders with new style seals (Roto Seals), slide (1) O-ring into O-ring groove closest to back head, then pre-form the seal by stretching it slightly. Position seal over O-ring, and with your fingers, resize the seal into the groove. For final re-sizing, slide coupling housing over the seal, using care not to nick the seal. Repeat this procedure for all the remaining seals. Finally, replace housing and bearing retainer, coupling cap and cap screws. Retorque per **Fastener Torque** table.

Roto-Seal Installation Tools

Hanna offers installation tools which significantly facilitate and simplify the replacement procedure for coupling Roto-Seals. For further information, contact your Hanna distributor.



20 GPM Coupling — Part No. R1756A Part No. R1755A
45 GPM Coupling — Part No. R1801A Part No. R1800A

FASTENER TORQUES

BORE	PARTS LIST ITEM #30 CAP SCREW		PARTS LIST ITEM #9 RETAINER SCREW		PARTS LIST ITEM #2 COUPLING CAP SCREW	
	SIZE	TORQUE	SIZE	TORQUE	SIZE	TORQUE
4.50	50-13	80 ft.-lbs	38-16	34 ft.-lbs	#10-24	4 ft.-lbs
6.00	50-13	80	38-16	34	#10-24	4
8.00	50-13	80	38-16	34	#10-24	4
10.00	62-11	150	38-16	34	#10-24	4
12.00	62-11	150	38-16	34	#10-24	4
14.00	62-11	150	38-16	34	#10-24	4
16.00	62-11	150	38-16	34	#10-24	4

Note: Replacement parts can be furnished quickly if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number, as shown on Pages 12 and 13. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

When ordering replacement parts, identify Model Number, Serial Number and Part Number as shown below.

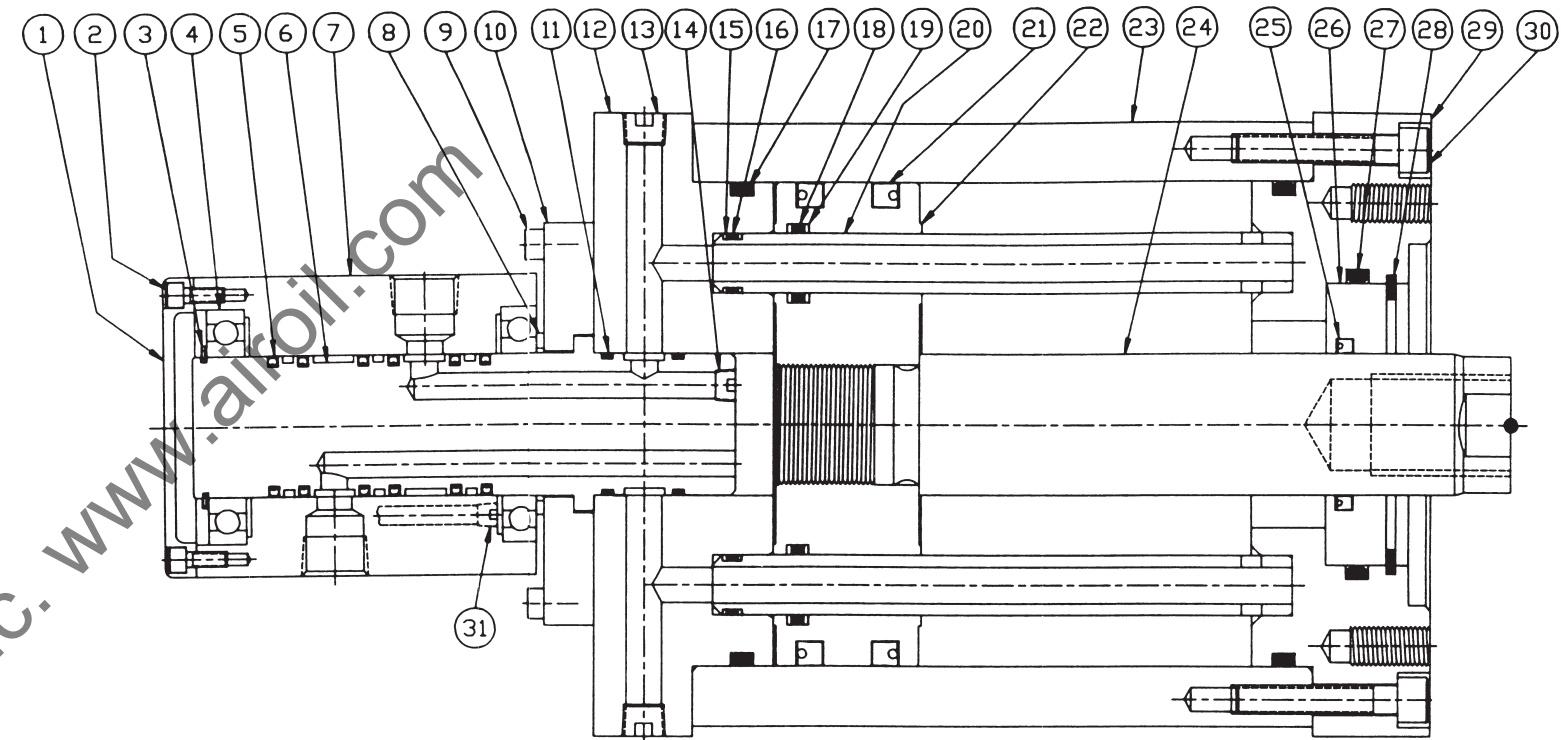
Part No.	No. Req'd.	Description
1	1	Coupling Cap
2	2	Coupling Cap Screw
3	1	Retaining Ring
4	2	Bearing
5*	6	Roto Seal
6	1	Coupling Shaft
7	1	Coupling Housing
8	1	Spacer
9	4	Retainer Screw
10	1	Coupling Retainer
11*	2	O-Ring (Shaft)
12	1	Back Head
13	2	Port Plug
14	2	Port Plug
15*	4	Back-up Washer
16*	2	O-Ring (Guide Pin)
17*	2	O-Ring (Tube)
18*	2	O-Ring (Piston Guide)
19*	4	Back-up Washer
20	2	Guide Ring
21*	2	Piston Packing
22	1	Piston
23	1	Tube
24	1	Piston Rod
25*	1	Rod Packing
26	1	Rod Bearing
27*	1	O-Ring (Bearing)
28	1	Retaining Ring
29	1	Front Head
30	**	Cap Screw
31	1	Port Plug

*Recommended spare parts

**As required

CYLINDER WEIGHTS

BORE	ROD CODE	BASE WT. AT ZERO STROKE	WT. PER INCH OF STROKE	COUPLER	
				20 GPM	45 GPM
4.50	I H	46 lbs	3.85 4.20	16 lbs. All Units	55 lbs. All Units
6.00	H K	85	6.00 6.75		
8.00	J L	145	7.80 8.90		
10.00	K M	215	9.90 11.25		
12.00	M P	345	14.30 16.10		
14.00	N R	460	18.75 20.80		
16.00	N R	780	28.00 31.33		



SEAL KITS

PISTON ROD KITS

Ordering Example
SEAL KIT H-2

From From
piston rod packing
rod code code

Order by Piston Rod Packing Code and Rod Diameter Code from nameplate as outlined:

- 2 — Standard Polyurethane Packing with Buna-N O-Ring Expander, Buna-N O-Ring
- 3 — Optional Viton Packing, Viton O-Ring

PISTON PACKING KITS

Ordering Example
SEAL KIT A-4.50

From Bore Size
piston
packing code

Order by Piston Packing Code and Bore Size from nameplate as outlined:

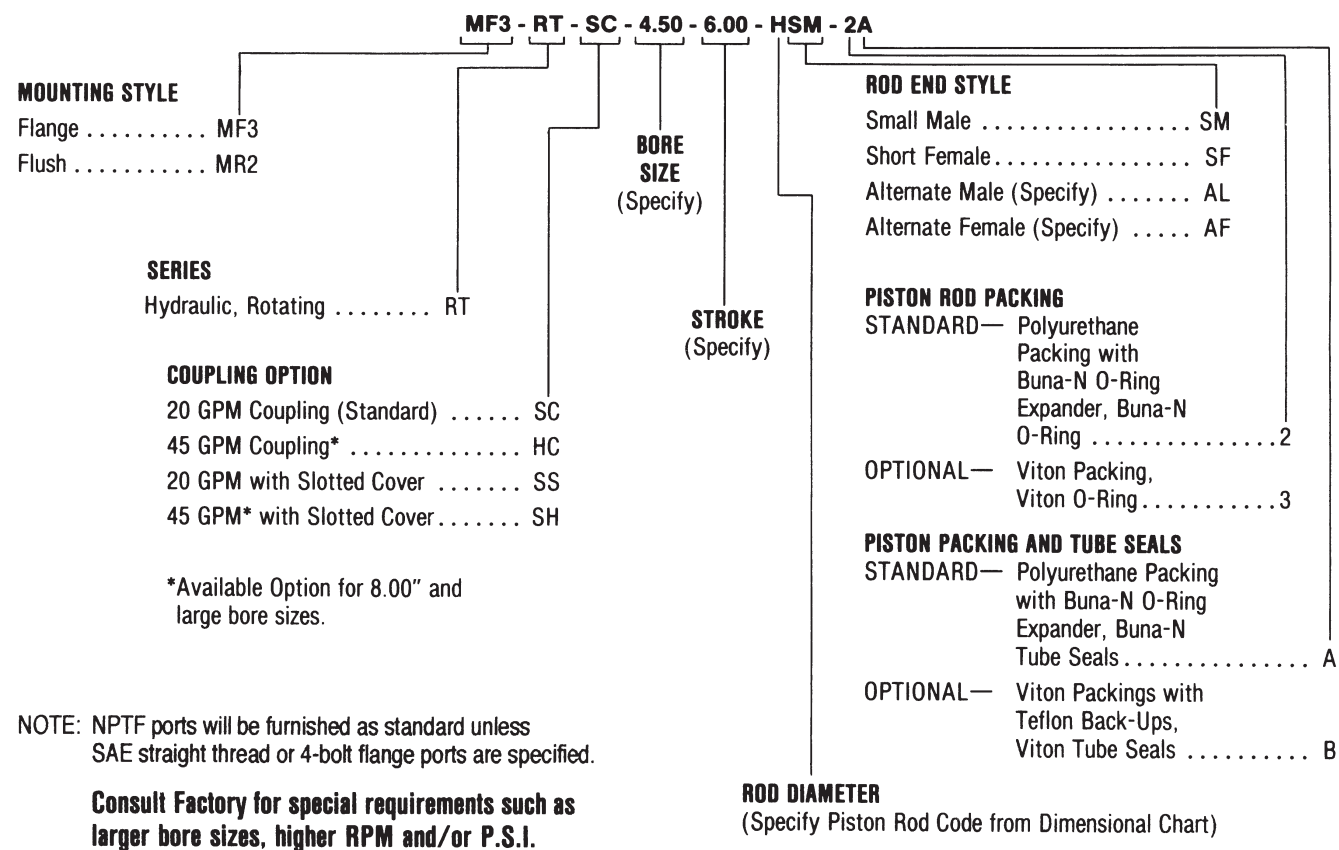
- A — Standard Polyurethane Packings with Buna-N O-Ring Expander, Buna-N Tube Seals
- B — Optional Viton Packings with Teflon Back-Ups, Viton Tube Seals

COUPLING SEAL KITS

Includes 6 carbon-graphite filled Teflon Roto Rings with 6 Viton Expander O-Rings and 2 Viton O-Rings.

Specify 20 or 45 GPM Coupling.

HOW TO ORDER



Series T750 Pneumatic and Hydraulic Cylinders

- 1.50" – 4.00" Bores
- 250 PSI Pneumatic Service
- 1,000 PSI Hydraulic Service
- Extra-Long Rod and Piston Bearings
- Rugged Construction for Extended Life
- Unique, Positive Cushioning Design
- Conform to JIC Standards

HANNA
cylinders

Series T750

**Heavy-Duty
Pneumatic
Medium-Duty
Hydraulic Cylinders**

Hanna's Series T750 cylinders are designed for heavy-duty pneumatic service up to 250 p.s.i., or medium-duty hydraulic service to 1000 p.s.i. Offered in 1.50" through 4.00" bore sizes, they are available in six mounting styles. The units conform to J.I.C. standards.

Featuring rugged construction and extra-long rod and piston bearings, Series T750 cylinders are engineered to provide extended life. Unique cushion design assures positive cushioning over the entire cushion stroke, with immediate full speed on return stroke.

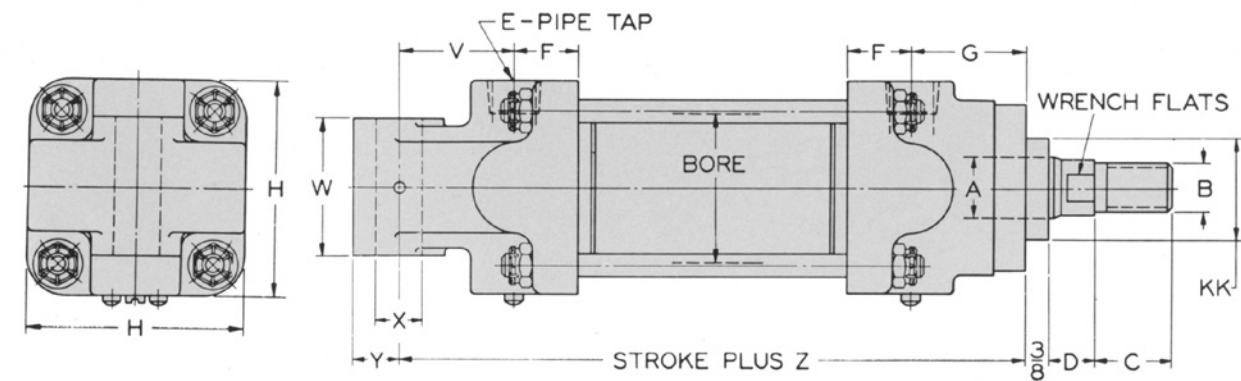
Ideal for a wide range of applications, Series T750 cylinders have been used extensively in packaging machinery and conveying equipment.

Dimensions

All dimensions shown are of cushioned and non-cushioned cylinders in inches. Dimensions are for

zero stroke. Rod ends shown will be furnished unless otherwise specified. Alternate rod ends are available.

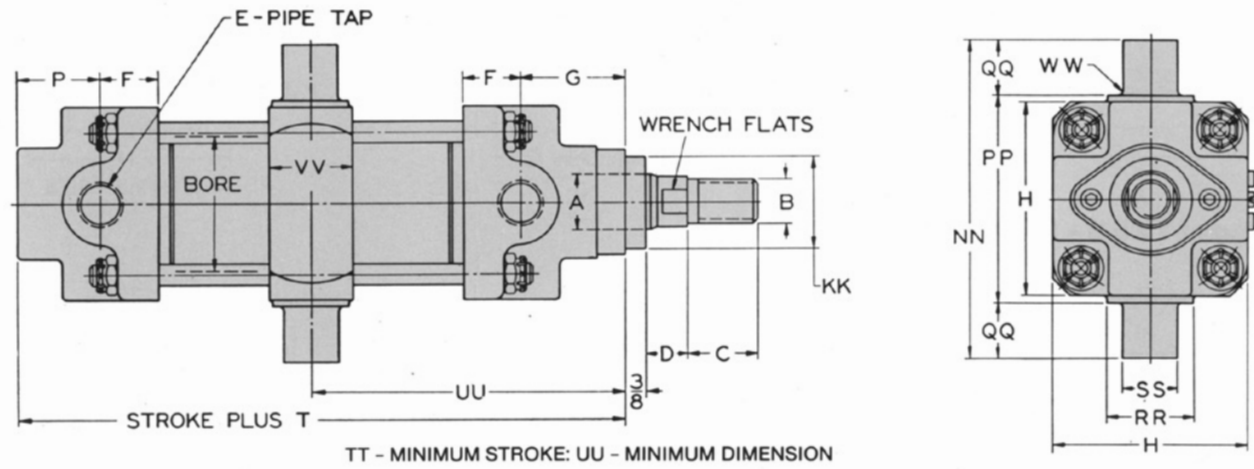
Model T751 - Hinge Mount



BORE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T
1½	¾	¾-20	¾	¾	¾	1¼	1¼	2½	1¼	1½	1¾	4¾	1¾	¾	¾	1¼	5¼	
2	¾	½-20	¾	¾	¾	1	1¼	3	1½	1¾	2	4¾	1¾	¾	½	2¾	6¾	
2½	1	¾-16	1¼	¾	¾	1¼	1¾	3½	1¾	1¾	2½	4¾	1¾	1½	½	2½	6¾	
3	1	¾-16	1¼	¾	¾	1¼	1¾	4¼	2½	1¾	3	5¾	1¾	1½	½	2¾	6¾	
4	1½	1-14	1¼	¾	¾	1¼	2¾	5¼	2¾	2¾	3¾	7¼	2¾	¾	¾	3¾	9¼	

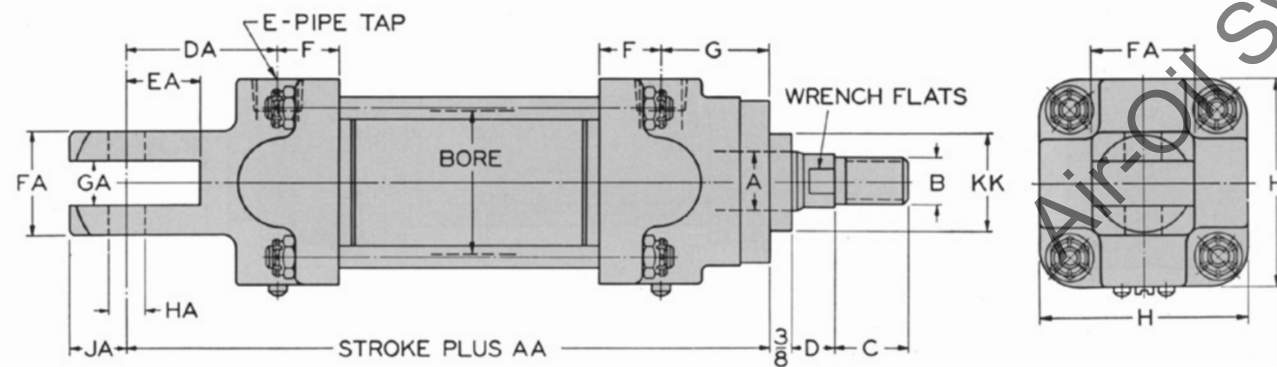
HANNA cylinders

Model T755 - Trunion Mount



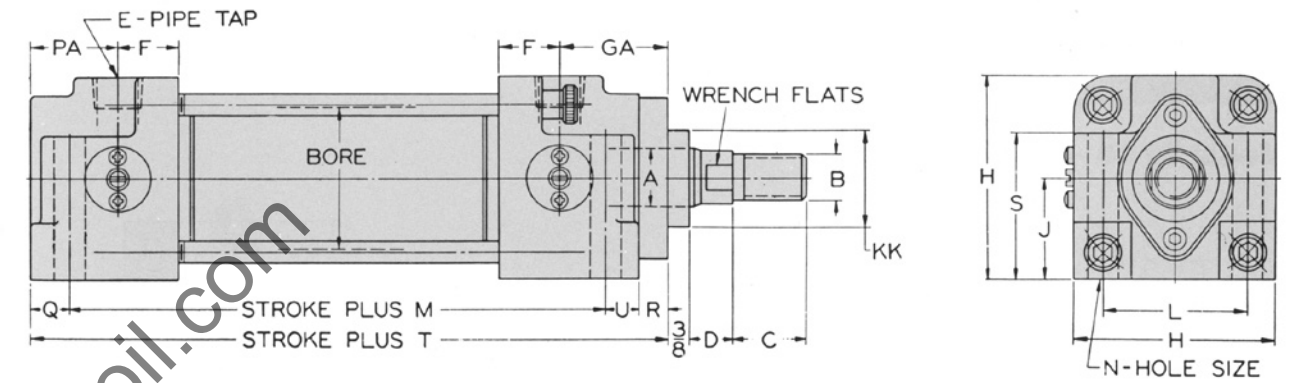
BORE	A	B	C	D	E	F	G	H	P	T	KK	NN	PP	QQ	RR	SS	TT	UU	VV	WW
1½	¾	¾-20	¾	¾	¾	1½	1½	2½	1¼	5½	1¼	4	2¾	¾	¾	¾	0	3	1	¾
2	¾	¾-20	¾	¾	¾	1	1½	3	1½	6	1½	5	3¼	¾	1½	¾	¾	3½	1¼	¾
2½	1	¾-16	1¼	¾	¾	1½	1½	3½	1½	6	1½	5	3¾	1	1½	1	¾	3½	1½	¾
3	1	¾-16	1¼	¾	¾	1½	1½	4¼	1½	6	1½	7	4½	1¼	1½	1¼	¾	3½	1¼	¾
4	1½	1-14	1¼	¾	¾	1¼	2	5¼	2	8½	2½	8	5¾	1½	2	1½	1	5	2¼	¾

Model T761 - Clevis Mount

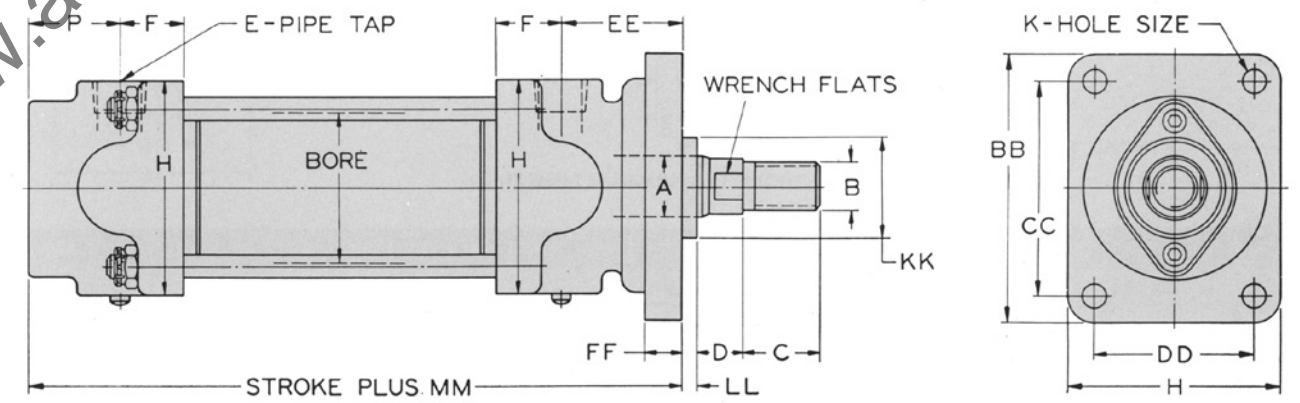


BORE	A	B	C	D	E	F	G	H	AA	KK	DA	EA	FA	GA	HA	JA
1½	¾	¾-20	¾	¾	¾	1½	1½	2½	6¾	1¼	2½	1½	1¼	¾	¾	¾
2	¾	¾-20	¾	¾	¾	1	1½	3	7½	1½	2½	1½	1½	¾	¾	¾
2½	1	¾-16	1¼	¾	¾	1½	1½	3½	7½	1½	2½	1¼	1¾	¾	¾	1
3	1	¾-16	1¼	¾	¾	1½	1½	4¼	7½	1½	2½	1¼	1¾	¾	¾	1
4	1½	1-14	1¼	¾	¾	1¼	2	5¼	10	2½	3¾	1½	2¼	1	¾	1½

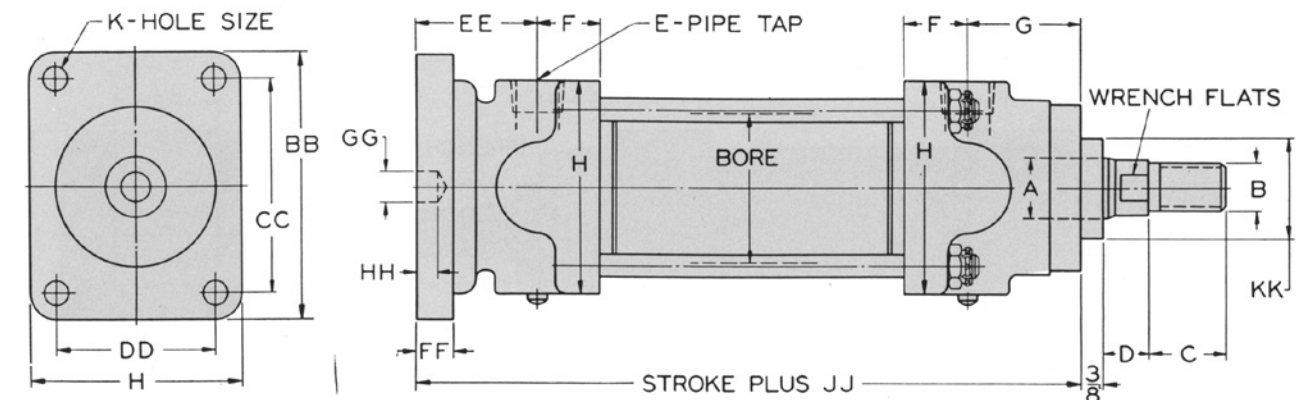
Model T752 - Foot Mount



Model T753 - Rod Flange Mount



Model T754 - Blind Flange Mount



U	V	W	X	Y	Z	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	PA	GA
½	1	1½	½	½	6½	3½	2¼	1¾	1½	¾	¾	¾	6	1¼	¼	6½	1¼	1½
½	1	1¼	¾	¾	6	4	3	2½	1½	½	¾	¾	6	1¾	¼	6½	1½	1½
¾	1	2¼	¾	¾	7	4¾	3½	2	2	¾	½	¾	7	1¾	¼	6	1½	1
¾	1	2½	¾	¾	7¼	5	4	3¼	2	¾	½	¾	7	1¾	¼	7	1½	1
¾	2	3	1	1	9	8	6½	3¾	2¼	1	½	½	9	2½	¼	8	2	3

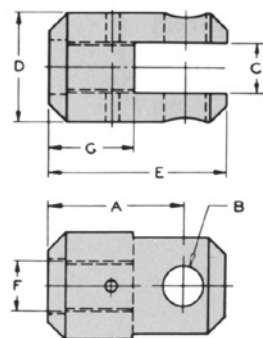
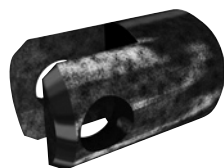
OPTIONS

PARTS LIST

Rod Clevis

The rod clevis attaches to the piston rod of Series T750 cylinders. Clevis pins are also available.

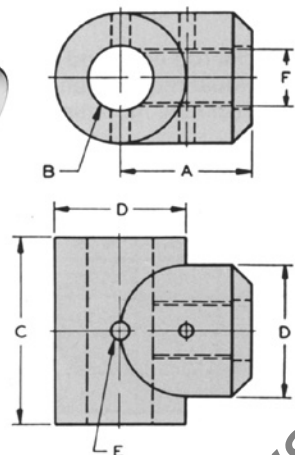
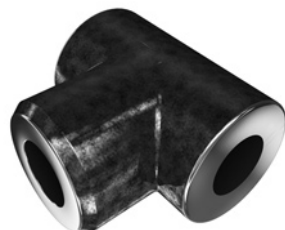
BORE	ITEM NO.	A	B	C	D	E	F	G
1½	V15	1½	¾	⅞	1	1½	⅜-20	¾
2	V20	1½	½	½	1¼	2	½-20	¾
2½	V25	2	¾	¾	1½	2½	¾-16	1¼
3	V30	2	¾	¾	1½	2½	¾-16	1¼
4	V40	3	¾	1	2½	4	1-14	1¾



Rod Eye

The rod eye attaches to the piston rod of Series T750 cylinders. May be used with or without mounting bracket.

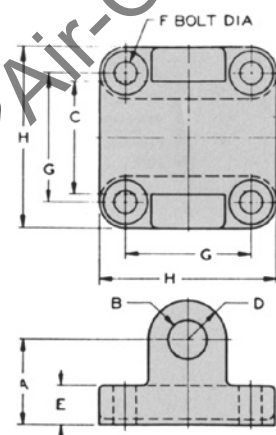
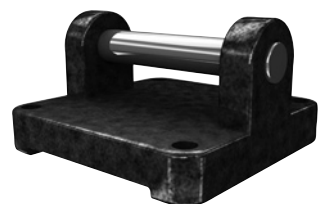
BORE	ITEM NO.	A	B	C	D	E	F
1½	Y15	1	½	1½	1	¾	⅜-20
2	Y20	1¼	¾	1¾	1¼	¾	½-20
2½	Y25	1¾	¾	2¼	1½	¾	¾-16
3	Y30	1¾	¾	2½	1¾	¾	¾-16
4	Y40	2¾	1	3	2	¾	1-14



Mounting Bracket

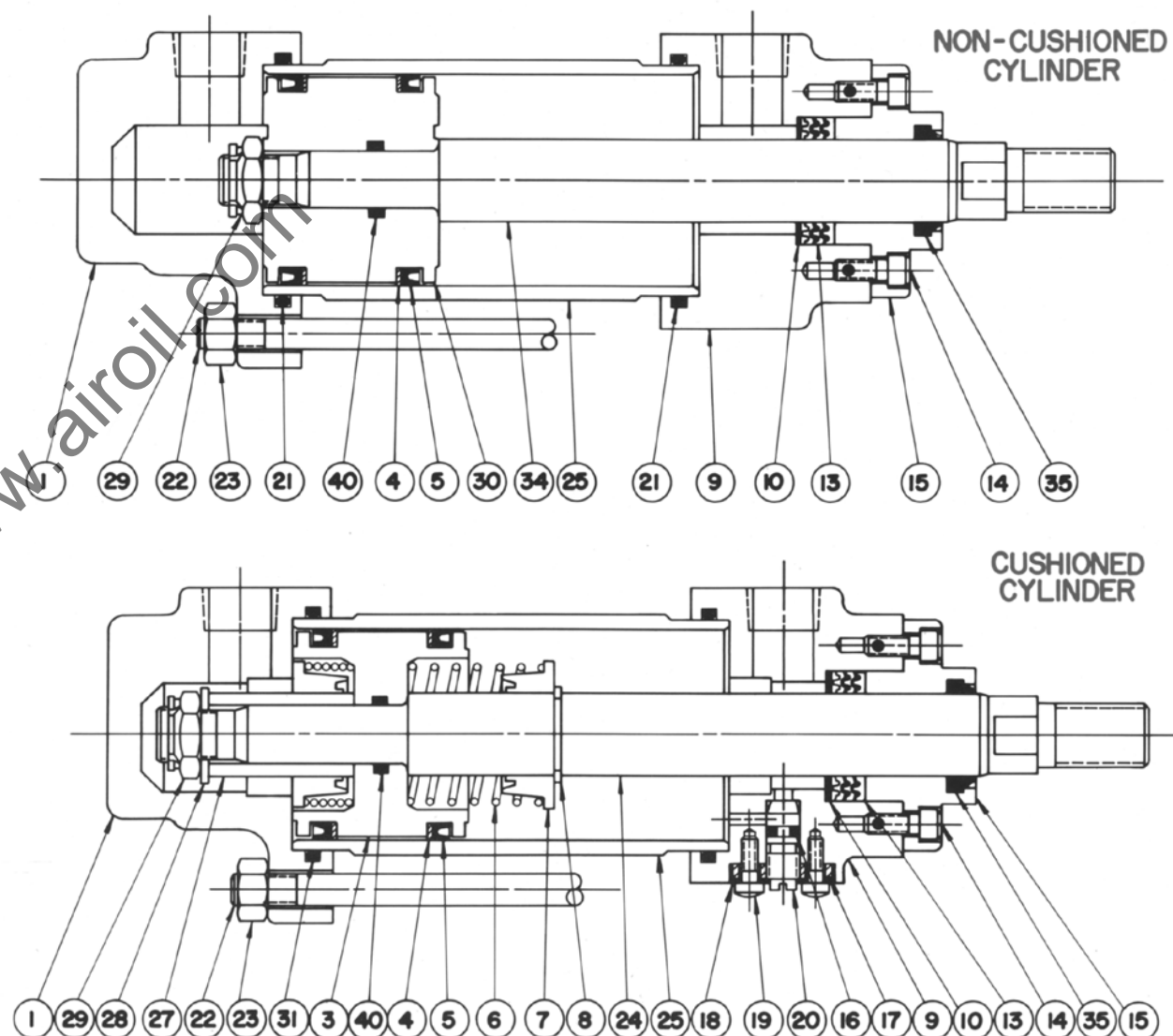
The mounting bracket fits the back head of the hinge mount cylinder. It may also be used on the rod end of any cylinder equipped with a rod eye. Comes complete with pin.

BORE	ITEM NO.	A	B	C	D	E	F	G	H
1½	B15	1½	½	1½	½	½	⅜-20	1¼	2½
2	B20	1¾	¾	1¾	¾	¾	¾	2¼	3
2½	B25	1¾	¾	2¼	¾	¾	¾	2½	3½
3	B30	1¾	¾	2½	¾	¾	¾	2½	4
4	B40	2¼	1	3	1	1	¾	3½	5



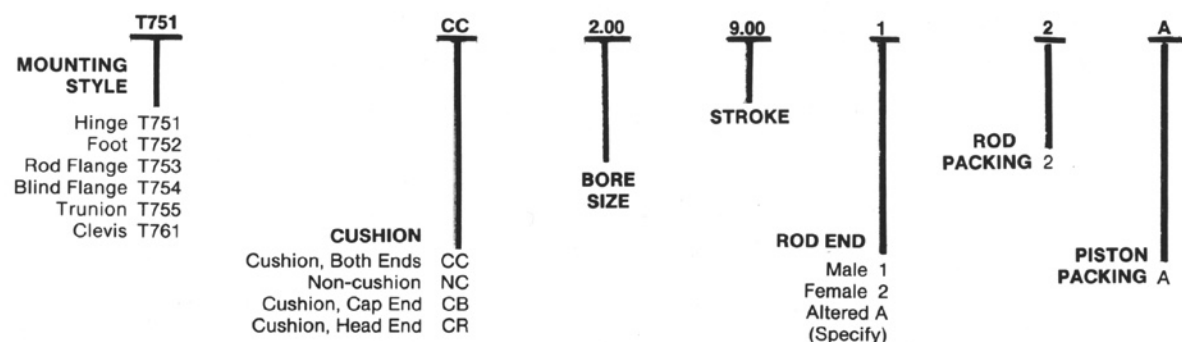
When ordering, please give Cylinder Serial Number, Parts List Page Number and Date, and Part Number. If Serial

Number is not available, please indicate Model Number, Bore, Stroke and Rod Diameter.



Item No.	Description	Item No.	Description
1	Back Head	20	Cushion Needle
3	Piston (Cushioned)	21	Head O-Ring
4	Back-up Washer	22	Tie Rod
5	Piston Packing	23	Tie Rod Nut
6	Cushion Spring	24	Piston Rod (Cushioned)
7	Cushion Valve	25	Tube
8	Cushion Retaining Ring	27	Cushion Valve Sleeve
9	Front Head	28	Cushion Retainer Washer
10	Packing Washer	29	Piston Rod Nut
13	Rod Packing Set	30	Piston (Non-Cushioned)
14	Screw	34	Piston Rod (Non-Cushioned)
15	Gland	35	Rod Wiper
16	Cushion Needle O-Ring	40	Piston O-Ring
17	Cushion Needle Retainer	45	Piston Kit C (Not Shown)
18	Cushion Plate	46	Gland Kit (Not Shown)
19	Retaining Screw		

HOW TO ORDER

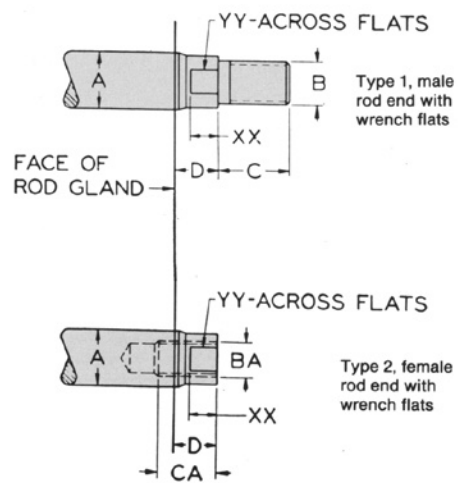


Rod End Dimensions

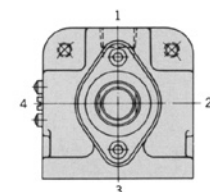
The two piston rod ends illustrated and dimensioned are standard. Rod End type 1 will be furnished on all cylinders unless otherwise specified. Type 2 is optional at no extra charge.

Special rod ends and rod extensions can be made to suit your individual requirements. Wrench flats as illustrated are standard, and facilitate mounting of the cylinder.

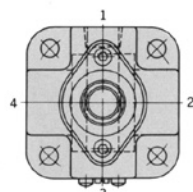
BORE	A	B	C	D	BA	CA	XX	YY
1½	¾	⅞-20	¾	¾	¾-24	½	¾	½
2	¾	⅞-20	¾	¾	¾-20	¾	½	⅝
2½	1	¾-16	1¼	¾	¾-18	1	½	13/16
3	1	¾-16	1¼	¾	¾-18	1	½	13/16
4	1½	1-14	1¾	¾	1-14	1½	¾	1¼



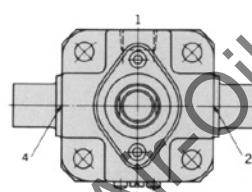
Pipe Port and Cushion Needle Adjustment Locations



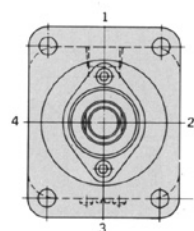
STANDARD LOCATION
 PIPE PORT AT 1
 CUSHION NEEDLE AT 4
 MODEL 752 & 752CC



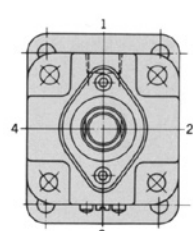
STANDARD LOCATION
 PIPE PORT AT 1
 CUSHION NEEDLE AT 3
 MODEL 751 & 751CC



STANDARD LOCATION
 PIPE PORT AT 1
 CUSHION NEEDLE AT 3
 MODEL 755 & 755CC



STANDARD LOCATION
 PIPE PORT AT 1
 CUSHION NEEDLE AT 3
 MODEL 753 & 753CC



STANDARD LOCATION
 PIPE PORT AT 1
 CUSHION NEEDLE AT 3
 MODEL 754 & 754CC


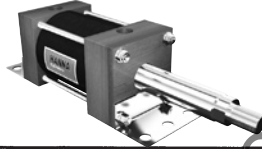







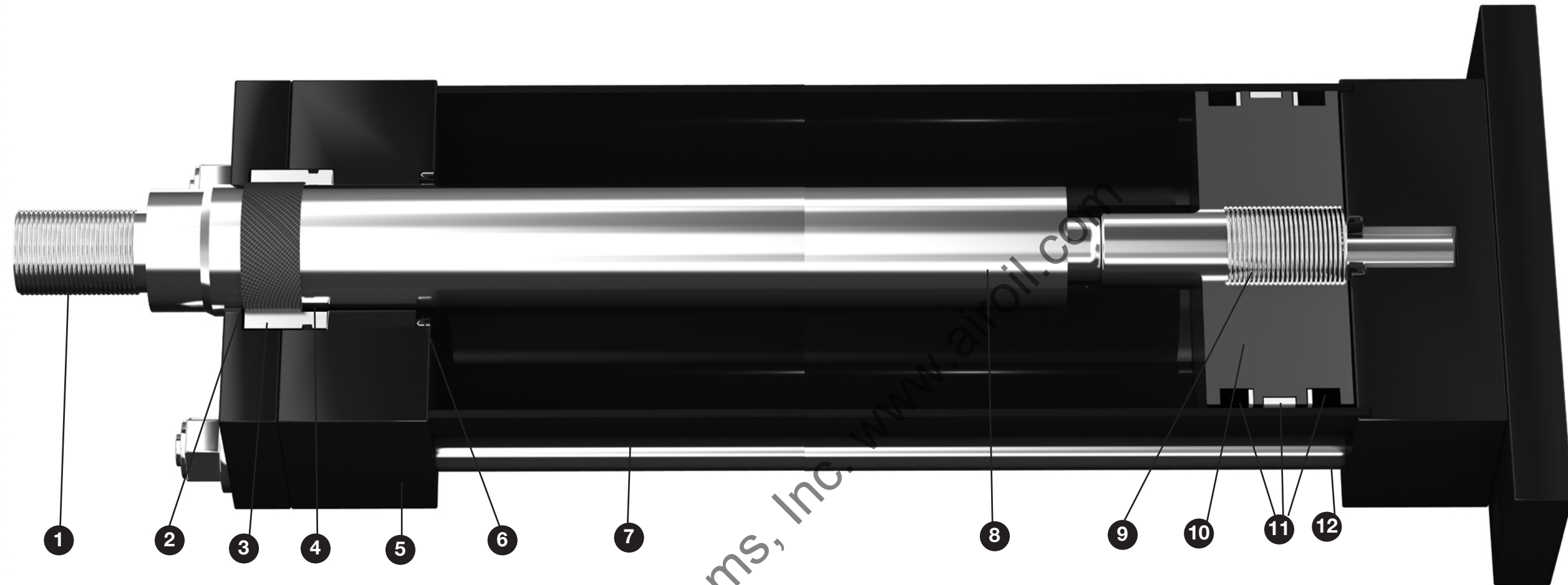
Series CA Composite Pneumatic Cylinders

- Corrosion Resistance
- High-Tech Duralon® Rod Bearing
- Advance-Design Rod and Piston Sealing System
- Heavy-Duty Piston-to-Rod Connection
- 1.50" – 6.00" Bores
- 150 PSI Pressure Ratings
- 11 N.F.P.A. Mounting Styles
- Lightweight, Easy to Install
- Optional AWWA Construction Available

SERIES CA COMPOSITE PNEUMATIC CYLINDERS

1.50" THRU 6.00" BORES

	Description	Page No.
	MX0-1-2-3-4 Tie Rod Mounts	242
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	MT1 Head Trunnion Mount	244
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	Pin	249
	Brackets	249
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	Force Data	250
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Series CA Features and Benefits

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity.

2. Duralon® Rod Bearing

Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high load conditions. The exact combination of woven Teflon® and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Because Duralon bearings are non-metallic, they minimize potential galling. In addition, they are capable of sustaining much higher compressive loads than either bronze or cast iron, have an extremely low coefficient of friction, require no lubrication to the bearing surface and are impervious to corrosion.

3. Gland Construction

Two-piece (gland plus retainer plate) with full-face retainer design for easy maintenance should the need for bearing or seal replacement arise. Made from corrosion-resistant stainless steel.

4. Rod Seal

Series CA cylinders incorporate a heavy cross-section polyurethane U-cup piston rod seal, assuring zero leakage and outstanding wear resistance.

5. Heads

Heads are made from laminated phenolic with enhanced strength and corrosion-resistant properties. Hanna's precision machining assures accurate alignment and close concentricity between piston, tube, piston rod and rod bearing, thus prolonging cylinder service life.

6. Cushion Check Seals

Series CA cushion check seals are closely fitted to cushion sleeve and spear. The seals serve as both cushion seal and check valve, providing effective cushioning and fast, smooth breakaway.

7. Tubing

Fiberglass tubing provides the combination of high strength and corrosion resistance needed for service in harsh environments. Inside diameter of tubing has a 12 micro-inch finish. Non-metallic piston bearing contact prevents galling, and provides for extremely low coefficient of friction.

8. Piston Rod

All piston rod sizes are made of Series 303 stainless steel, and are hard-chrome plated for scratch and corrosion resistance. To maximize seal and bearing life, plated surface is polished to a 6-8 micro-inch finish. The rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress concentration.

9. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

10. Piston

One-piece piston is made of high-strength, non-corrosive, impact-resistant aluminum. Threaded to the piston rod, the piston is furnished with break-away spirals on each side. For AWWA-approved water service, optional cadmium-plated piston is available.

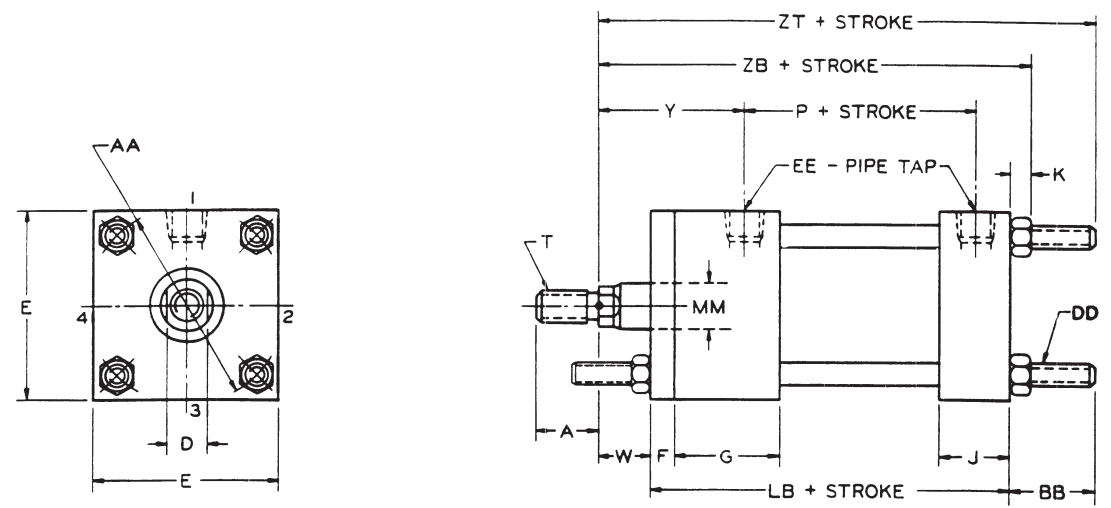
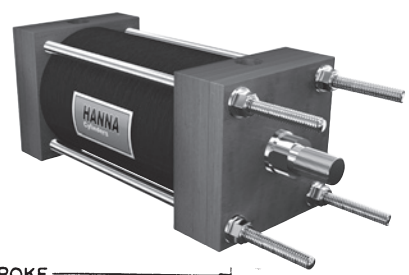
11. Piston Sealing System

Two Buna U-cups with a bronze-filled Teflon bearing strip are standard. The wear strip provides a non-metallic bearing point on the piston, assuring long life and extremely low friction. For non-lubricated service, an optional glass-filled Teflon, O-ring energized piston seal, with wear strip, is available.

12. Tie Rods

Made from high-strength, corrosion-resistant Series 303 stainless steel. Tie rod nuts, washers and all other fasteners are also made of stainless steel for corrosion resistance and low maintenance.

MX0, MX1, MX2, MX3, MX4 Tie Rod Mounts



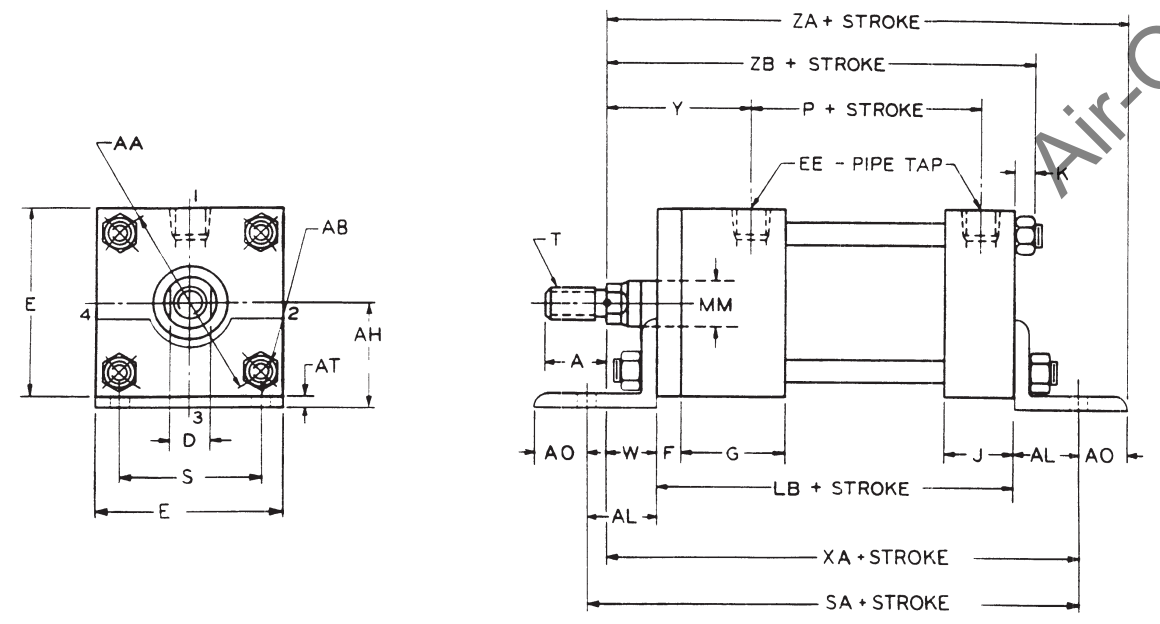
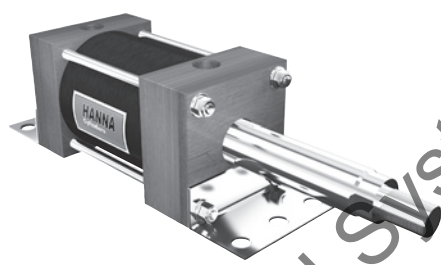
MX0, MX1, MX2, MX3, MX4, MS1

These Dimensions are Constant Regardless of Rod Diameter

BORE	AA	AB	AH	AL	AO	AT	BB	DD	E	EE (NPTF)	F	G	J	K	LB	P	S	SA
1.50	2.02	.41	1.19	1.00	.50	.12	1.00	.25-20	2.00	1/4	.38	1.50	1.00	.38	4.00	2.31	1.25	6.00
2.00	2.60	.41	1.44	1.00	.50	.12	1.12	.31-18	2.50	1/4	.38	1.50	1.00	.41	4.00	2.31	1.75	6.00
2.50	3.10	.41	1.62	1.00	.50	.19	1.12	.31-18	3.00	1/4	.38	1.50	1.00	.41	4.12	2.44	2.25	6.12
3.25	3.90	.53	1.94	1.25	.75	.19	1.38	.38-16	3.75	3/8	.62	1.75	1.25	.53	4.88	2.69	2.75	7.38
4.00	4.70	.53	2.25	1.25	.75	.19	1.38	.38-16	4.50	3/8	.62	1.75	1.25	.53	4.88	2.69	3.50	7.38
5.00	5.80	.66	2.75	1.38	.62	.19	1.81	.50-13	5.50	3/8	.62	1.75	1.25	.69	5.12	2.94	4.25	7.88
6.00	6.90	.78	3.25	1.38	1.12	.19	1.81	.50-13	6.50	1/2	.75	2.00	1.50	.69	5.75	3.19	5.25	8.50

NOTE: Specify Tie Rod Extension. "BB" dimension if other than standard.
 MX0 = No Tie Rods Extended
 MX1 = 4 Tie Rods Extended Both Ends
 MX2 = 4 Tie Rods Extended Cap End
 MX3 = 4 Tie Rods Extended Head End
 MX4 = 2 Tie Rods Extended Both Ends

MS1 End Angle Mount

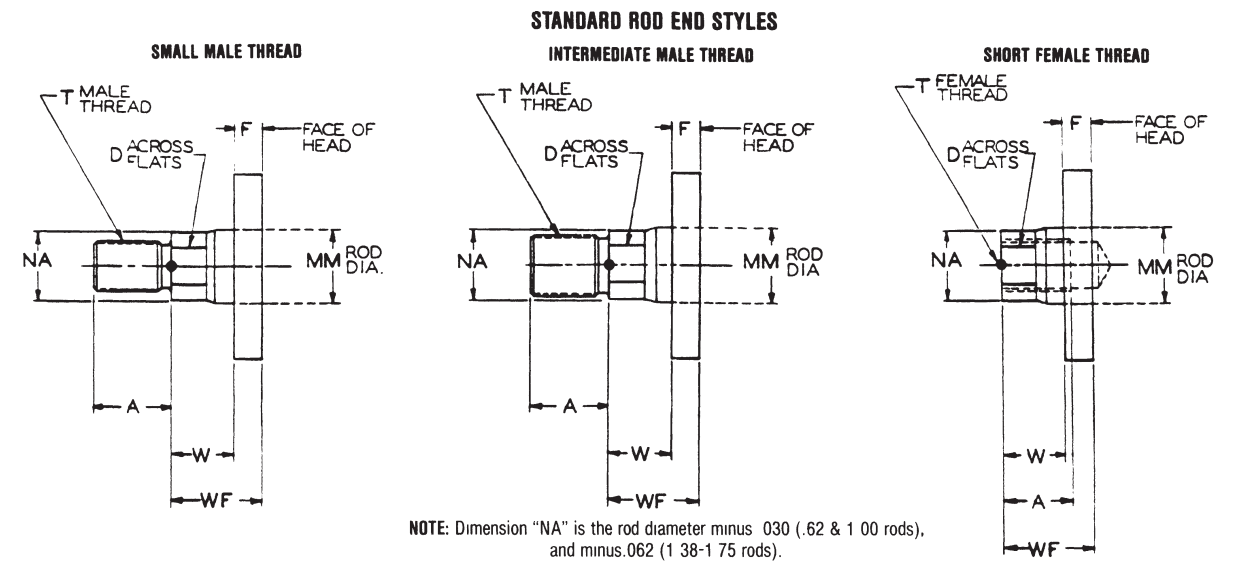


Dimensions are Affected by the Rod Diameter

BORE	CYLINDER ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD)			W	XA	Y	ZA	ZB	ZT
					SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	.50	.44-20	.50-20	.44-20	.62	5.62	1.88	6.12	5.00	5.62
2.00	D	.62	.75	.50	.44-20	.50-20	.44-20	.62	5.62	1.88	6.12	5.03	5.75
	F	1.00	1.12	.88	.75-16	.88-14	.75-16	1.00	6.00	2.25	6.50	5.41	6.12
2.50	D	.62	.75	.50	.44-20	.50-20	.44-20	.62	5.75	1.88	6.25	5.16	5.88
	F	1.00	1.12	.88	.75-16	.88-14	.75-16	1.00	6.12	2.25	6.62	5.53	6.25
3.25	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	6.88	2.38	7.62	6.16	7.00
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.12	2.62	7.88	6.41	7.25
4.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	6.88	2.38	7.62	6.16	7.00
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.12	2.62	7.88	6.41	7.25
5.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	7.25	2.38	7.88	6.56	7.69
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.50	2.62	8.12	6.81	7.94
6.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	.88	8.00	2.75	9.12	7.31	8.44
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12	1.12	8.25	3.00	9.38	7.56	8.69

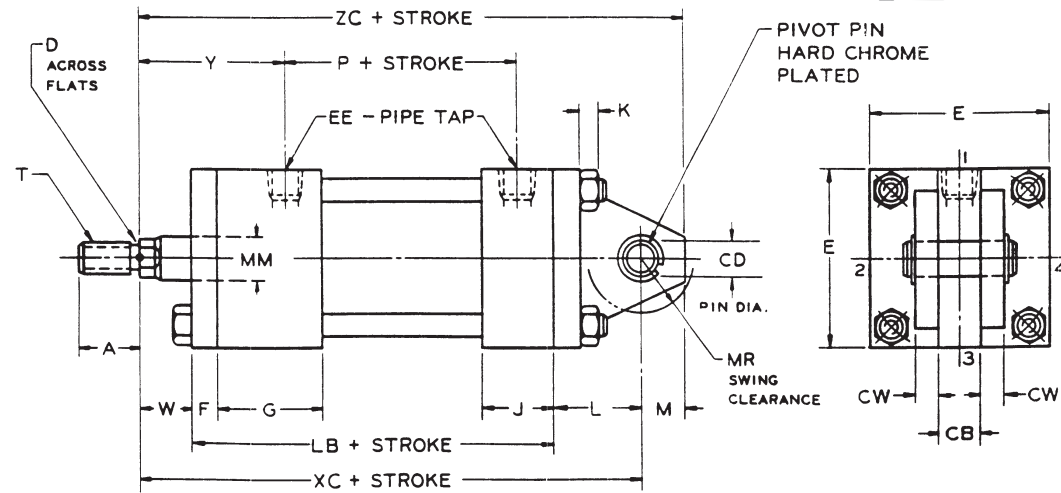
PRESSURE RATING: 150 P.S.I. maximum operating pressure. Check Stroke Limitation Data (Page 250) which may reduce maximum operating pressure. Check Stop Tube Data (Page 251) to see if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), and minus .062 (1.38-1.75 rods).

MP1 Fixed Clevis Mount



MP1, MT1

These Dimensions are Constant Regardless of Rod Diameter

BORE	CB +0.16 +0.47	CD	CW	E	EE (NPTF)	F	G	J	K	L	LB	M	MR	P	TD +0.000 -0.002	TL	UT
1.50	.750	500	19	2.00	1/4	.38	1.50	1.00	38	75	4.00	50	.62	2.31	1.000	1.00	4.00
2.00	.750	500	.19	2.50	1/4	.38	1.50	1.00	41	75	4.00	50	.62	2.31	1.000	1.00	4.00
2.50	.750	500	.19	3.00	1/4	.38	1.50	1.00	41	75	4.12	50	.62	2.44	1.000	1.00	5.00
3.25	1.250	750	38	3.75	3/8	.62	1.75	1.25	53	1.25	4.88	75	1.12	2.69	1.000	1.00	5.75
4.00	1.250	750	38	4.50	3/8	.62	1.75	1.25	53	1.25	4.88	75	1.12	2.69	1.000	1.00	6.50
5.00	1.250	750	.38	5.50	3/8	.62	1.75	1.25	.69	1.25	5.12	75	1.12	2.94	1.000	1.00	7.50
6.00	1.500	1.000	38	6.50	1/2	.75	2.00	1.50	69	1.50	5.75	1.00	1.38	3.19	1.375	1.38	9.25

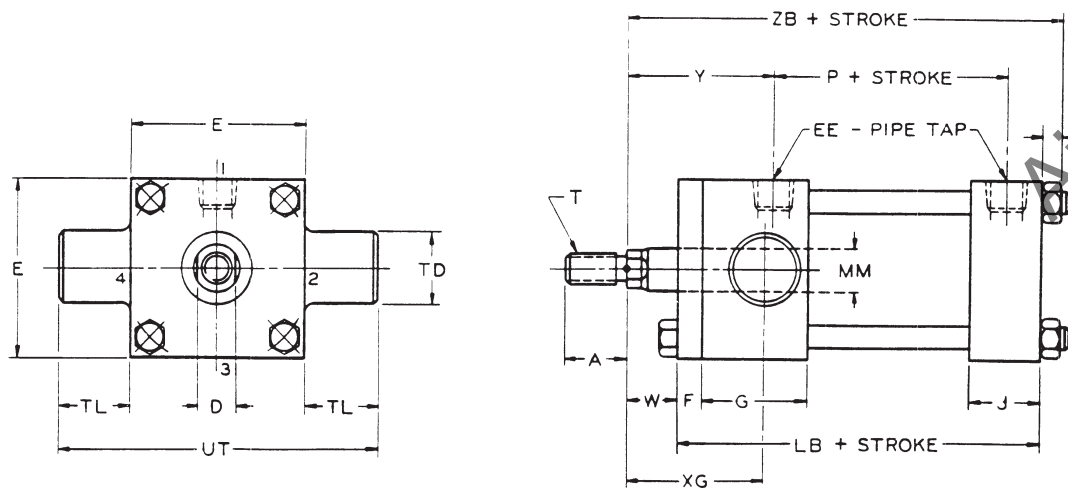
Dimensions are Affected by the Rod Diameter

BORE	CYLINDER ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD)			W	XC	XG	Y	ZB	ZC
					SMALL MALE SM	INTER- MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	.50	44-20	50-20	44-20	.62	5.38	1.75	1.88	5.00	5.88
2.00	D	.62	.75	.50	44-20	50-20	44-20	.62	5.38	1.75	1.88	5.03	5.88
	F	1.00	1.12	.88	75-16	88-14	75-16	1.00	5.75	2.12	2.25	5.41	6.25
2.50	D	.62	.75	.50	44-20	50-20	44-20	.62	5.50	1.75	1.88	5.16	6.00
	F	1.00	1.12	.88	75-16	88-14	75-16	1.00	5.88	2.12	2.25	5.53	6.38
3.25	F	1.00	1.12	.88	75-16	88-14	75-16	.75	6.88	2.25	2.38	6.16	7.62
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.12	2.50	2.62	6.41	7.88
4.00	F	1.00	1.12	.88	75-16	88-14	75-16	.75	6.88	2.25	2.38	6.16	7.62
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.12	2.50	2.62	6.41	7.88
5.00	F	1.00	1.12	.88	75-16	88-14	75-16	.75	7.12	2.25	2.38	6.56	7.88
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	7.38	2.50	2.62	6.81	8.12
6.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	.88	8.12	2.62	2.75	7.31	9.12
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12	1.12	8.38	2.88	3.00	7.56	9.38

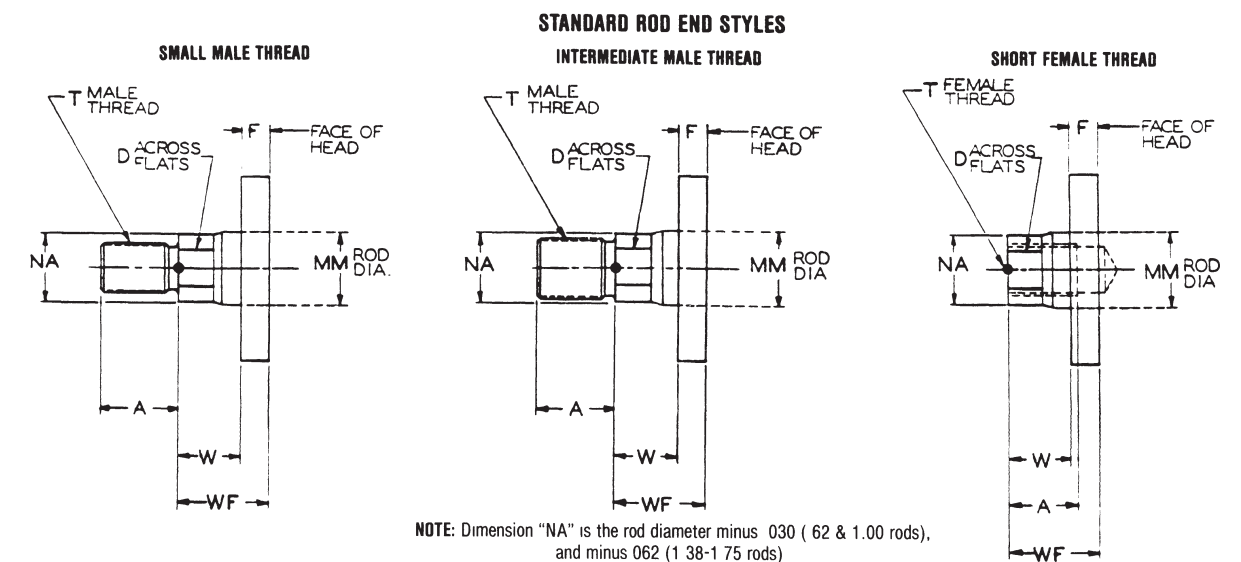
PRESSURE RATING: 150 P.S.I. maximum operating pressure. Check Stroke Limitation Data (Page 250) which may reduce maximum operating pressure. Check Stop Tube Data (Page 251) to see if stop tube is required.

NOTE: Dimensions are nominal except where specifically tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

MT1 Head Trunnion Mount

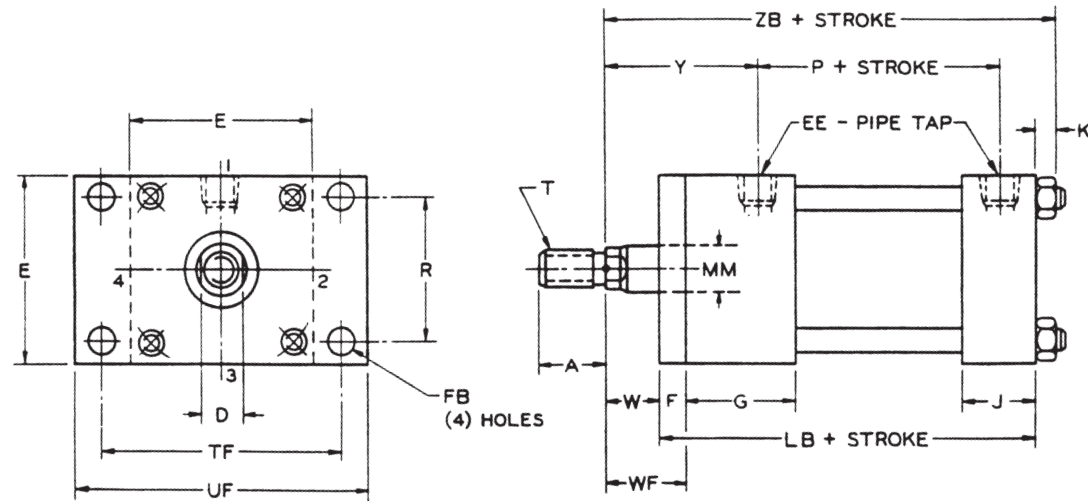


NOTE: Align and mount pillow blocks to avoid bending moments in trunnions



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), and minus .062 (1.38-1.75 rods)

MF1 Head Rectangular Flange Mount



MF1, MF2

These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE (NPTF)	F	FB +.005 - .000	G	J	K	LB	P	R ±0.10	TF ±0.10	UF
1.50	2.00	1/4	.38	.312	1.50	1.00	.38	4.00	2.31	1.43	2.75	3.38
2.00	2.50	1/4	.38	.375	1.50	1.00	.41	4.00	2.31	1.84	3.38	4.12
2.50	3.00	1/4	.38	.375	1.50	1.00	.41	4.12	2.44	2.19	3.88	4.62
3.25	3.75	3/8	.62	.438	1.75	1.25	.53	4.88	2.69	2.76	4.69	5.50
4.00	4.50	3/8	.62	.438	1.75	1.25	.69	4.88	2.69	3.32	5.44	6.25
5.00	5.50	3/8	.62	.562	1.75	1.25	.69	5.12	2.94	4.10	6.62	7.62
6.00	6.50	1/2	.75	.438	2.00	1.50	.84	5.75	3.19	4.88	7.62	8.62

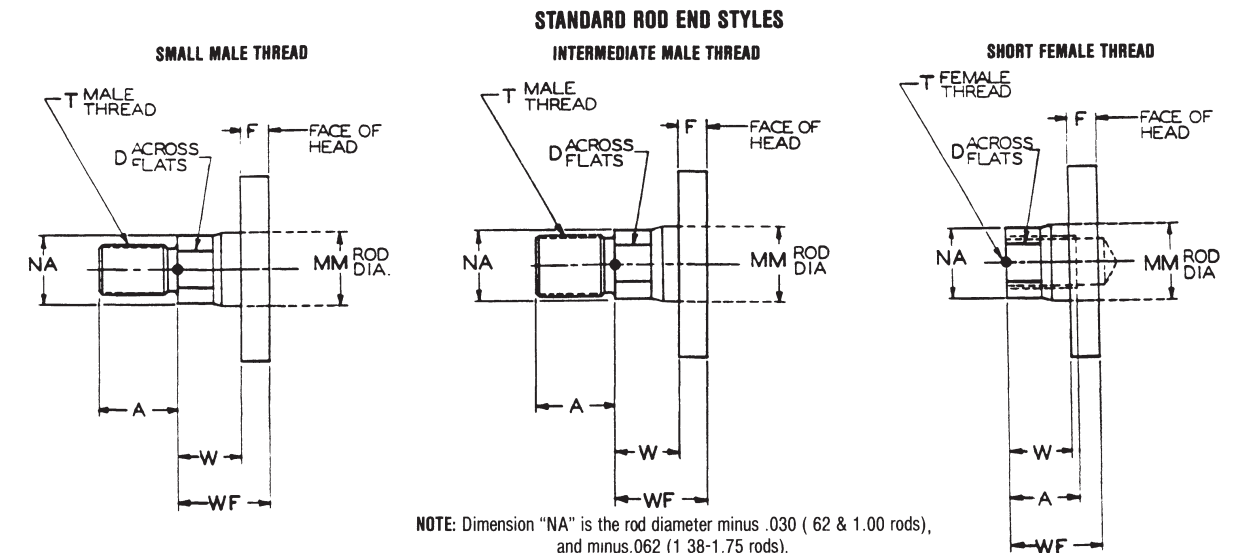
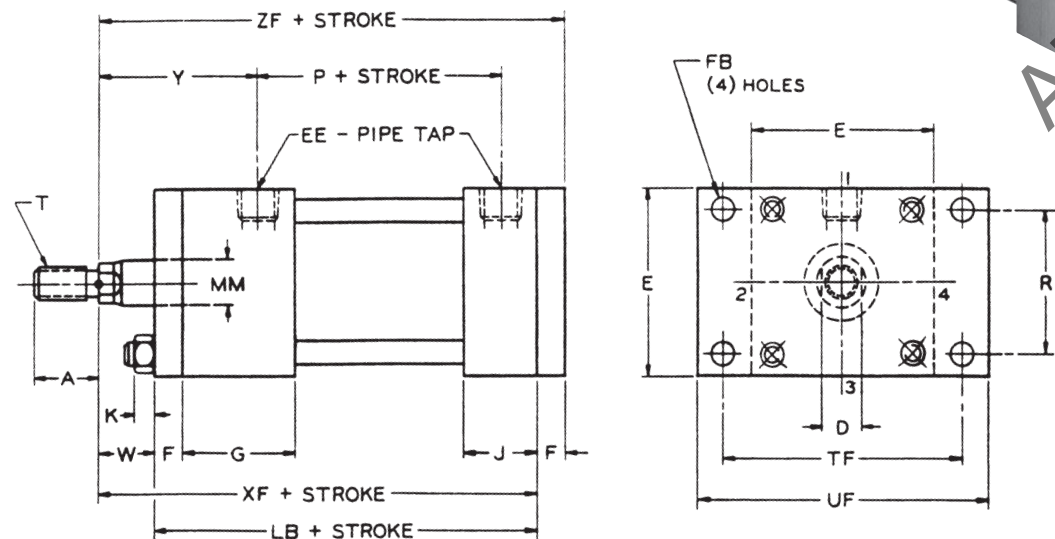
Dimensions are Affected by the Rod Diameter

CYLINDER			A		T (THREAD)			W	WF	Y	ZB	ZF	ZJ
BORE	ROD DIA. CODE	MM ROD DIA.	A	D	SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF						
1.50	D	.62	.75	.50	.44-20	50-20	.44-20	.62	1.00	1.88	5.00	5.00	4.62
2.00	D	.62	.75	.50	.44-20	.50-20	.44-20	.62	1.00	1.88	5.03	5.00	4.62
	F	1.00	1.12	.88	.75-16	.88-14	.75-16	1.00	1.38	2.25	5.41	5.38	5.00
2.50	D	.62	.75	.50	.44-20	50-20	.44-20	.62	1.00	1.88	5.16	5.12	4.75
	F	1.00	1.12	.88	.75-16	.88-14	.75-16	1.00	1.38	2.25	5.53	5.50	5.12
3.25	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	1.38	2.38	6.16	6.25	5.62
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	1.62	2.62	6.41	6.50	5.88
4.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	1.38	2.38	6.16	6.25	5.62
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	1.62	2.62	6.41	6.50	5.88
5.00	F	1.00	1.12	.88	.75-16	.88-14	.75-16	.75	1.38	2.38	6.56	6.50	5.88
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1.00	1.62	2.62	6.81	6.75	6.12
6.00	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	.88	1.62	2.75	7.31	7.38	6.62
	H	1.75	2.00	1.50	1.25-12	1.50-12	1.25-12	1.12	1.88	3.00	7.56	7.62	6.88

PRESSURE RATING: 150 P S I maximum operating pressure. Check Stroke Limitation Data (Page 250) which may reduce maximum operating pressure. Check Stop Tube Data (Page 251) to see if stop tube is required.

NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

MF2 Cap Rectangular Flange Mount



STROKE LIMITATION DATA

The rod diameter has to be capable of withstanding any compressive force developed by the cylinder working against the load. A piston rod diameter with adequate column strength to handle the compressive force of the application can be selected from the convenient pre-calculated chart at right.

To use this chart find the force value, developed by the application, in the left column. Next, select the figure which resembles your application and then multiply "D" times the factor given in that figure. Finally, opposite the corresponding force value, find the value of "L" which is equal to, or greater than, the figure derived from factoring "D". Directly above is the rod diameter which is capable of withstanding the forces developed in the application.

EXAMPLE: Cylinder Bore = 4.00" Operating PSI = 150
 Force Value - 1885 lbs.
 Application - Resembles Fig. 2 - End Angle Mtg.
 Stroke = 40"
 "L" = .07 x 40; L = 28"
 Correct Rod Diameter = 1.00"

The total force is 1885 lbs., and the value of "L" is 28 inches in this application. The smallest diameter rod capable of handling this situation is 1.00 inch.

If a stop tube is required for the application, be sure to include the stop tube length when determining the length of "D".

FORCE VALUE in pounds	VALUE OF "L" IN INCHES PISTON ROD DIAMETER			
	.62	1.00	1.38	1.75
100	66			
200	47			
400	33	85		
600	27	70	132	
800	24	60	114	184
1000	21	54	102	165
1300	18	47	90	145
1700	16	41	78	127
2100	14	37	71	114
2500	13	34	65	104
3000	12	31	58	95
4000	10	27	51	83
5000	9	24	46	74
6000	8	22	42	67
8000	7	19	36	58

NOTE: SEE APPLICATION FIGURES AT RIGHT.

FORCE DATA

BORE	ROD CODE	ROD DIA.	CYL. WORK ACTION	WORK AREA SQ. IN.	PNEUMATIC PRESSURE					FLUID Required PER INCH OF STROKE CU. FT.
					50	70	90	100	150	
1.50	D	.62	PUSH	1.77	89	124	160	177	266	.00102
			PULL	1.46	73	102	131	146	219	.00084
2.00	D	.62	PUSH	3.14	157	220	283	314	471	.00182
			PULL	2.83	142	198	255	283	424	.00164
2.50	D	.62	PUSH	4.91	245	344	442	491	736	.00284
			PULL	4.60	230	322	414	460	690	.00266
3.25	F	1.00	PUSH	8.29	414	580	746	829	1244	.00480
			PULL	7.51	375	525	676	751	1126	.00435
4.00	G	1.38	PUSH	12.57	628	880	1131	1257	1886	.00727
			PULL	11.78	589	825	1060	1178	1767	.00682
5.00	G	1.75	PUSH	19.64	982	1375	1768	1964	2946	.01136
			PULL	18.85	942	1319	1696	1885	2827	.01091
6.00	H	1.75	PUSH	28.27	1413	1979	2544	2827	4240	.01636
			PULL	25.86	1293	1810	2327	2586	3879	.01497

STOP TUBE DATA

Long stroke cylinders can be subjected to a buckling action and excessive bearing wear due to the weight of the exposed rod. To reduce wear a stop tube is recommended.

To determine if a stop tube is required, find the total value of "L" using the stroke limitation chart. Compare this value with the stop tube chart. If the value of "L" exceeds 40 inches, you can find the recommendation for stop tube length at the bottom of the chart.

EXAMPLE PROBLEM:
 Cylinder Model MP1-CA-NC-4.00 x 27.00 - GSM-1G
 Accessory - SV-3 Clevis
 Pressure - 150 PSI
 Clevis Mount - Horizontal

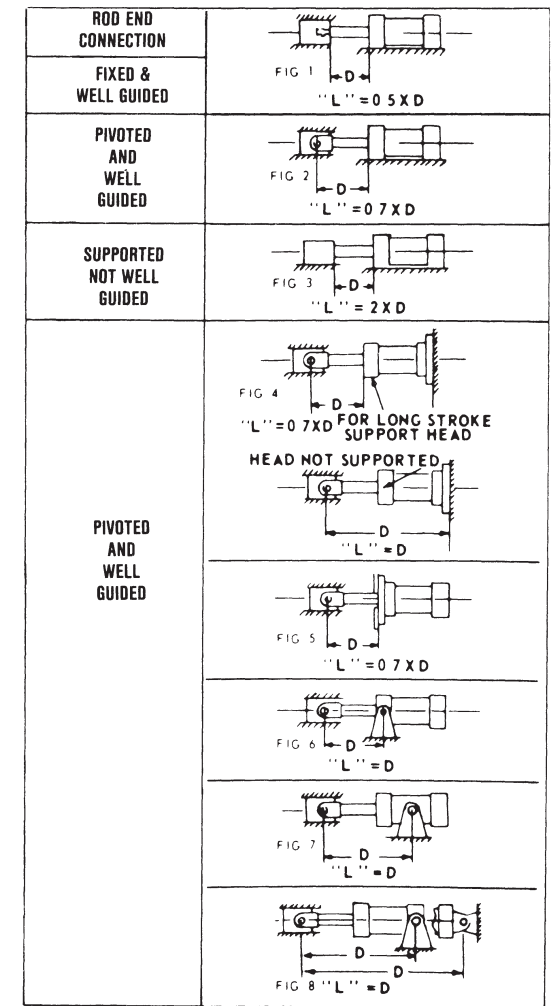
From the description, the cylinder falls into Fig. 8. To determine the value of "L":

ADD: MP1 "XC" Dimension 7.12"
 SV-3 "CE" Dimension 3.12"
 Two times stroke (2 x 27) 54.00"

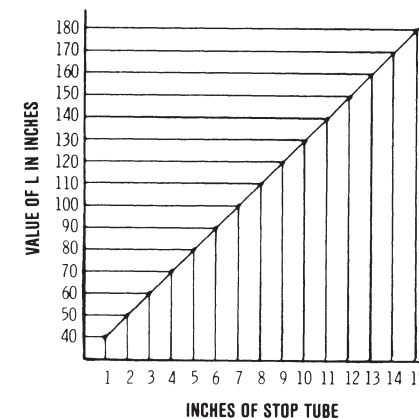
Total Value of "L" 64.24"

Looking this up on the chart, you'll find a recommended stop tube length of 4 inches.

The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and recheck column strength on stroke limitation chart.



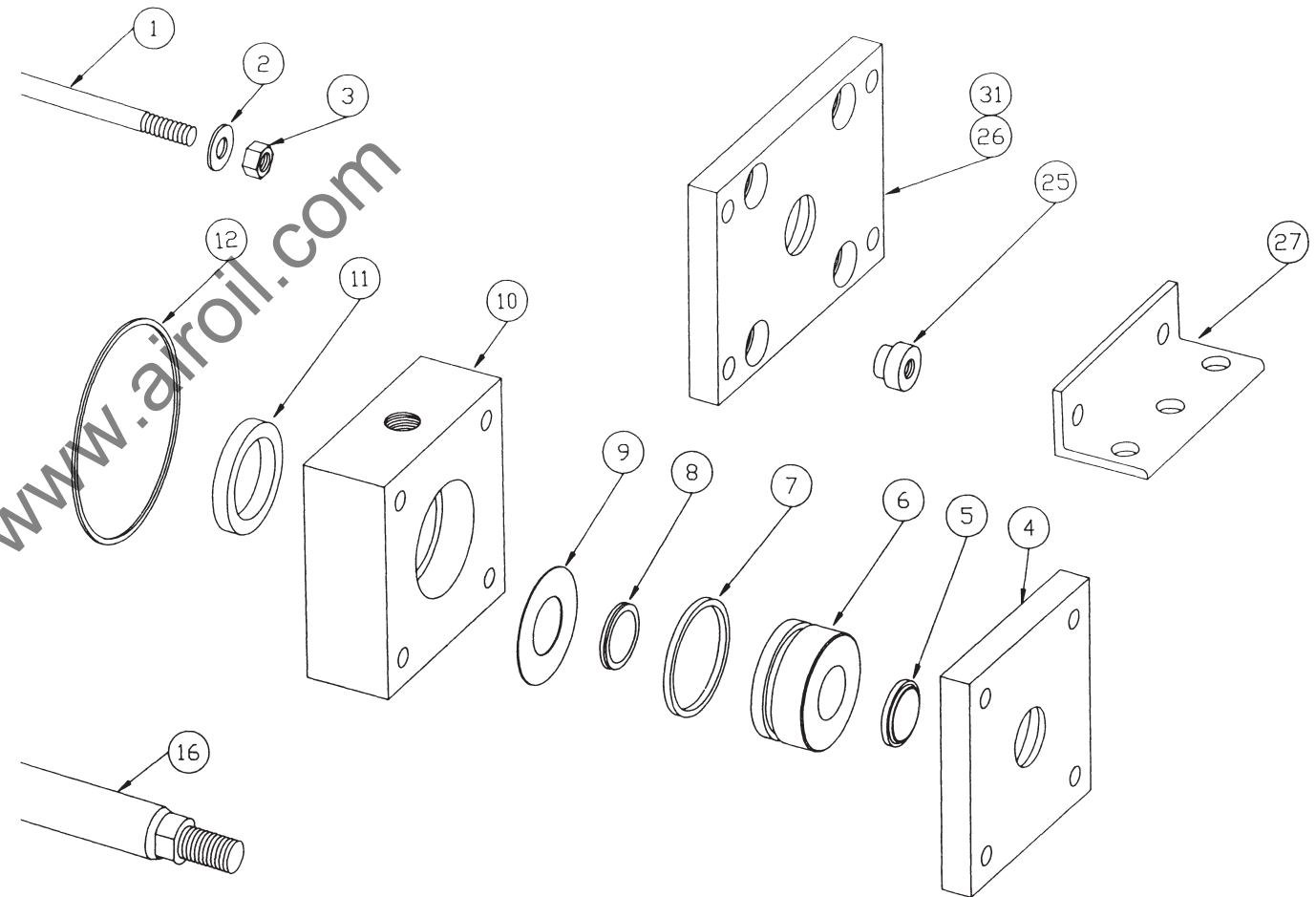
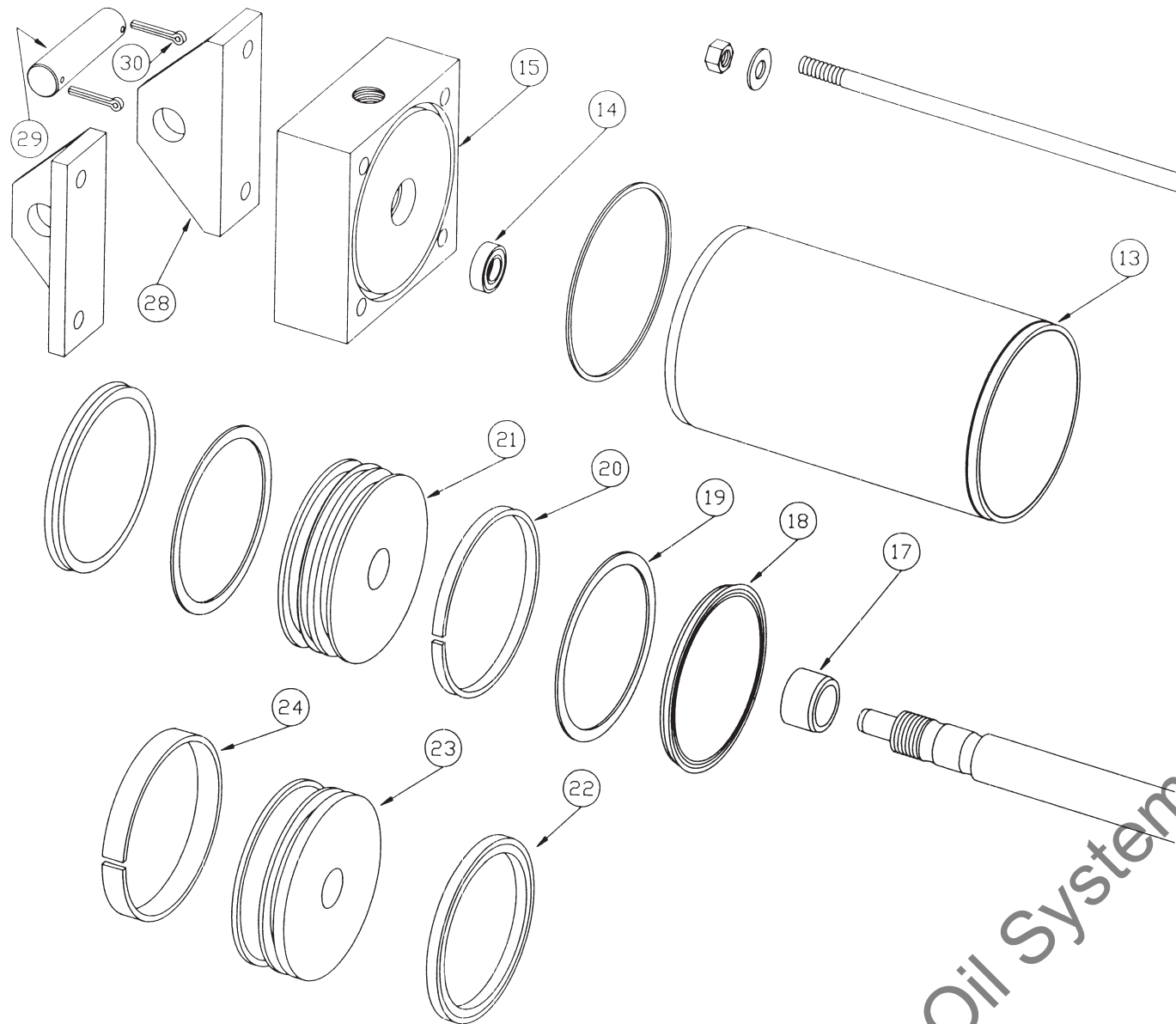
STOP TUBE CHART



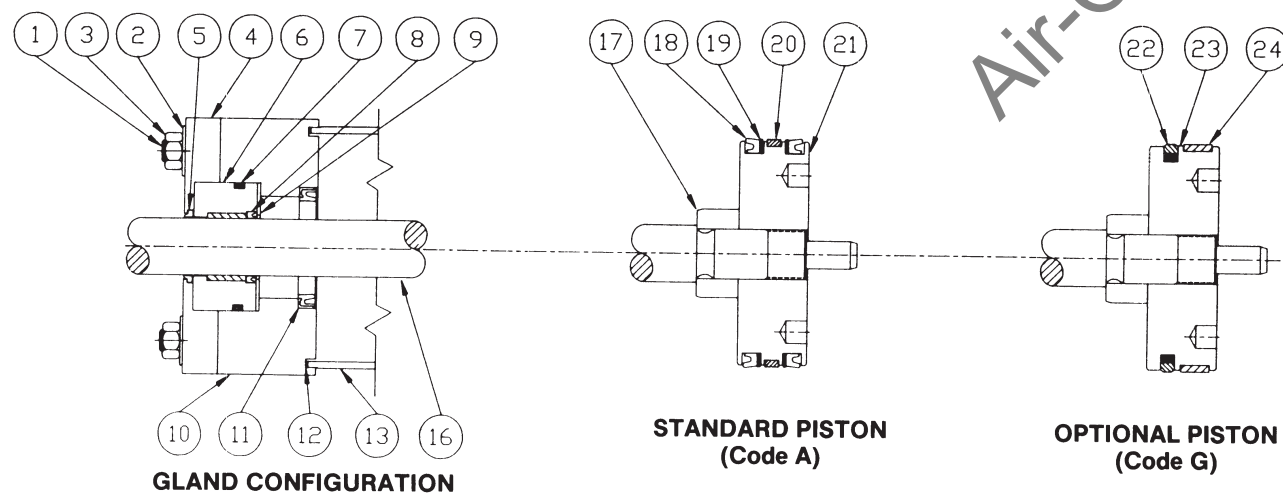
CYLINDER WEIGHTS

CYLINDER BORE	BASE WEIGHT AT ZERO STROKE	BODY WEIGHT PER INCH OF STROKE	ROD DIAMETER	ROD WEIGHT PER INCH OF STROKE
1.50	1.200 lbs.	0.100 lbs	0.625	0.052 lbs.
2.00	2.100	0.150	1.000	0.223
2.50	2.760	0.160	1.375	0.421
3.25	5.500	0.220	1.750	0.682
4.00	7.000	0.240		
5.00	9.750	0.370		
6.00	16.300	0.390		

PARTS LIST



When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.



PART NO.	NO. REQ'D.	DESCRIPTION	PART NO.	NO. REQ'D.	DESCRIPTION
1	4	Tie Rod	17	1	Cushion Sleeve
2	4/8	Tie Rod Washer	18	2	Piston Seal
3	4/8	Tie Rod Nut	19	2	Back-Up Washer (1.5" - 4" Bores Only)
4	1	Retainer Plate	20	1	Wear Strip
5	1	Rod Wiper	21	1	Piston
6	1	Gland	22	1	Filled Teflon Seal with Buna Expander*
7	1	O-Ring (Gland)	23	1	Optional Piston*
8	1	Rod Packing	24	1	Wear Strip
9	1	Rod Washer	25	4	Tie Rod Insert (Flange Mounts)
10	1	Front Head	26	1	Front Flange
11	1	Front Cushion Seal	27	2	End Angle Bar
12	2	Gasket	28	2	Clevis Bracket
13	1	Tube	29	1	Pivot Pin
14	1	Rear Cushion Seal	30	2	Cotter Pin
15	1	Back Head	31	1	Rear Flange
16	1	Piston Rod			

*Optional Part

STORAGE:

Hanna Series CA Composite Cylinders are delivered with colored plastic port plugs which protect the inside of the cylinder from external contamination. Keep these protective port plugs in the cylinders until the time of installation. Store the cylinders indoors in a clean, dry environment, keeping them in a vertical position with the rod up, whenever practical.

INSTALLATION:

Proper mounting alignment, mounting fasteners, torque and cleanliness are essential to assure efficient operation and long service life of your CA cylinders. Special care should be taken, as follows:

Trunnion Mount (MT1): Lubricated pillow blocks with bearing tolerances, rigidly mounted and properly aligned, should be used. Make sure the cylinder is free to swing without interference or binding.

Tie Rod Mounts (MX0, MX1, MX2, MX3, MX4): Refer to **Tie Rod Torque** chart for proper thread size and recommended torque value.

Cap Fixed Clevis Mount (MP1): Remove cotter pin, align cylinder pin holes with mounting member hole, insert cylinder pin, and replace cotter pin. Make sure the cylinder moves through its required arc without binding or interference. Properly align piston rod parallel to blind end.

Flange Mounts (MF1, MF2): Washers *must* be used to mount all flange mount cylinders! Refer to **Flange Mount Cylinder Torque** chart.

Pipe Ports and Connections: Series CA Composite Cylinders are furnished with standard NPTF pipe ports. Refer to **Recommended Pipe Torques** chart for proper torque value by port size. **The use of Teflon tape is not recommended.**

MAINTENANCE:

By following Hanna's Storage and Installation recommendations, you can expect long service life from your Series CA Composite Cylinders.

To replace rod seals and rod wiper, relieve the front end tie rod torque, and remove retainer plate and gland. Position the new rod seal and rod wiper in the appropriate grooves. Use only genuine Hanna replacement parts. Replace gland, retainer plate and tie rods. Tighten tie-rod nuts to proper torque value as shown in the **Tie Rod Torque** chart.

To replace piston seals, disassemble the entire cylinder. Then, for **Standard Piston Seals (Code A)**, cut and remove the old U-cup seals from the piston grooves. When installing the new U-cups, be careful not to cut the seals, or damage the sealing lips.

For Optional Piston Seals (Code G), cut the old piston seal, and remove it and the O-ring from the groove. Install new O-ring. Next, slightly stretch the Teflon piston seal and work it into the groove. Carefully insert the ram assembly into the tube — this will assure the Teflon seal is reshaped equally.

When replacing either **Code A or Code G** Piston Seals, also replace gaskets at both tube ends.

Traditionally, buyers of air cylinders have faced a dilemma when selecting units for service in hostile environments. Typical air cylinders offered at competitive prices just don't provide the corrosion-resistant properties demanded by such applications.

The purchase decision, therefore, generally comes down to a choice from several high-cost, yet less-than-adequate options: all stainless steel cylinders; models made from brass, bronze or other non-ferrous metals; cylinders plated with nickel, cadmium, or zinc; and those coated with epoxy paint, among others, have all been employed in the attempt to conquer the problem of corrosion.

Nor only does the user pay a stiff price in the initial purchase. Often, these high-cost cylinders fail to provide an effective solution to the problem. Just a minor scratch, dent or crack in the plating or coating, and the cylinder is vulnerable to corrosive attack—and ultimate failure.

Hanna innovates a better answer

Hanna Corporation recognized that the marketplace desperately required a better choice, and thus set out to innovate an air cylinder that would provide long service life in corrosive environments—and at an affordable price.

In selecting the materials to be used for this cylinder, Hanna's Design Engineers sought the optimum balance between corrosion resistance, high strength, operating performance and cost.

Series CA — a truly new concept

The result of Hanna's extensive research and development program is the Series CA Composite Pneumatic Cylinder line. These unique models are manufactured entirely of materials that meet the required cost/performance balance goals.

Series CA cylinders are designed and precision-manufactured to be impervious to most types of corrosion—from atmospheric conditions, galvanic reactions and microbiological attack, as well as localized corrosion typically caused by pitting, surface scratches, plating or coating defects.

CA cylinders also provide excellent resistance to a wide range of chemicals. They are not attacked by common solvents such as alcohol or petroleum products. They may be used in environments with low concentrations of mineral acids, and with fruit acids such as citric, acetic and lactic. In addition, the cylinders are unaffected by most salt solutions.

Caution: Some of the materials used in the manufacture of CA cylinders are attacked by oxidizing acids such as chromic and nitric. Contact with alkali solutions should also be avoided, unless the solutions are in very dilute concentrations.

In cases where the composite materials used in standard CA cylinders are not appropriate, extensive engineering knowledge of composite materials enables Hanna to provide the proper material selection for specific operating environments.

With minor factory modifications*, CA cylinders meet **American Water Works Association (AWWA)** specifications **C504/C540** for non-metallic water hydraulic and pneumatic cylinder applications.

Wide range of applications

The unique combination of utmost corrosion resistance and affordability makes Hanna Series CA Composite Cylinders ideal for a wide range of low-pressure air cylinder applications. Typical operating environments include:

- Municipal and industrial waste treatment plants
- Food processing plants
- Pulp and paper mills
- Textile mills
- Dairies and bottling plants
- Chemical and petrochemical plants
- Car washes
- Other corrosive environments

Excellent design flexibility

Series CA cylinders provide outstanding flexibility in machinery design. Developed for pressure ratings of 150 p.s.i., they are offered in bore sizes from 1.50" through 6.00". 11 N.F.P.A. mounting styles are available.

Hanna also offers a selection of electrical controls for CA cylinders. Proximity switches, totally unaffected by harsh environments, are available for mounting on bore sizes from 2.50" through 6.00". In addition, standard and 3-Amp Reed switches, also well suited for hostile environment use, are available on CA cylinders, 1.50" through 5.00" bores.

Add up the advantages of Hanna's CA Composite Pneumatic Cylinders. Corrosion resistance, high strength, low-maintenance service *and* affordable cost combine to make them the best value in cylinders that stand up to the toughest conditions.

* Consult Hanna Corporation

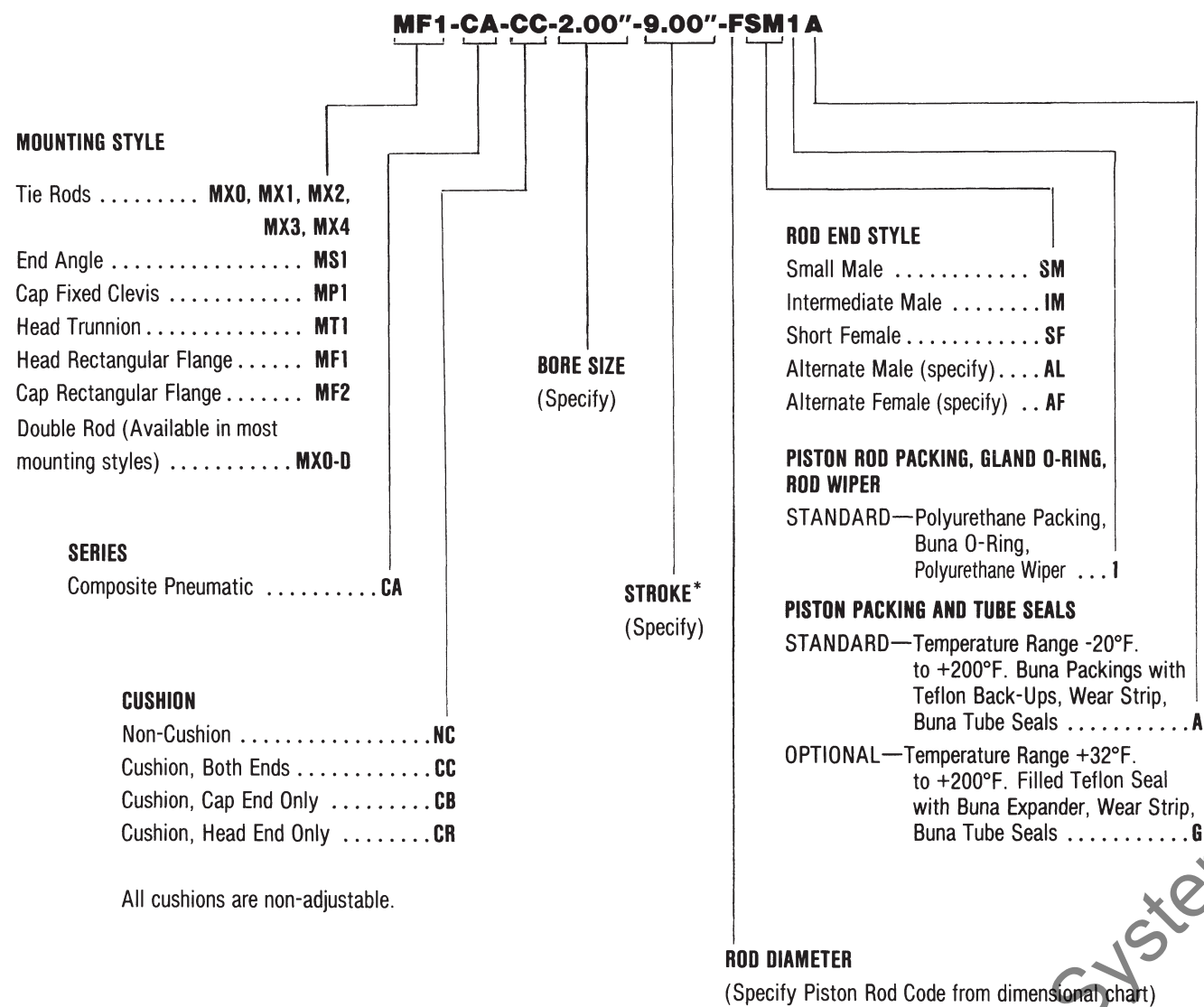
FASTENER TORQUES

TIE ROD TORQUES		
BORE	SIZE	TORQUE
1.50	.25-20	3 ft.-lbs.
2.00	.31-18	7 ft.-lbs.
2.50	.31-18	7 ft.-lbs.
3.25	.38-16	15 ft.-lbs.
4.00	.38-16	15 ft.-lbs.
5.00	.50-13	25 ft.-lbs.
6.00	.50-13	25 ft.-lbs.

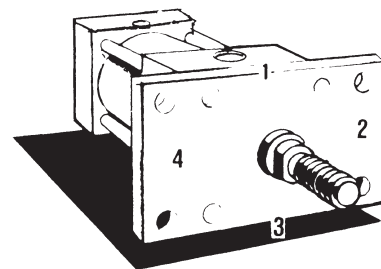
RECOMMENDED MOUNTING BOLT TORQUE FOR FLANGE MOUNTS	
BORE	TORQUE
1.50	4 ft.-lbs.
2.00	10 ft.-lbs.
2.50	10 ft.-lbs.
3.25	20 ft.-lbs.
4.00	20 ft.-lbs.
5.00	30 ft.-lbs.
6.00	30 ft.-lbs.

RECOMMENDED PIPE TORQUES	
NPTF SIZE	TORQUE MAX.
1/4"	15 ft.-lbs.
3/8"	25 ft.-lbs.
1/2"	40 ft.-lbs.

HOW TO ORDER



* Maximum stroke is 9 ft. Consult factory for longer stroke lengths.



Port location: if other than position 1, must be specified. Mounting accessories and switches must be specified if required.



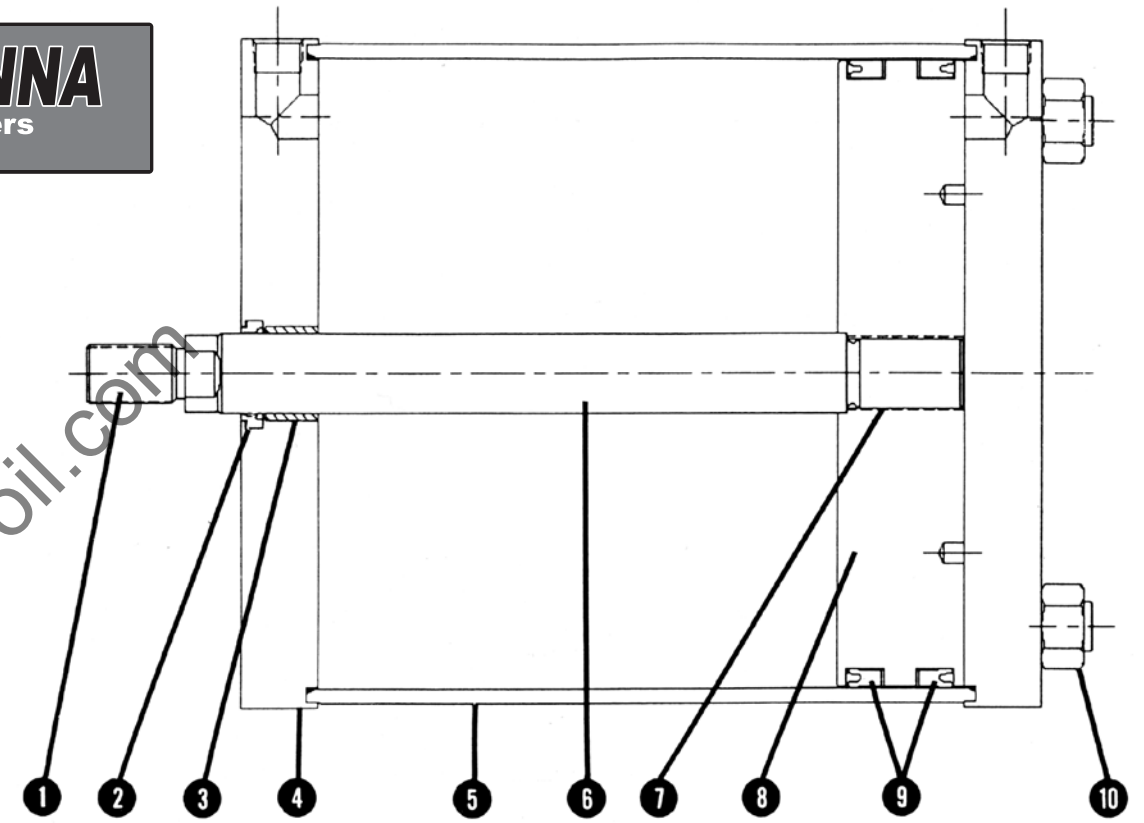
- Series LA
Air/Water Cylinders**
- High-Tech Duralon® Rod Bearing
 - 150 PSI Air or Water Pressure Ratings
 - 3.25" – 26.00" Bore Sizes
 - MX3 and ME3 Mounting Styles
 - AWWA Construction Available
 - Optional Bronze or Stainless Steel Construction Available

NOTE: For optional AWWA construction, specify Cadmium-Plated Piston with Standard Piston Packing and Tube Seals. (Code A).

When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

SERIES LA AIR/WATER CYLINDERS

HANNA
cylinders



Series LA Features and Benefits

1. Piston Rod End

Integral thread construction, precision machined for close concentricity.

2. Rod Seal and Wiper

Self-regulating, pressure-energized Buna N material prevents contaminants from entering cylinder.

3. Duralon Rod Bearing

Non-metallic bearing is impervious to corrosion, has an extremely low coefficient of friction and requires no lubrication to the bearing surface. Capable of sustaining much higher compressive loads than either bronze or cast iron.

4. Heads

Steel heads are precision machined to assure accurate alignment and close concentricity between piston, tube, piston rod and rod bearing.

5. Tubing

Steel tubing is precision-honed to 16 rms, and chrome-plated for corrosion resistance.

6. Piston Rod

Hanna's piston rods are machined to a close tolerance with minimum stock removal to maximize shank size and reduce stress. Relief grooves are machined in areas of high stress to guard against fatigue failures. All sizes are hard chrome-plated for scratch and corrosion resistance, and polished to a 6-8 micro-inch finish.

7. Piston-to-Rod Connection

Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

8. Piston

One piece ductile iron piston is threaded to piston rod, and furnished with breakaway spirals on each side.

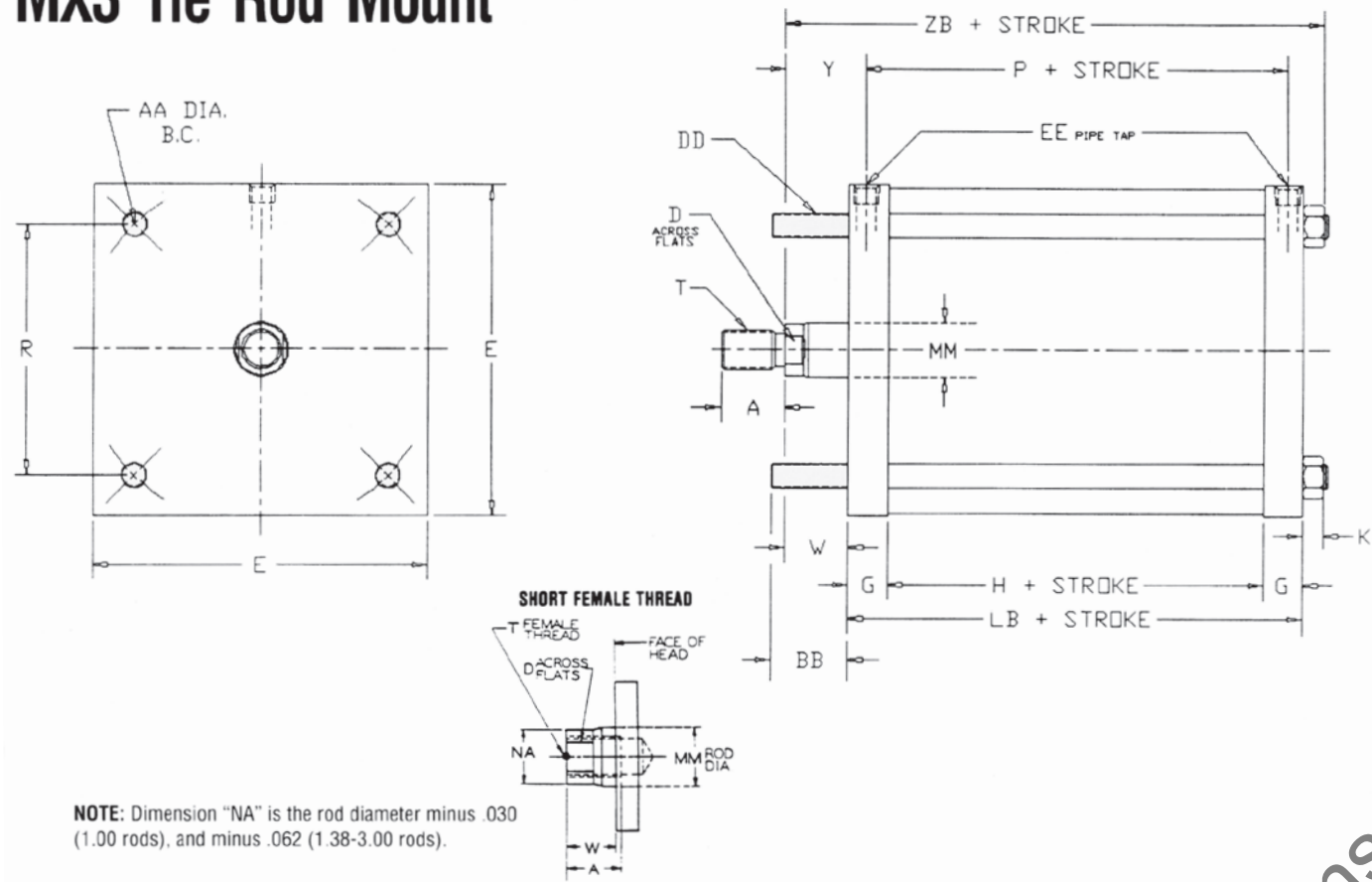
9. Piston Sealing System

Two Buna U-cups seals are self-regulating and pressure-energized for excellent sealing capabilities.

10. Tie-Rods and Tie-Rod Nuts

Tie-rods and tie-rod nuts are made of high strength, corrosion-protected steel.

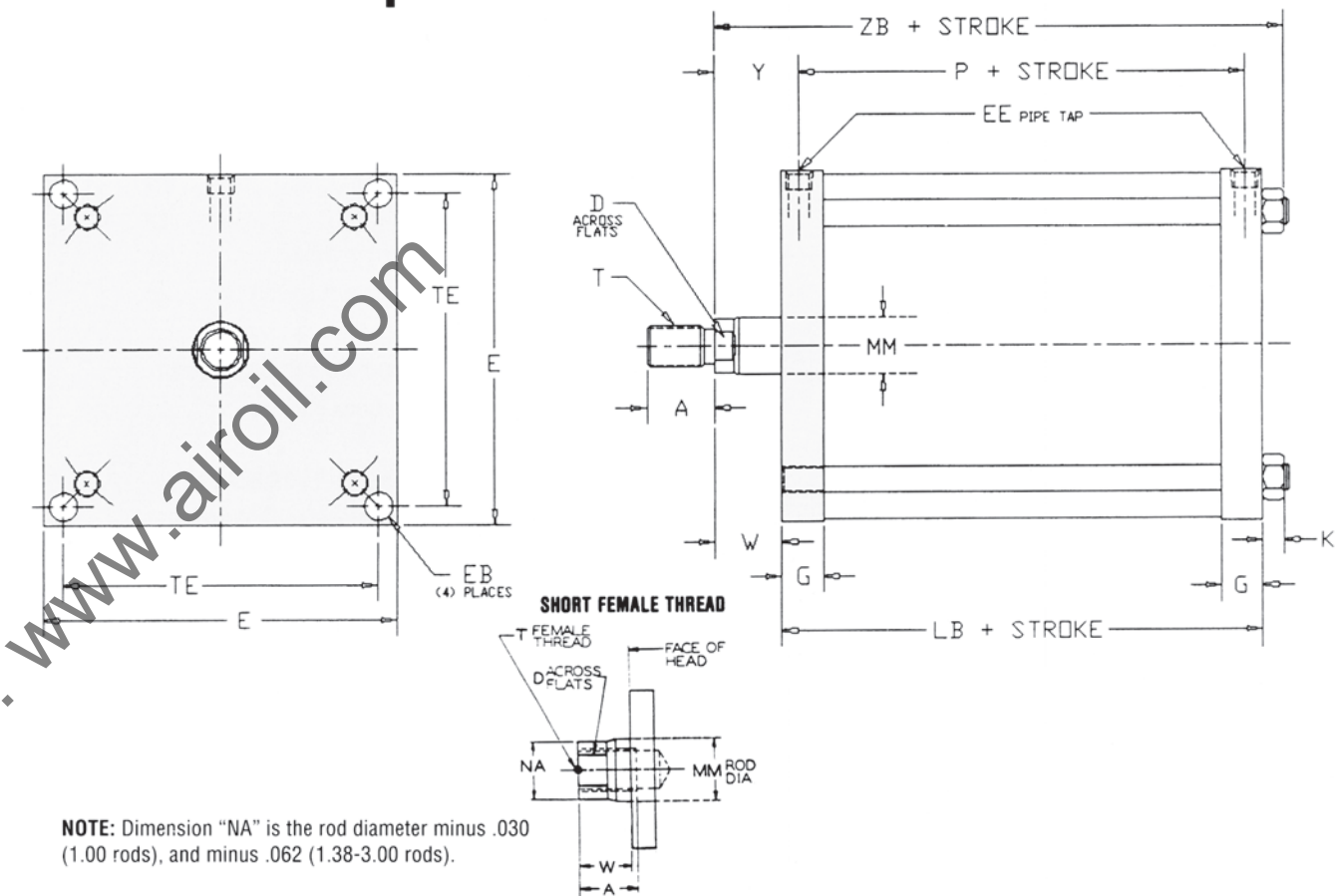
MX3 Tie Rod Mount



CYLINDER																T (THREAD)							
BORE	ROD DIA. CODE	MM ROD DIA.	A	AA	BB	D	DD	E	EE NPTF	G	H	K	LB	P	R	SMALL MALE SM	SHORT FEMALE SF	W	ZB	TE	Y	ZB	
3.25	F	1.00	1.12	3.90	1.38	0.88	.38-24	4.00	1/4	0.88	1.25	0.38	3.00	2.31	2.76	.75-16	.75-16	0.75	0.34	4.12			
4.00	F	1.00	1.12	4.70	1.38	0.88	.38-24	4.50	3/8	1.00	1.25	0.38	3.25	2.44	3.32	.75-16	.75-16	0.75	0.41	4.38			
5.00	F	1.00	1.12	5.80	1.81	0.88	.50-20	5.50	3/8	1.00	1.50	0.44	3.50	2.69	4.10	.75-16	.75-16	0.75	0.41	4.69			
6.00	F	1.00	1.12	6.90	1.81	0.88	.50-20	6.50	3/8	1.00	1.50	0.44	3.50	2.69	4.88	.75-16	.75-16	0.88	0.41	4.81			
7.00	F	1.00	1.12	8.10	2.00	0.88	.62-18	7.50	3/8	1.00	1.62	0.56	3.62	2.81	5.73	.75-16	.75-16	0.88	0.41	5.06			
8.00	F	1.00	1.12	9.10	2.00	0.88	.62-18	8.62	3/8	1.00	1.62	0.56	3.62	2.81	6.44	.75-16	.75-16	0.88	0.41	5.06			
10.00	F	1.00	1.12	11.20	2.25	0.88	.75-16	10.75	1/2	1.25	2.12	0.66	4.62	3.53	7.92	.75-16	.75-16	1.00	0.55	6.28			
12.00	G	1.38	1.62	13.30	2.25	1.12	.75-16	12.75	1/2	1.25	2.62	0.66	5.12	4.03	9.40	1.00-14	1.00-14	1.00	0.55	6.78			
14.00	G	1.38	1.62	15.40	2.50	1.12	.88-14	14.75	3/4	1.50	3.12	0.75	6.12	4.81	10.90	1.00-14	1.00-14	1.00	0.66	7.87			
16.00	H	1.75	2.00	17.80	2.75	1.50	1.00-14	17.00	3/4	2.00	2.50	0.94	6.50	5.00	12.59	1.25-12	1.25-12	1.25	0.75	8.69			
18.00	J	2.00	2.25	20.00	3.25	1.69	1.12-12	19.00	3/4	2.00	2.50	1.12	6.50	5.00	14.14	1.50-12	1.50-12	1.50	0.75	9.12			
20.00	J	2.00	2.25	22.30	3.25	1.69	1.25-12	21.00	3/4	2.00	2.50	1.19	6.50	5.00	15.77	1.50-12	1.50-12	1.50	0.75	9.19			
22.00	K	2.50	3.00	24.50	3.25	2.06	1.25-12	23.25	1	2.50	2.75	1.19	7.75	5.75	17.32	1.88-12	1.88-12	1.50	1.00	10.44			
24.00	K	2.50	3.00	26.50	3.25	2.06	1.25-12	25.25	1	2.50	2.75	1.19	7.75	5.75	18.74	1.88-12	1.88-12	1.50	1.00	10.44			
26.00	L	3.00	3.00	28.50	3.25	2.62	1.25-12	27.25	1	2.50	2.75	1.19	7.75	5.75	20.15	2.25-12	2.25-12	1.50	1.00	10.44			

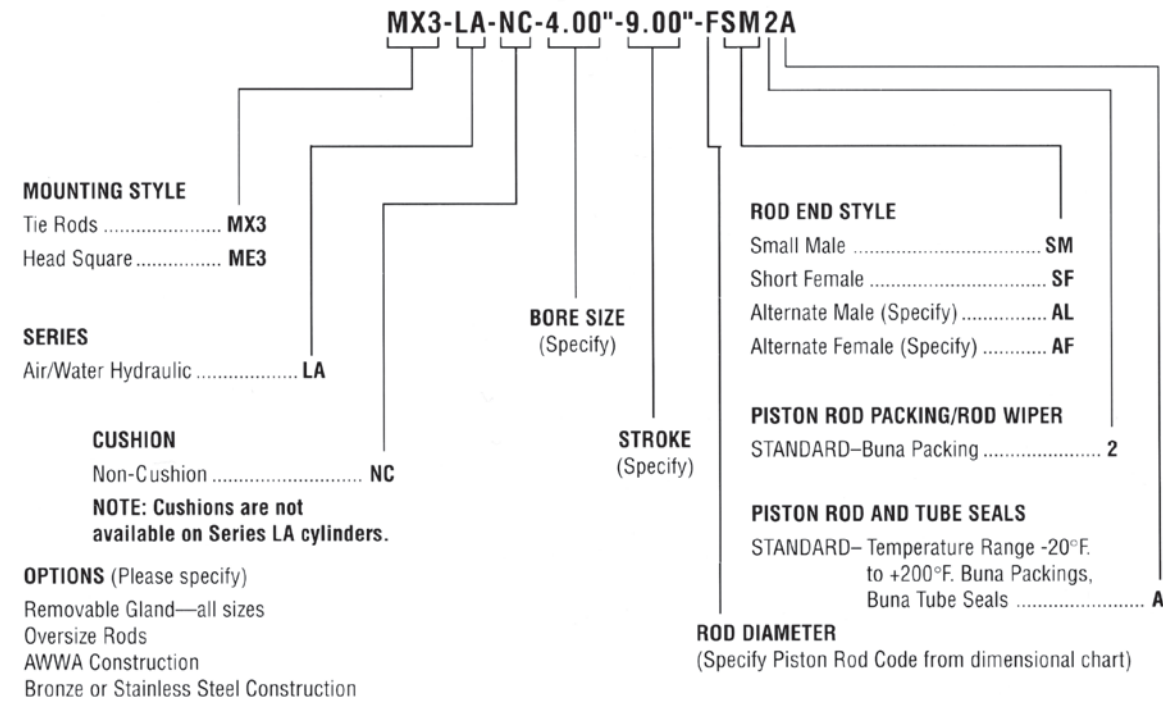
Note: 16.00" bore & larger will have tie rod washers.

ME3 Head Square Mount



CYLINDER																T (THREAD)						
BORE	ROD DIA. CODE	MM ROD DIA.	A	D	E	EB*	EE NPTF	G	K	LB	P	SMALL MALE SM	SHORT FEMALE SF	TE	W	Y	ZB					
8.00	F	1.00	1.12	0.88	8.62	0.62	3/8	1.00	0.56	3.62	2.81	.75-16	.75-16	7.57	0.88	0.41	5.06					
10.00	F	1.00	1.12	0.88	10.75	0.75	1/2	1.25	0.66	4.62	3.53	.75-16	.75-16	9.40	1.00	0.55	6.28					
12.00	G	1.38	1.62	1.12	12.75	0.75	1/2	1.25	0.66	5.12	4.03	1.00-14	1.00-14	11.10	1.00	0.55	6.78					
14.00	G	1.38	1.62	1.12	14.75	0.88	3/4	1.50	0.75	6.12	4.81	1.00-14	1.00-14	12.87	1.00	0.66	7.87					
16.00	H	1.75	2.00	1.50	17.00	1.00	3/4	2.00	0.94	6.50	5.00	1.25-12	1.25-12	14.85	1.25	0.75	8.69					
18.00	J	2.00	2.25	1.69	19.00	1.12	3/4	2.00	1.12	6.50	5.00	1.50-12	1.50-12	16.53	1.50	0.75	9.12					
20.00	J	2.00	2.25	1.69	21.00	1.25	3/4	2.00	1.19	6.50	5.00	1.50-12	1.50-12	18.46	1.50	0.75	9.19					
22.00	K	2.50	3.00	2.06	23.25	1.25	1	2.50	1.19	7.75	5.75	1.88-12	1.88-12	20.75	1.50	1.00	10.44					
24.00	K	2.50	3.00	2.06	25.25	1.25	1	2.50	1.19	7.75	5.75	1.88-12	1.88-12	22.75	1.50	1.00	10.44					
26.00	L	3.00	3.00	2.62	27.25	1.25	1	2.50	1.19	7.75	5.75	2.25-12	2.25-12	24.75	1.50	1.00	10.44					

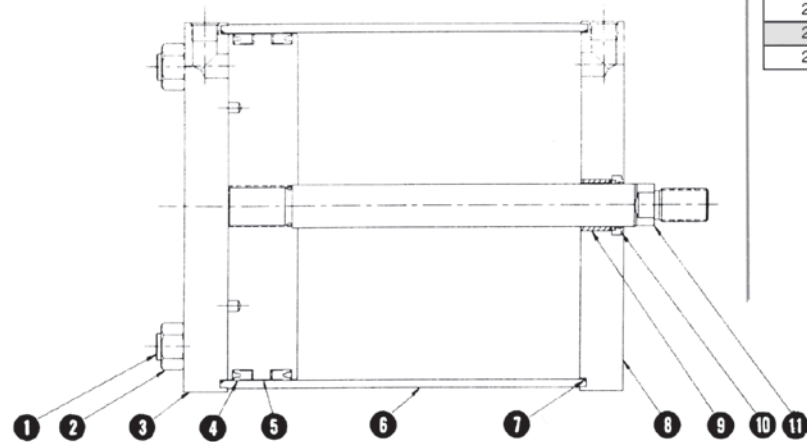
*Mounting holes are .06 larger than bolt size.



PARTS LIST

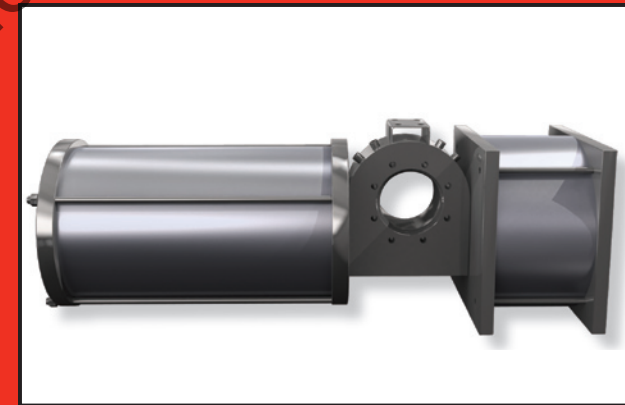
When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

PART NO.	QTY.	DESCRIPTION
1	4	Tie Rod
2	4	Tie Rod Nut
3	1	Back Head
4	2	U-Cup Packing
5	1	Piston
6	1	Tube
7	2	O-Ring
8	1	Front Head
9	1	Duralon Rod Bearing
10	1	Rod Wiper-Seal
11	1	Piston Rod



TIE-ROD TORQUES

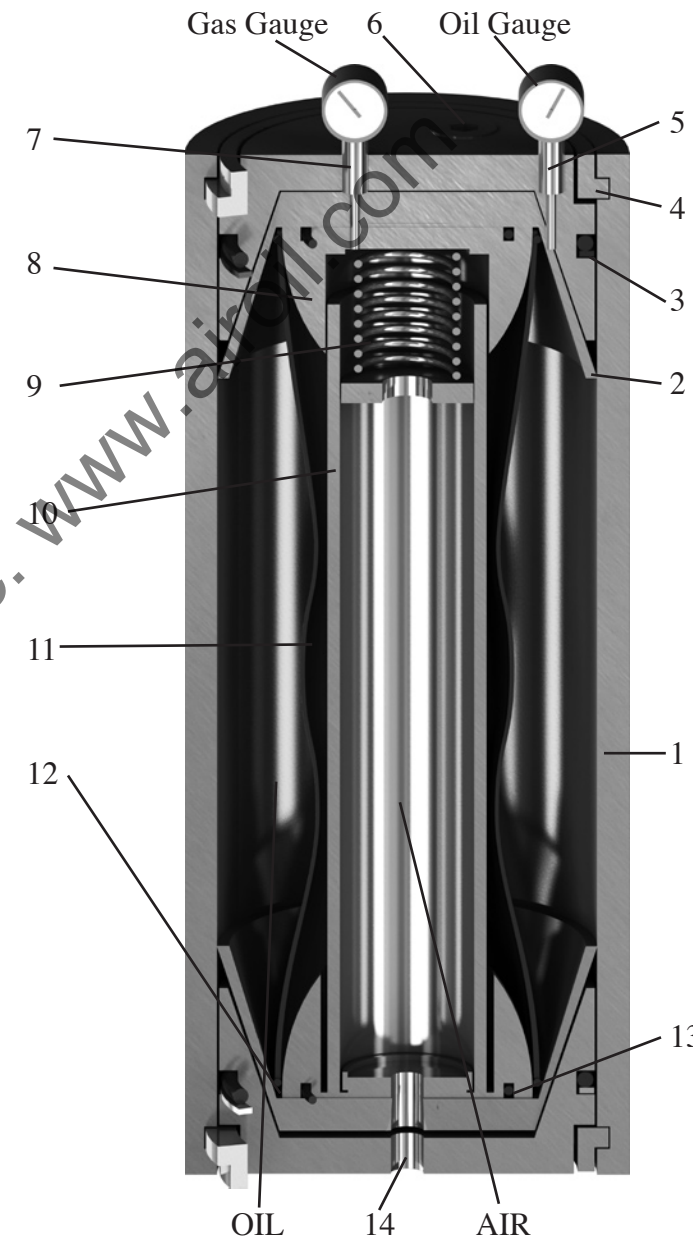
BORE	SIZE	TORQUE IN FT.-LBS.	
		MX3	ME3
3.25	.38-24	30	—
4.00	.38-24	30	—
5.00	.50-20	50	—
6.00	.50-20	50	—
7.00	.62-18	75	—
8.00	.62-18	75	50
10.00	.75-16	95	65
12.00	.75-16	95	65
14.00	.88-14	150	100
16.00	1.00-14	240	160
18.00	1.12-12	330	220
20.00	1.25-12	500	350
22.00	1.25-12	500	350
24.00	1.25-12	500	350
26.00	1.25-12	500	350



**Series Accumulators/
Nuclear Actuators**

Accumulators

Sleeve Bladder Type



- | | |
|-------------------------------------|-----------------------------|
| 1. High strength steel tube | 8. Sleeve cap |
| 2. Steel end cap | 9. Spring |
| 3. "O" ring and back-up | 10. Sleeve stop tube |
| 4. Split shear ring | 11. Sleeve bladder |
| 5. Fluid opening for pressure gauge | 12. Sleeve bladder end seal |
| 6. Safety fuse | 13. Sleeve cap "O" ring |
| 7. Gas opening for pressure gauge | 14. Fluid discharge port |
| | 15. Optional fluid port |

The Sleeve Bladder Accumulator, (patent applied for) is very unique in that unlike conventional bladder accumulators which have a balloon type bladder open on only one end, it has many features and advantages as are emphasized as follows:

- A. When recharged with gas, filling the entire accumulator, if gas charge begins to leak out, or if excessive oil pressure is supplied to the accumulator, or if precharge pressure is somewhat under estimated or even under charged for any reason, the fluid pressure will tend to crush and distort the bladder which has no backing to resist the action. The sleeve bladder accumulator has a sleeve stop tube to back up the bladder in this event.
- B. Having end caps, gauge ports for either end of the accumulator can be supplied for monitoring both gas charge and fluid pressure. Try that on a conventional bladder accumulator.
- C. Like its counter part the Poppet Piston Accumulator with internal stop tube, has the ability to monitor the gas pressure to match the fluid pressure. If any precharge is lost for whatever reason and the sleeve bladder lays against the sleeve stop tube, then the gas and fluid gauges will not agree with each other. Further, by noting the gas pressure gauges, it can be determined exactly how much gas charge is left and how much fluid it will deliver and at what pressure.
- D. If you look closely at the assembly, it can be noted that there are no fasteners required to assemble the sleeve bladder accumulator. What's more, it cannot be disassembled accidentally when pressure is in the gas chamber. It is pressure locked at the end caps, such that the end caps must be depressed inward to release the split shear ring. This cannot be done under pressure without knowledge that much more force than the spring is holding the end cap for depressing even without a gauge to note pressure.
- E. The sleeve bladder accumulator can be installed horizontally without damage resulting to the bladder. Don't try this with a balloon type bladder accumulator or you will find out how quickly you can rub a hole in the bladder.
- F. The sleeve bladder accumulator can also be mounted with a common end cap to another accumulator for manifolding or piping convenience.
- G. Other than these fantastic features the Sleeve Bladder Accumulator is just like any other old bag type accumulator.

Poppet Piston Accumulator Lasts 5 Times Longer...

Compared to the service life of conventional piston accumulators, it takes 5 times longer to reach detectable leakage... why?

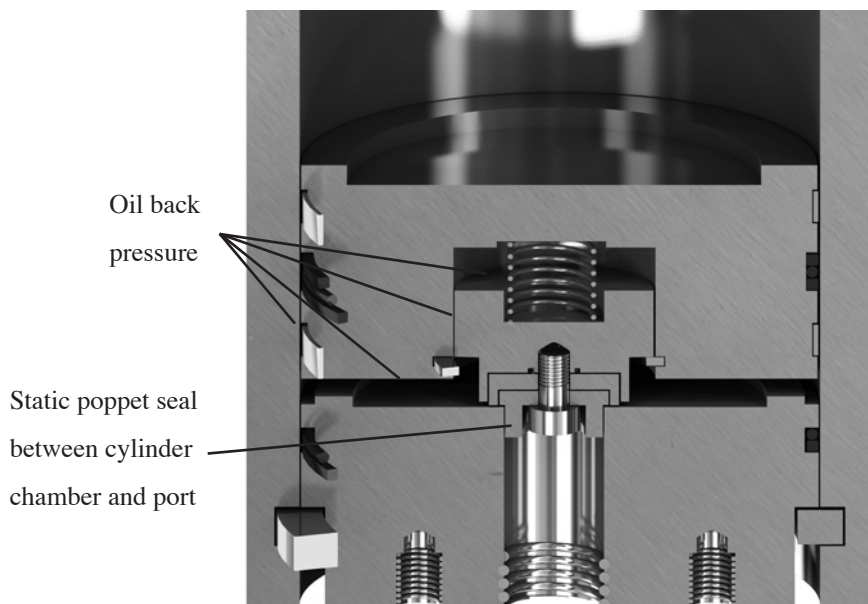
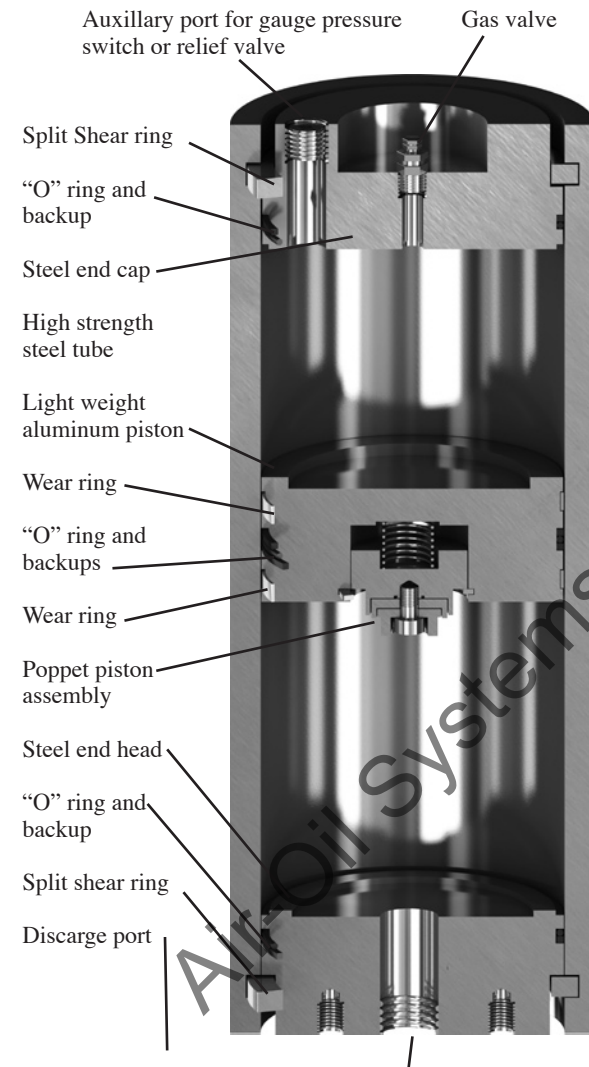
This is why...

The addition of a patented poppet piston assembly with a built-in cushion secured within the main piston makes all the difference. By retaining a small unusable portion of the accumulator oil from discharging, then pressure is balanced on both sides of the piston. With oil on one side and gas on the other, the precharge gas cannot get past the piston seal, since the oil is never completely discharged from the accumulator, even when the pressure in the discharge line drops to zero.

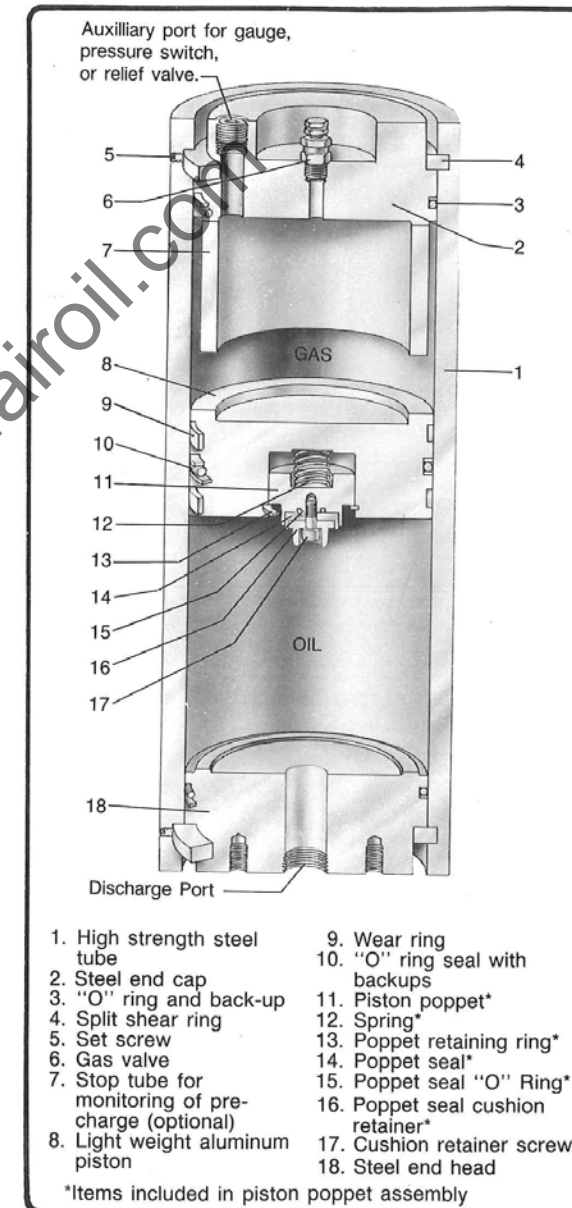
The poppet seal assembly depends on zero leakage and it is. By trapping oil between the poppet seal and the piston seal, the piston seal is pressure energized on both sides, which compensates for piston seal wear. The end result is that the integrity of the main piston seal is no longer critical and leakage emphasis is shifted to the integrity of the poppet seal, hence giving the piston seal 5 or more times its normal life, regardless of the mounting position, and can even be self monitored. Try that with a bladder or conventional piston accumulator.

The poppet seal is not subject to frictional wear from moving back and forth in the cylinder because it is a static seal and called upon to perform only when the main piston bottoms out, (which is when the gas escapes other accumulators). The main piston seal (a dynamic seal) must be and is very much subject to wear. In fact, every time the piston changes position in the slightest there is dynamic wear on the piston seal.

Accumulators are used in oil industry applications, power generating, military aerospace, commercial aviation, ships, environmental water control, dams, mobile and off-highway equipment.

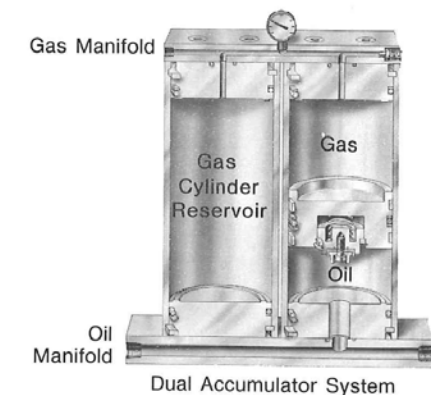


ACCUMULATORS POPPET PISTON TYPE



The patented "Poppet" Piston Accumulator is an old established accumulator design with a new twist. By adding the poppet feature to the piston, a host of advantages takes place.

- A. By trapping a small portion of the accumulator fluid from discharging, there is created a pressure balance on both sides of the piston. With fluid on one side and gas on the other it is nearly impossible to lose the precharge of gas; the fluid is never completely discharged from the accumulator when the pressure drops to zero in the discharge line, while full gas precharge acts on the piston seal.
- B. This accumulator can be mounted horizontal, right side up or upside down. Most manufacturers do not recommend their product be mounted horizontally. The piston poppet is just as effective either way.
- C. The poppet piston accumulator makes an excellent de-surger because fluids are usually completely discharged each time the piston strokes, again trapping fluid and thereby balancing pressure on both sides of the piston. The cushion plunger automatically decelerates the piston momentum.
- D. Optional internal stop tube can be installed in order to monitor gas pressure compared to fluid pressure, and note to operator when gas pressure gauge and fluid pressure gauge do not match exactly, how much gas charge is remaining in order to deliver the amount of fluid and the minimum pressure to perform the required function.
- E. Accumulator and gas cylinder may be separate but coupled with a common end cap for greater volume but with full monitoring capability. (See dual unit below.)
- F. Designed in safety: accumulator can not be disassembled as long as unit is under pressure.



Patented in U.S.A.
Foreign patents applied for.

ACCUMULATORS HYDRO-PNEUMATIC POPPET PISTON TYPE

- Poppet Piston Design Maintains Precharge.
- Cushioned Cylinder Eliminates Abrupt Bottoming Resulting in Less Wear and Noise.
- Non Welded Construction; Both End Caps Removable.

- Water Operating Models Available.
- ASME Coded Models Available.

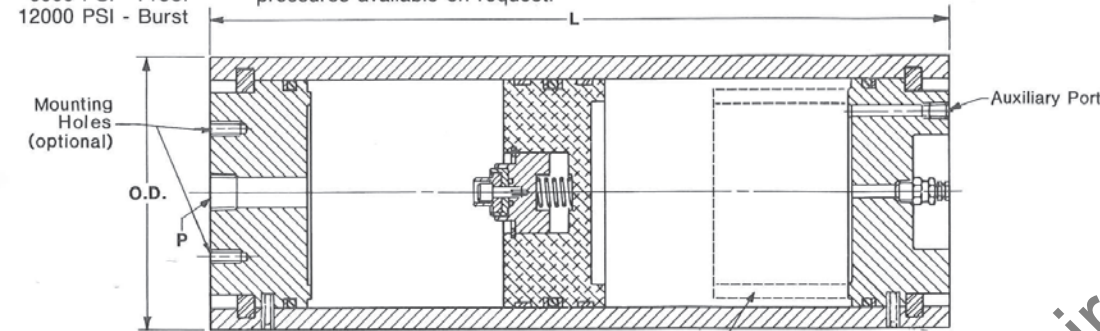
Sizes and General Data

Volumes not shown in chart are available as specials; consult factory.

Size	Model No.	Total Volume cu. in.	P Port Size	O.D. in.	L Length in.	Dry Weight lbs.	Size	Model No.	Total Volume cu. in.	P Port Size	O.D. in.	L Length in.	Dry Weight lbs.
10 in. ³	10C-25	10	3/8"	2.86	7.82	7 1/4	2 1/2 Gal.	2-5G-8	580	3/8"	9.03	21.29	184
30 in. ³	30C-25	30	to 3/4"	2.86	11.90	9	5 Gal.	5G-8	1155	to 1 1/2"	9.03	32.73	230
60 in. ³	60C-25	60	NPT	2.86	18.00	11	7 1/2 Gal.	7-5G-8	1740	NPT or Straight Thd.	9.03	44.37	276
60 in. ³	60C-4	60	1/2"	4.53	12.27	27	10 Gal.	10G-8	2315	2 1/2" NPT or Opt. Flange Ports	9.03	55.81	322
1/2 Gal.	05G-4	116	to 1 1/2"	4.53	16.73	31	15 Gal.	15G-8	3470		9.03	78.78	414
1 Gal.	1G-4	231	NPT or Straight Thd.	4.53	25.88	40	20 Gal.	20G-8	4625		9.03	101.76	506
1 1/2 Gal.	1-5G-4	350		4.53	35.35	49	25 Gal.	25G-8	5780		9.03	124.74	597
2 1/2 Gal.	2-5G-4	580		4.53	53.66	66	30 Gal.	30G-8	6970		9.03	148.42	693
1 Gal.	1G-6	231		6.78	16.54	83	35 Gal.	35G-8	8085		9.03	170.60	781
2 1/2 Gal.	2-5G-6	580	3/4"	6.78	28.88	110	10 Gal.	10G-10	2315		11.28	40.99	455
4 Gal.	4G-6	925	1 1/2"	6.78	41.09	137	15 Gal.	15G-10	3470		11.28	55.71	547
5 Gal.	5G-6	1155	or 2 1/2" NPT or Straight Thd. Opt. Flange Ports	6.78	49.22	155	20 Gal.	20G-10	4625		11.28	70.44	638
7 1/2 Gal.	7-5G-6	1740		6.78	69.91	200	25 Gal.	25G-10	5780		11.28	85.12	731
10 Gal.	10G-6	2315		6.78	90.24	245	30 Gal.	30G-10	6970		11.28	100.27	825
12 Gal.	12G-6	2776		6.78	106.55	281	40 Gal.	40G-10	9240		11.28	129.17	1007
15 Gal.	15G-6	3470		6.78	131.10	335	50 Gal.	50G-10	11550		11.28	158.58	1188
20 Gal.	20G-6	4625		6.78	171.95	425	60 Gal.	60G-10	13860		11.28	188.00	1365

*2 1/2" ports are available on special order due to larger piston poppet assembly required.

3000 PSI - Working 5,000, 10,000 and 20,000 PSI working For larger volumes, see Dual Accumulator Systems.
6000 PSI - Proof pressures available on request.
12000 PSI - Burst



Operating temperature range: 20°F to 175°F.
Optional temperature operating ranges: -60°F to 350°F.
Oil Volume at indicated Operating Pressures.
(10 in.³ to 30 Gallon capacities only.)

DUAL ACCUMULATOR SYSTEMS HYDRO-PNEUMATIC POPPET PISTON TYPE

Sizes and General Data

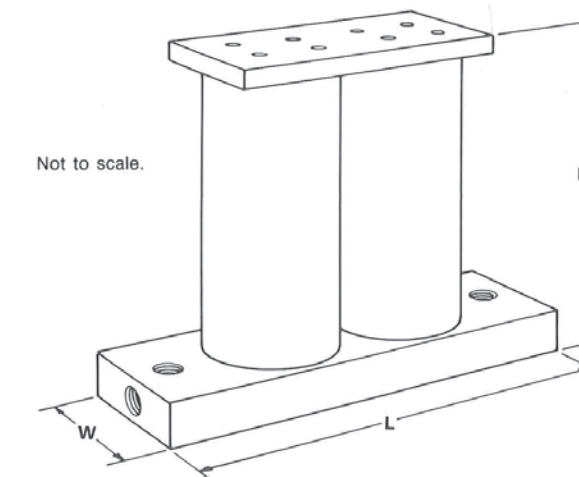
- Water Operating Models Available.
- ASME Coded Models Available.

Size	Model No.	Max. Oil Vol. cu. in.	Total Volume cu. in.	L-Length W-Width in.	H Height in.	Dry Weight lbs.	Size	Model No.	Max. Oil Vol. cu. in.	Total Volume cu. in.	L-Length W-Width in.	H Height in.	Dry Weight lbs.
10 Gal.	D5G-6	1155	2388	L=23.50 W=7.75	52.70	330	20 Gal.	D10G-10	2315	4942	L=33.00 W=12.00	44.98	857
15 Gal.	D7-5G-6	1740	3558		73.41	375	30 Gal.	D15G-10	3470	7252		59.68	949
20 Gal.	D10G-6	2315	4708		93.74	420	40 Gal.	D20G-10	4625	9562		74.39	1041
25 Gal.	D12-5G-6	2887	5852		114.00	465	50 Gal.	D25G-10	5780	11872		89.09	1133
30 Gal.	D15G-6	3470	7018	L=27.50 W=10.00	134.60	510	60 Gal.	D30G-10	6970	14252	L=38.00 W=14.00	104.24	1228
40 Gal.	D20G-6	4625	9328		175.45	600	80 Gal.	D40G-10	9240	18792		133.15	1408
10 Gal.	D5G-8	1155	2485		36.47	499	100 Gal.	D50G-10	11550	23412		162.56	1592
15 Gal.	D7-5G-8	1740	3655		48.11	545	120 Gal.	D60G-10	13860	28032		191.97	1775
20 Gal.	D10G-8	2315	4805	L=27.50 W=10.00	59.54	591	60 Gal.	D30G-12	6970	14252	L=38.00 W=14.00	78.88	1495
30 Gal.	D15G-8	3470	7115		82.52	683	90 Gal.	D45G-12	10395	21102		109.15	1748
40 Gal.	D20G-8	4625	9425		105.45	776	120 Gal.	D60G-12	13860	28032		139.79	2004
50 Gal.	D25G-8	5780	11735		128.45	867	150 Gal.	D75G-12	17325	34962		170.43	2259
60 Gal.	D30G-8	6970	14115	L=27.50 W=10.00	152.15	962	180 Gal.	D90G-12	20790	41892	L=38.00 W=14.00	201.07	2514

Volumes not shown in chart are available as specials; consult factory.

Operating temperature range: 20°F to 175°F.
Optional temperature ranges: -60°F to 350°F.

3000 PSI - Working 5,000, 10,000 and 20,000 PSI working
6000 PSI - Proof pressures available on request.
12000 PSI - Burst



Model (Last Digit)	End Port NPT	Top of Plate Options	Bottom Plate Options	Flange
-6	1 1/2"	NPT	2 1/2"	2 1/2"
-8	1 1/2"	2 1/2"	2 1/2"	2 1/2"
-10	1 1/2"	2 1/2"	3"	3"
-12	1 1/2"	2 1/2"	3"	3"

Oil Volume at indicated Operating Pressures.
(10 in.³ to 30 Gallon capacities only.)

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 1 Gallon

OPERATING PRESSURE - PSI ISOTHERMAL

PRECHARGE PRESSURE - PSI	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000				
100		123	164	184	196	205	211	215	218	221	223	225	226	227	228	229	230	231																
200			81.2	123	147	164	175	184	191	196	201	205	208	210	213	215	216	218	219	220	222	223	224	225	226									
300				62.2	98.7	123	141	153	164	172	178	184	189	193	196	199	202	204	207	209	210	212	213	214	216	217	218	219	220	221				
400					48.9	81.4	106	123	137	147	156	164	169	175	179	184	188	191	194	196	199	201	203	205	206	208	209	211	212	213				
500						40.7	71.0	92.6	109	123	134	143	153	158	164	169	173	177	181	184	185	189	190	194	196	198	199	202	203	204				
600							34.9	61.2	81.4	97.7	112	123	131	141	147	153	159	164	168	172	175	178	181	184	186	189	191	193	195	196				
700								30.4	54.3	73.3	88.8	103	114	123	131	136	144	148	155	158	162	167	171	174	175	179	182	184	186	188				
800									27.2	49.9	66.8	81.5	94.1	106	115	123	129	137	142	147	152	156	158	164	167	168	173	175	177	178				
900										25.4	45.5	62.1	76.1	88.3	98.7	108	116	123	129	135	139	145	147	151	155	158	164	167	169	172				
1000											22.2	41.7	57.2	71.0	82.4	92.6	101	109	116	123	129	134	139	143	145	153	155	158	161	164				
1100												21.3	38.6	53.3	66.2	77.2	87.3	95.7	104	111	117	123	128	133	138	141	145	149	153	155				
1200													19.7	35.9	49.9	62.2	72.8	82.4	91.0	98.7	106	112	117	123	128	131	137	141	145	147				
1300														18.4	33.6	46.8	56.5	66.6	76.2	86.5	94.0	101	105	113	118	123	127	132	136	139				
1400															17.3	31.5	44.0	52.2	65.3	74.2	82.4	89.9	96.5	103	106	114	118	123	127	131				
1500																16.3	29.7	41.7	52.5	62.1	69.9	78.6	86.0	92.6	98.7	104	109	115	119	123				
1600																	15.4	28.1	39.6	49.8	59.2	67.5	75.1	82.4	89.0	95.0	98.5	106	111	115				
1700																		12.5	26.7	37.7	47.4	56.5	64.7	72.4	79.2	85.5	91.7	97.1	102	107				
1800																			13.8	25.4	35.9	45.4	54.0	62.0	69.4	76.1	82.4	88.1	93.5	98.7				
1900																				13.2	24.2	34.2	43.5	51.8	59.6	66.7	73.4	79.7	83.4	88.7				
2000																					12.6	23.2	32.8	41.7	49.9	57.2	66.7	76.6	82.4					
2100																						12.0	22.3	31.6	39.2	48.0	55.3	62.2	68.5	74.5				
2200																							11.5	21.3	29.4	38.7	46.3	53.4	58.0	66.3				
2300																								11.0	19.6	29.2	37.2	44.8	51.4	58.0				
2400																										9.8	19.8	28.2	36.0	43.1	48.0			
2500																											9.5	19.1	27.2	34.8	41.9			
2600																												10.01	18.6	26.4	33.6			
2700																													9.8	17.9	25.4			

Size: 1 1/2 Gallon

OPERATING PRESSURE - PSI ISOTHERMAL

PRECHARGE PRESSURE - PSI	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000		
100		191	255	286	305	317	327	332	338	343	345																					
200			125	191	227	255	270	286	297	302	312	317	323	325	329	333	336	336	341	341	345	345										
300				95.0	153	191	219	239	255	268	277	286	293	298	305	309	314	317	322	322	327	329	331	331	332	333	334	338	340	343		
400					76.1	125	158	191	210	223	243	255	264	272	277	286	291	297	302	303	307	312	313	315	318	321	323	325	327	329		
500						63.4	108	143	168	191	209	223	235	243	254	262	269	275	281	284	288	293	297	300	305	306	311	313	313	315		
600							54.2	96.0	127	153	174	191	203	219	229	239	247	255	262	265	270	275	280	286	288	293	296	298	301	303		
700								47.4	84.4	115	139	159	174	191	203	214	224	233	241	246	253	258	263	268	272	278	282	284	287	293		
800									42.3	76.1	104	125	145	158	178	191	202	212	221	227	234	241	247	253	257	262	268	270	276	277		
900										38.1	69.3	95.0	117	137	153	165	178	191	202	208	216	223	230	237	242	247	253	257	269	265		
1000											34.6	63.6	87.3	108	125	143	157	168	180	191	198	209	216	221	227	235	241	243	248	252		
1100												31.7	58.4	81.5	102	118	135	149	162	170	180	191	197	205	212	218	226	232	237	241		
1200													29.1	54.4	76.1	95.1	113	127	141	151	164	173	182	191	198	201	211	217	223	227		
1300														27.0	50.6	71.3	89.3	106	121	132	144	154	164	173	181	191	196	203	211	216		
1400															25.4	47.4	66.9	84.2	102	113	125	139	149	159	166	176	184	191	198	203		
1500																23.6	44.7	63.4	80.3	95.1	108	120	133	143	153	162	167	176	185	191		
1600																	22.4	42.1	60.1	76.0	90.4	102	116	127	138	145	155	165	172	178		
1700																		21.0	40.1	57.1	72.0	86.0	99.1	112	122	132	142	148	156	163		
1800																			20.1	38.0	54.4	69.1	82.6	95.0	107	117	125	134	145	153		
1900																				19.1	36.1	51.5	66.1	79.3	93.2	103	113	123	132	141		
2000																					18.0	34.4	49.5	63.6	76.0	87.5	103	108	119	127		
2100																						17.0	33.2	47.6	60.9	73.0	84.5	96.0	106	113		
2200																							16.4	31.7	45.7	58.6	70.5	81.4	91.4	102		
2300																								15.7	30.5	43.9	56.3	68.1	78.2	88.6		
2400																									15.3	29.2	42.3	54.5	65.2	76.1		
2500																										14.3	28.2	40.7	52.3	63.6		
2600																											14.0	27.5	39.4	50.6		
2700																												13.6	26.1	38.1		

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 2 1/2 Gallon

OPERATING PRESSURE - PSI ISOTHERMAL

PRECHARGE PRESSURE - PSI	100	200	300	400	500	
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ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 15 Gallon

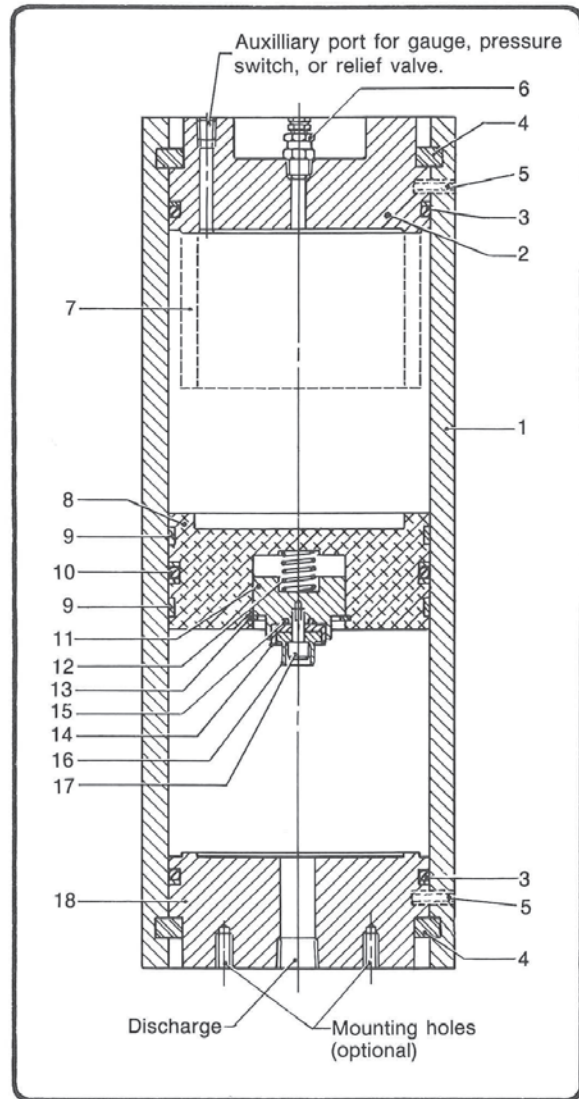
PRECHARGE PRESSURE - PSI		OPERATING PRESSURE - PSI ISOTHERMAL																																											
		100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000														
100		1732	2309	2598	2771	2887	2969																																						
200			1154	1732	2078	2309	2474	2598	2694	2771	2834	2887	2931	2969																															
300				866	1385	1732	1979	2165	2109	2425	2519	2598	2664	2722	2771	2814	2853	1887	2917	2944	2969																								
400					692	1454	1484	1732	1924	2078	2204	2309	2398	2474	2540	2598	2649	2693	2735	2771	2804	2834	2862	2887	2910	2931	2951	2969																	
500						577	989	1299	1540	1732	1889	2021	2132	2227	2309	2382	2445	2502	2553	2598	2639	2677	2711	2743	2771	2798	2823	2846	2867	2887															
600							494	866	1154	1385	1574	1732	1865	1979	2078	2165	2242	2309	2370	2425	2474	2519	2561	2598	2633	2665	2694	2722	2748	2769															
700								433	769	1039	1259	1442	1599	1732	1847	1949	2037	2117	2188	2252	2309	2362	2410	2454	2494	2531	2566	2598	2628	2656															
800									384	692	944	1154	1332	1484	1616	1732	1834	1924	2006	2078	2144	2204	2259	2309	2356	2398	2438	2474	2509	2540															
900										346	629	866	1066	1237	1385	1515	1630	1732	1823	1905	1970	2047	2109	2165	2217	2265	2309	2351	2389	2425															
1000											314	577	799	989	1154	1299	1426	1539	1641	1732	1814	1889	1958	2021	2078	2132	2181	2227	2270	2309															
1100												288	533	742	923	1082	1222	1337	1458	1559	1649	1732	1807	1876	1940	1999	2053	2103	2150	2194															
1200													266	494	692	866	1019	1154	1276	1385	1484	1574	1657	1732	1801	1865	1924	1979	2031	2078															
1300														247	461	649	815	962	1094	1212	1319	1417	1506	1488	1663	1732	1796	1856	1911	1963															
1400															230	433	611	769	911	1039	1154	1259	1355	1556	1632	1703	1768	1828	1885	1937															
1500																216	407	577	729	866	989	1102	1205	1299	1385	1465	1539	1608	1672	1732															
1600																	203	384	549	693	824	944	1053	1154	1247	1333	1414	1484	1553	1616															
1700																		192	364	519	659	787	903	1010	1108	1199	1288	1361	1433	1601															
1800																			182	346	594	629	753	866	970	1076	1154	1237	1314	1385															
1900																				173	332	473	608	723	831	934	1026	1114	1189	1271															
2000																					164	314	451	577	732	838	935	1026	1109	1188															
2100																						157	303	433	554	666	770	866	956	1039															
2200																						150	288	416	533	641	742	836	923																
2300																							144	277	399	513	618	717	809																
2400																								138	266	384	493	597	694																
2500																									133	256	372	479	577																
2600																										131	247	358	461																
2700																											123	239	347																

Size: 20 Gallon

PRECHARGE PRESSURE - PSI		OPERATING PRESSURE - PSI ISOTHERMAL																																											
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000																
200		1774	2661	3194	3549	3802	3991	4140	4259	4355	4436	4505	4563	4614																															
300			1329	2129	2661	3042	3327	3549	3726	3871	3992	4094	4183	4259	4325	4384	4435	4483	4525	4563	4597																								
400				1064	1774	2281	2661	2957	3194	3387	3549	3685	3801	3904	3992	4071	4140	4203	4259	4309	4355	4398	4436	4472	4504	4535	4563	4589	4614																
500					887	1521	1996	2366	2661	2903	3105	3276	3422	3549	3660	3758	3845	3922	3992	4056	4113	4166	4214	4261	4300	4338	4373	4404	4434																
600						760	1330	1774	2129	2419	2661	2866	3042	3194	3327	3444	3549	3642	3726	3801	3870	3935	3992	4046	4095	4140	4183	4222	4258																
700							665	1183	1597	1943	2218	2456	2661	2839	2994	3131	3253	3362	3460	3549	3629	3703	3771	3833	3890	3943	3992	4038	4081																
800								591	1064	1450	1773	2047	2281	2484	2661	2818	2957	3082	3194	3295	3387	3472	3549	3620	3685	3746	3802	3855	3905																
900									532	966	1330	1637	1901	2129	2328	2504	2661	2802	2928	3042	3145	3240	3327	3407	3481	3549	3612	3671	3727																
1000										483	887	1228	1521	1774	1996	2192	2365	2521	2661	2788	2903	3009	3105	3194	3275	3352	3427	3498	3568																
1100											443	818	1140	1419	1663	1879	2070	2241	2395	2535	2661	2777	2883	2981	3071	3154	3232	3304	3371																
1200												409	760	1131	1330	1565	1774	1961	2129	2281	2419	2546	2661	2768	2866	2957	3042	3120	3194																
1300													380	709	998	1252	1478	1681	1863	2028	2177	2314	2440	2555	2661	2759	2852	2937	3016																
1400														354	665	939	1183	1401	1597	1774	1935	2083	2218	2342	2457	2563	2661	2752	2839																
1500															332	626	887	1120	1330	1521	1693	1851	1996	2129	2252	2366	2471	2570	2661																
1600																313	591	840	1064	1266	1451	1620	1774	1916	2047	2169	2281	2386	2484																
1700																	295	560	798	1014	1209	1388	1557	1703	1842	1971	2091	2203	2307																
1800																		280	532	760	967	1157	1330	1490	1638	1774	1901	2019	2129																
1900																			266	507	725	923	1109	1277	1433	1577	1711	1835	1952																

ACCUMULATORS

PARTS LIST



To order parts for listed accumulators, specify:
 1. Part Number
 2. Part Name
 3. Quantity desired
 4. Accumulator model number
 5. Accumulator serial number
 6. Accumulator size

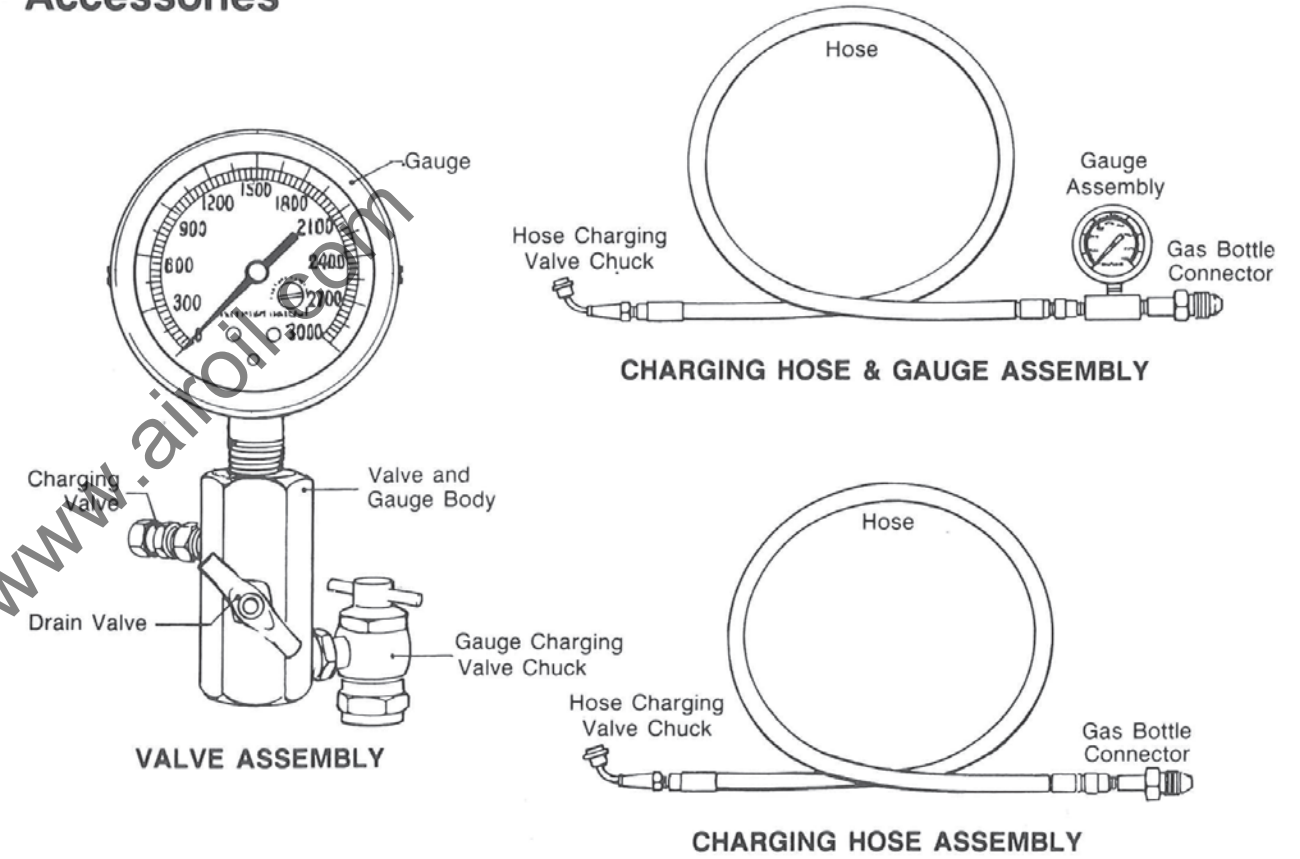
Example: Part No. 4, split shear ring, 2, 15GA-7, serial No., 15 gallon.

2A Part No.	No. Req'd.	Part Name
1	1	High strength steel tube
2	1	Steel end cap
3	2	"O" ring and back-up
4	2	Split shear ring
5	2	Set screw
6	1	Gas valve
7	1	Stop Tube (optional)
8	1	Light weight aluminum piston
9	2	Wear ring
10	1	"O" ring seal with back-ups
11*	1	Piston poppet
12*	1	Spring
13*	1	Poppet retaining ring
14*	1	Poppet seal
15*	1	Poppet seal "O" ring
16*	1	Poppet seal cushion retainer
17*	1	Cushion retainer screw
18	1	Steel end head

*Items included in piston poppet assembly.

ACCUMULATORS

Accessories



PARTS LIST

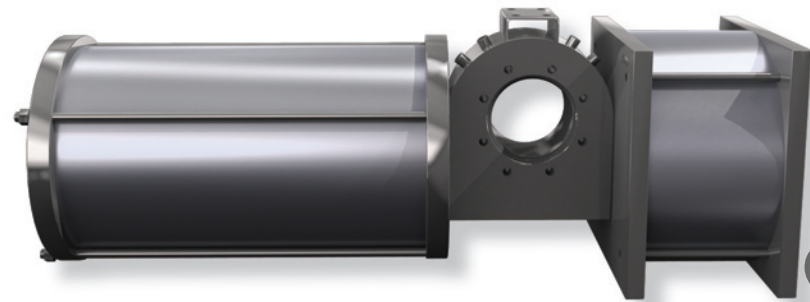
Item	Part No.	Description
Complete Valve Assembly No. CVA 200	V4240	Valve and Gauge Body
	V2145	Gauge Charging Valve Chuck
	V52564	Drain Valve
	V71466	Charging Valve
Complete Charging Hose Assy. No. CHA 300	V41371	Gauge
	H33114	Hose Charging Valve Chuck
	H6614	Hose
	H5880	Gas Bottle Connector
No. CHVA 400 - Complete Charging Hose and Valve Assembly		
No. CHGA 500 - Complete Charging Hose and Gauge Assembly		

Nuclear Actuators

Hanna Cylinders' quarter turn and rising stem nuclear actuators are constructed to withstand severe duty applications. All of our nuclear actuators are manufactured in accordance to the standards of our 10CFR50 appendix B quality assurance program.

Hanna supplies all 3 sections (cylinder, center mechanism {scotch yoke design}, and spring pack) which allows us to be unique in the marketplace.

1. Our quarter turn mechanisms are manufactured in (3) frame sizes with torque values ranging from 1,000 ft/lbs ~ 150,000 ft/lbs.
2. Designed for inside / outside containment & safety / non-safety related applications.
3. Qualify to IEEE 323-2003, IEEE 344-1987, & IEEE 382-1996 specifications.
4. Qualify to latest Westinghouse specifications:
 - APP-PV11-Z0-001 rev. 0 (valve specification)
 - APP-PV11-Z0R-001 rev. 0 (data sheet report)
 - APP-GW-VP-010 rev. 0 (EQ for valves)
5. High pressure direct spring actuators for rising stem valves.
6. Air and hydraulic valving panels, optional override accessories for nuclear & non-nuclear applications.



**Series Mobile/
Welded Cylinders**

Mobile Custom Welded

Heavy-Duty Custom Welded Cylinders

Construction and mining machinery, heavy-duty forklifts, material handling equipment, manlifts, mobile cranes, off-road vehicles, military equipment, marine and off-shore drilling rigs – and more – are some of the tough applications for Hanna's heavy-duty, custom-welded cylinders. Standard sizes through 12.00" bores. We also have the capability to produce cylinders with bore sizes to 30.00", and stroke lengths of 25' and beyond.



Double-Welded Cylinders

DW Series Lift & Steering Cylinders

Widely used on high-quality, high-volume consumer and commercial lawn and garden equipment, Hanna's DW Series hydraulic cylinders are also ideal for material handling equipment, industrial cleaning machines, agricultural and many other "off-road" applications. Pressure ratings up to 3,000 p.s.i. are available. Standard bore sizes are 1.00" through 3.00" with larger sizes available if required.



Air-Oil Systems, Inc. www.airoil.com

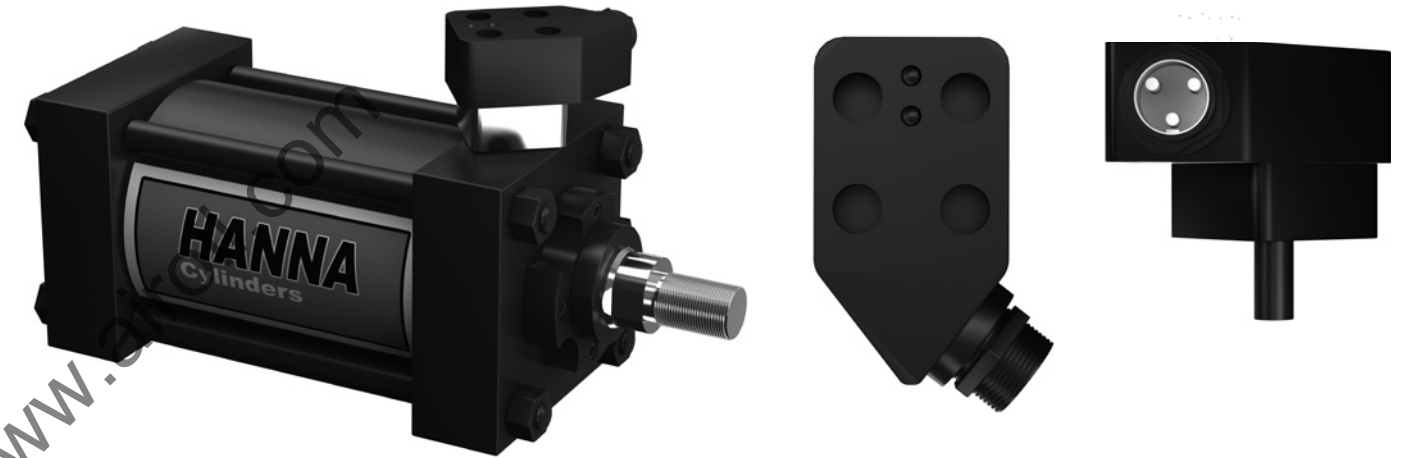
Air-Oil Systems, Inc. www.airoil.com



Electrical Options

Proximity Switches

for hydraulic and pneumatic cylinders



ADVANTAGES

- Mount directly on hydraulic or pneumatic cylinders.
- Unique mounting allows 90° rotation.
- Weld immune circuit with standard SCP.
- Harsh environments don't affect sensing.
- No external mounting brackets required.
- Wide application flexibility.

Hanna offers the NAMCO EE230 Series Cylindicator® Proximity Switches for mounting on hydraulic and pneumatic cylinders. The sensing probe looks at the piston cushion or spud, providing full extend or full retract indication. Since the probe is inside the cylinder, harsh external environments cannot affect sensing. There are no costly external mounting brackets required.

The 2-wire AC circuit operates on 20 to 230 VAC for wide application flexibility. It operates reliably as a programmable controller input or with relay coils. The low 1.7 mA "off-state," leakage current allows direct input to programmable controllers without adding shunt resistors.

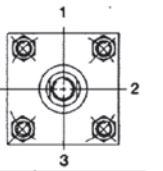
A LED indicator marked READY indicates that power is being supplied to switch. Another LED indicator marked TARGET indicates switch activation. Both LEDs flashing indicates a short circuit. Short circuit protection is standard, and protects the switch from shorts in the load or line. Upon sensing a short condition (.5 Amp or greater current) the switch assumes a non-conducting mode. The fault condition must be removed and power turned off to reset, preventing automatic restarts.

EE230 Series Cylindicators meet UL requirements for 3000 psi hydraulic systems. Four mounting holes allow 90° rotation increments, without costly spacer blocks and without changing probe length.

The units are designed to work within 1" of resistance welder tips carrying 20,000 Amperes. EE230 Series Cylindicators are ideal for stroke detection on hydraulic or pneumatic cylinders.

PROXIMITY SWITCH MOUNTING POSITIONS AVAILABLE FOR 3A,

3AN, CA and 3L SERIES CYLINDERS



Position location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End. Position #5 is at back face of Blind Head.

BORE	ME3		ME4		MF1		MF2		MF5		MF6		MP1		MP2		MS2		MS3			
	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H		
1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5	-	5
*2.00	-	-	-	-	1	1	1	1	-	1	1	-	1	1	1	1	1	1	-	-	-	
	-	-	-	-	2	2	-	-	2	2	-	2	2	2	2	2	-	-	-	-	-	
	-	-	-	-	3	3	3	3	-	3	3	-	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	4	-	-	-	-	-	
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
*2.50	-	-	-	-	1	1	1	1	-	1	1	-	1	1	1	1	1	1	1	1	1	
	-	-	-	-	2	2	-	-	2	2	-	2	2	2	2	-	-	-	-	-	-	
	-	-	-	-	3	3	3	3	-	3	3	-	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	4	-	-	-	-	-	
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
3.25	-	-	-	-	1	1	1	1	-	1	1	-	1	1	1	1	1	1	1	1	1	
	-	-	-	-	2	2	-	-	2	2	-	2	2	2	2	-	-	-	-	-	-	
	-	-	-	-	3	3	3	3	-	3	3	-	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	4	-	-	-	-	-	
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
4.00	-	-	-	-	1	1	1	1	-	1	1	-	1	1	1	1	1	1	1	1	1	
	-	-	-	-	2	2	-	-	2	2	-	2	2	2	2	-	-	-	-	-	-	
	-	-	-	-	3	3	3	3	-	3	3	-	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	4	-	-	-	-	-	
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
5.00	-	-	-	-	1	1	1	1	1	1	-	1	1	1	1	1	1	1	1	1	1	
	-	-	-	-	2	2	2	-	2	2	2	-	2	2	2	2	-	-	-	-	-	
	-	-	-	-	3	3	3	3	3	3	-	3	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	4	-	4	4	4	-	4	4	4	4	4	-	-	-	-	-
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
6.00	-	-	-	-	1	1	1	1	1	1	-	1	1	1	1	1	1	1	1	1	1	
	-	-	-	-	2	2	2	-	2	2	2	-	2	2	2	2	2	2	-	-	-	
	-	-	-	-	3	3	3	3	3	3	-	3	3	3	3	3	-	-	3	3	3	
	-	-	-	-	4	4	4	-	4	4	4	-	4	4	4	4	4	4	-	-	-	-
	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	-	5	-	5	-	5
8.00	1	1	1	1	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	
	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2	2	2	-	-	-	
	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3	3	-	-	3	3	3	
	4	4	4	4	-	-	-	-	-	-	-	-	4	4	4	4	4	4	-	-	-	
	-	5	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	5	-	5

F/H = Front Head, B/H = Blind Head

*Note: Switch is not available on F/H 2.00 BORE 1.38 DIA. ROD, 2.50 BORE 1.75 DIA. ROD

BORE	MS4		MS1/MS7		MT1		MT2		MT4		MX0		MX1		MX2		MX3		MX4		
	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	
1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	5	-	-	-	5	-	5	-	5	-	5	-	5	-	-	-	-	5	-	-
*2.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	5	-	5	-	5	-	5	-	-	-	-	5	-	-
*2.50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	5	-	5	-	5	-	5	-	-	-	-	5	-	-
3.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	5	-	5	-	5	-	5	-	-	-	-	5	-	-
4.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-
5.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
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	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-
6.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-	5	-
8.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4	4
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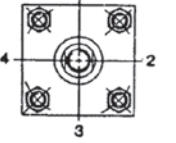
F/H = Front Head, B/H = Blind Head

*Note: Switch is not available on F/H 2.00 BORE 1.38 DIA. ROD, 2.50 BORE 1.75 DIA. ROD

PROXIMITY SWITCH MOUNTING POSITIONS AVAILABLE FOR

2H SERIES CYLINDERS

Position location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End. Position #5 is at back face of Blind Head.



BORE	ME5		ME6		MF1		MF2		MF5		MF6		MP1		MS2		MS3	
	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H
1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
2.00	1	1	1	1	1	1	1	1	-	1	1	-	1	1	1	1	-	-
	-	2	2	-	-	2	2	-	-	2	2	-	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	-	3	3	-	3	3	-	-	3	3
	-	4	4	-	-	4	4	-	-	4	4	-	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
2.50	1	1	1	1	1	1	1	1	-	1	1	-	1	1	1	1	1	1
	-	2	2	-	-	2	2	-	-	2	2	-	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	-	3	3	-	3	3	-	-	3	3
	-	4	4	-	-	4	4	-	-	4	4	-	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
3.25	1	1	1	1	1	1	1	1	-	1	1	-	1	1	1	1	1	1
	-	2	2	-	-	2	2	-	-	2	2	-	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	-	3	3	-	3	3	-	-	3	3
	-	4	4	-	-	4	4	-	-	4	4	-	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
4.00	1	1	1	1	1	1	1	1	-	1	1	-	1	1	1	1	1	1
	-	2	2	-	-	2	2	-	-	2	2	-	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	-	3	3	-	3	3	-	-	3	3
	-	4	4	-	-	4	4	-	-	4	4	-	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
5.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	-	2	2	-	-	2	2	2	2	2	2	2	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	3	3
	-	4	4	-	-	4	4	4	4	4	4	4	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
6.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	-	2	2	-	-	2	2	2	2	2	2	2	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	3	3
	-	4	4	-	-	4	4	4	4	4	4	4	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
7.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	-	2	2	-	-	2	2	2	2	2	2	2	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	3	3
	-	4	4	-	-	4	4	4	4	4	4	4	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5
8.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	-	2	2	-	-	2	2	2	2	2	2	2	2	2	-	-	-	-
	3	3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	3	3
	-	4	4	-	-	4	4	4	4	4	4	4	4	4	-	-	-	-
	-	5	-	-	-	5	-	-	-	5	-	-	-	-	5	-	-	5

F/H = Front Head, B/H = Blind Head

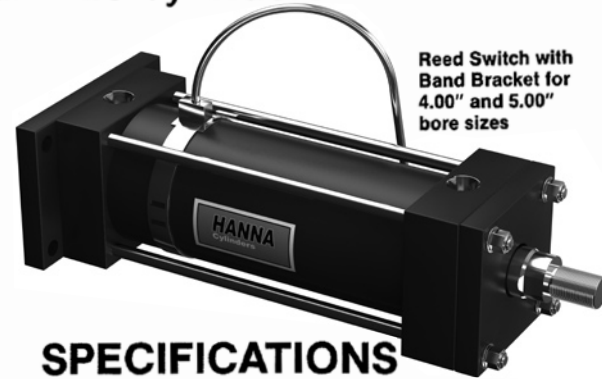
BORE	MS4		MS7		MT1		MT2		MT4		MX0		MX1		MX2		MX3		MX4	
	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H
1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	5	-	-	-	5	-
2.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
2.50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
3.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
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	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
4.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
5.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
6.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
7.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-
8.00	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	2	2	2	-	2	2	-	2	2	2	2	2	2	2	2	2	2	2	2
	-	-	-	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	5	-	-	-	5	-	-	5	-	5	-	5	-	-	-	-	-	5	-

F/H = Front Head, B/H = Blind Head

Reed Switches for pneumatic cylinders



Reed Switch with Conduit Fitting for 1.50" through 3.25" bore sizes only



Reed Switch with Band Bracket for 4.00" and 5.00" bore sizes

ADVANTAGES

- Adjustable mounting permits switch location anywhere within range of piston travel.
- Several switches may be mounted to control or initiate any sequence function.
- No external moving parts to wear or maintain.
- Suited for use in harsh plant environments.
- Neon indicator light (LED) for 3-Amp model provides convenient positioning and troubleshooting of switch and circuits.
- Suitable for AC or DC service.
- 3-Amp switch provides internal transient protection under normal conditions.

Hanna Corporation offers Reed Switches manufactured by PHD, Inc. The switches are available in two types: a standard switch and a 3-Amp version.

Basically, the Reed Switch consists of two overlapping ferro magnetic blades (reeds). The reeds are hermetically sealed inside a glass tube leaving a small air gap between them.

Since the reeds are magnetic, they will assume opposite polarity, and be attracted to each other when influenced by a magnetic field. Sufficient magnetic flux density will cause the reeds to flex and contact each other. When the magnetic field is removed, they will again spring apart to their normal positions.

The cylinder/Reed Switch combination operates by using a magnetic band on the cylinder piston, which closes the externally mounted switch as it approaches. When the piston moves away again, the switch opens.

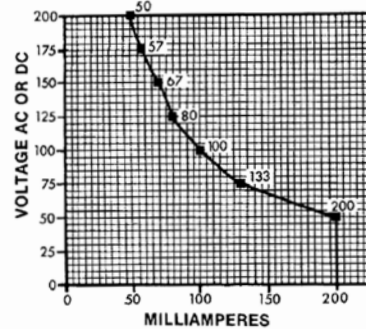
Standard switches can be operated on both AC or DC current. They are ideal for use as input for many types of sequences and programmable controllers. In some cases they can be used to drive some relays or valve solenoids.

However, electrical transients (inrush currents or line spikes) associated with inductive or capacitive loads can damage and shorten the life of the switch.

For such applications, the 3-Amp Reed Switch (AC only) is your best choice. This switch is very similar in construction to the standard Reed Switch. The difference is the inclusion of a triac which upgrades the contact rating to 3 Amps. The 3-Amp switch also has built-in protection against electrical transients.

SPECIFICATIONS

AN12 Voltage vs. Amperes Derating Curve



Model AN12

SPST - Form A
Breakdown voltage - 400 V DC Min.
Switching voltage - 200 V DC Max.
240 V AC Max.

Indicator Lights

Current Draw 0.3 milliamp
Min. DC on voltage - 90 V DC
Min. AC on voltage - 65 V AC

Model 13109-02-6 3-Amp

Circuit Normally open
VA (maximum) 360
Switching voltage 24-120 VAC (50/60 Hz)
Current (break) 3.0 Amp
Leakage 1.7 mA
Response time 1.5 ms On, 0-8.3 ms Off
Switch burden current 5 mA

Note: All incandescent loads derate switch capacity to 10% due to inrush current.

Shock Rating

The basic switch can withstand up to 60 G maximum in the direction of contact closure without misfire or malfunction.

Vibration Sensitivity

Switch will withstand vibration amplitude of 30 G at frequencies up to 6000 Hz without misfire. False operation can occur at vibration frequency levels higher than 6000 Hz.

Operating Temperature

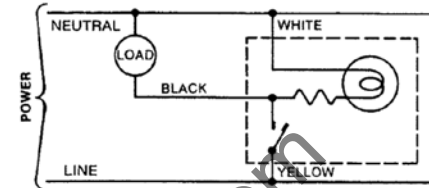
-40° to +170° F for standard cable.

Cable Specification

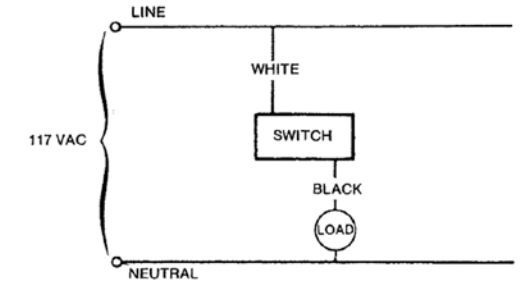
The conductors are tinned copper with polyethylene insulation. Conductors are cabled with rayon braid, a tinned copper braided shield and a chrome vinyl jacket on both AN12 and 13109-02-6 models.

WIRING DIAGRAMS

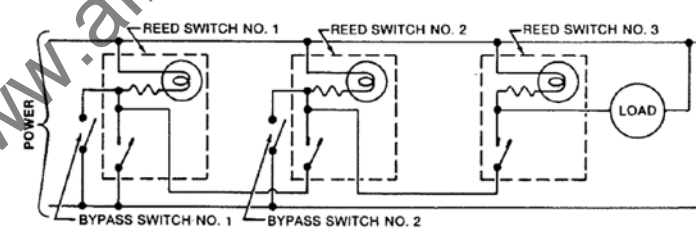
AN12 Switch Wiring Schematic



13109-02-6 3-Amp Switch Wiring Schematic



Series Connected Switches

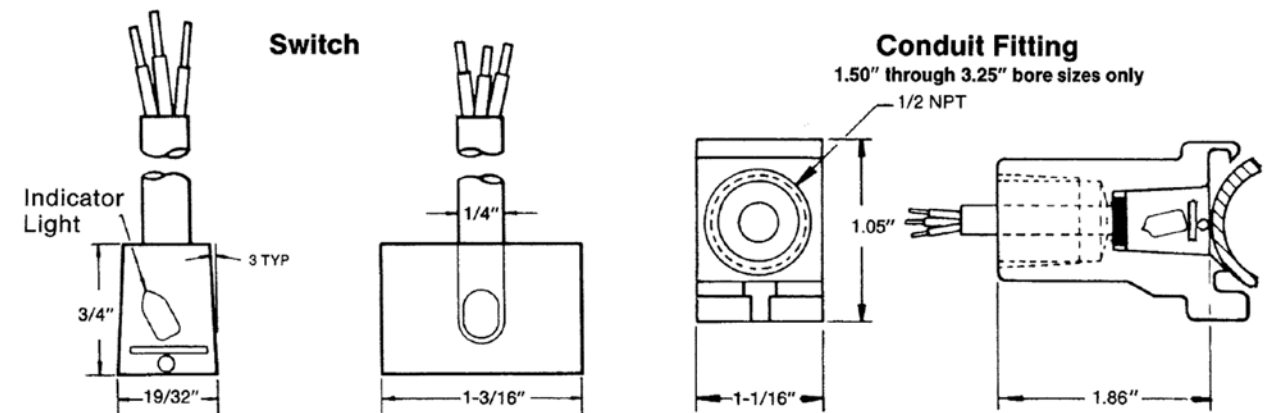


The use of manually operated bypass switches (as shown above) in series reed switch connections permits each switch indicator light to be used to set up or check a reed switch. In the example shown here, when bypass switch #1 is closed, reed switch #2 may be set using its indicator light.

Caution: Do not connect switch without a load. Permanent damage to switch will result.

Note: Switch is internally protected against failure due to normal electrical transient levels. However it may be necessary to use additional transient protection if high levels exist.

DIMENSIONS



ORDERING INFORMATION

Reed Switches are available on Hanna Series 3A, 3AN, CA and MA cylinders, 1.50" bores through 5.00" bores. All cylinders are furnished with aluminum tubes, except for fiberglass tubes on CA cylinders.

When ordering, specify either Switch Model AN12 or Model 13109-02-6, and quantity per cylinder.

Limit Switch Assembly

for hydraulic and pneumatic cylinders



ADVANTAGES

- Dust and moisture resistant housing.
- Corrosion resistant and non-conducting housing.
- Fast readjustment time.
- Low maintenance costs.
- All wiring contained in a single housing.
- Fast installation — only 4 mounting screws.
- Optimum number of switches per foot.
- Enclosure prevents false tripping.

Hanna offers the Model PL-1 Limit Switch Assembly which has proven its reliability and versatility in countless applications. A cam and multiple switch package, the PL-1 assembly is easily mounted to Hanna hydraulic or pneumatic cylinders. The unit provides precise electronic control of cycling, programming, digital sensing and servo-positioning operations. All wiring and switches are enclosed in a corrosion resistant and non-conducting housing for ease of installation, low maintenance.

SPECIFICATIONS

Conduit connection 1" NPT tapped in rear head
 Insulation Fiber or fiberglass paper at each switch plus full area gaskets at cover and heads
 Sealing Fully gasketed to exclude moisture and dirt
 Rod seals Abrasive-resistant polyurethane wipers
 Cam rods Hard chrome-plated C1144 accuracy stock
 Switch location Infinitely adjustable
 Housing Extruded 6061-T6 aluminum, with non-conducting hard anodic coating
 Operating temperature range -40° F to +180° F.
 Operating differential Approx. 3/16 inch each switch
 Operating force 12 pounds max., depending on length
 Housing length Stocked up to 8'. Longer on special orders
 Cover fastening Quarter turn lock bars (captive)
 Hinged covers as optional extra
 Switches See facing page for a wide range of switch options

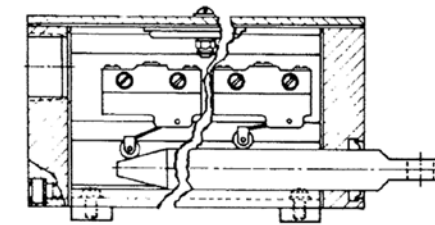
SWITCHES FOR MODEL PL-1 LIMIT SWITCH ASSEMBLY

(12 switches per foot, 6 each side, 6 positions.)

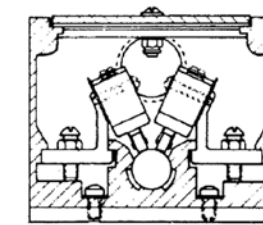
SWITCH	CIRCUIT	TERM'LS	125 VAC	250 VAC	480 VAC	125 VDC	250 VDC
MICRO* BZ-2RW822-A2	SPDT	3 Screw	15A 1/8 HP	15A 1/4 HP	15A	0.5A	0.25A
LICON 16-404	SPDT	4 Lug	10A	10A	—	—	—
MICRO RZ-3YWT822	SPDT (SPLIT)	5 Screw	5A	5A	—	—	—

NOTE: By reversing one switch, two adjacent switches may operate as close as 1 inch apart.

*Standard unless otherwise specified.



Model PL-1 Side View shows roller level switches that provide smoother action, longer life and reliability. Large screw terminals accept wire or solderless connectors. One piece 3/4" cam rod design eliminates backlash and fretting. Double end option makes possible momentary or customized cam profiles.



Model PL-1 End View shows unique Vee placement of switches for unlimited overlap possibilities. Massive snap-in bracket has double clamp screws with lock-nuts for vibration-proof setting. Maximum of 12 miniature switches per foot (6 per side); or 26 sub-miniature switches per foot (13 per side).

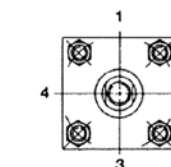
ORDERING INFORMATION

To order Limit Switch Assembly only, specify:

- Stroke in inches.
- Switch specifications: Unless specified, an equal number of left and right hand switches will be furnished. Left and right hand switches may be converted at any time. State choice and quantity:
 - Miniature Micro BZ-2RW822-A2
 - Sub-Miniature Licon 16-404 up to 26 switches per foot.
 Alternate Miniature MICRO 5 terminal switch BZ-3YWT822.
- Optional hinged cover at small additional cost. Specify right or left hand opening, viewed from rod end.
- Specify extra cam rod length required beyond standard in inches. Often required for front flange mounted cylinders.

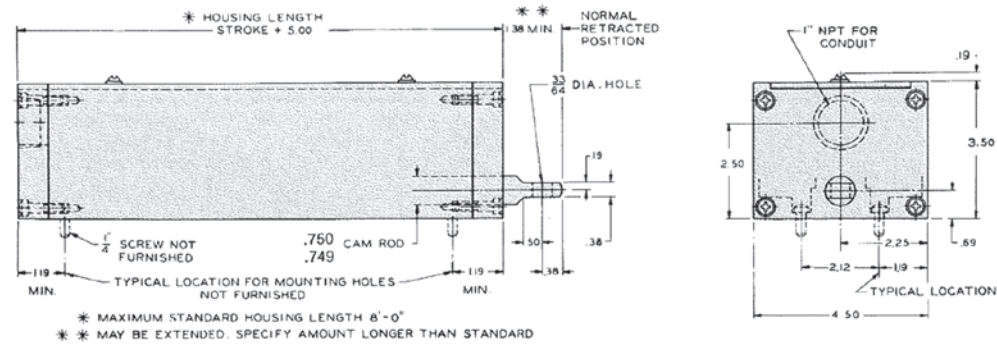
To order Limit Switch Assembly in combination with cylinder, and the Limit Switch Assembly is to be mounted to cylinder, specify:

- Cylinder model number.
- Piston rod diameter
- Cushions, if required
- Rod end type
- Cylinder diameter
- Cylinder stroke
- Side of cylinder on which the Limit Switch Assembly should be mounted. Refer to numbered positions on end view of cylinder as shown here.
- Location of pipe ports and cushion needles (if cushioned). Pipe ports will normally be furnished at Position 4.

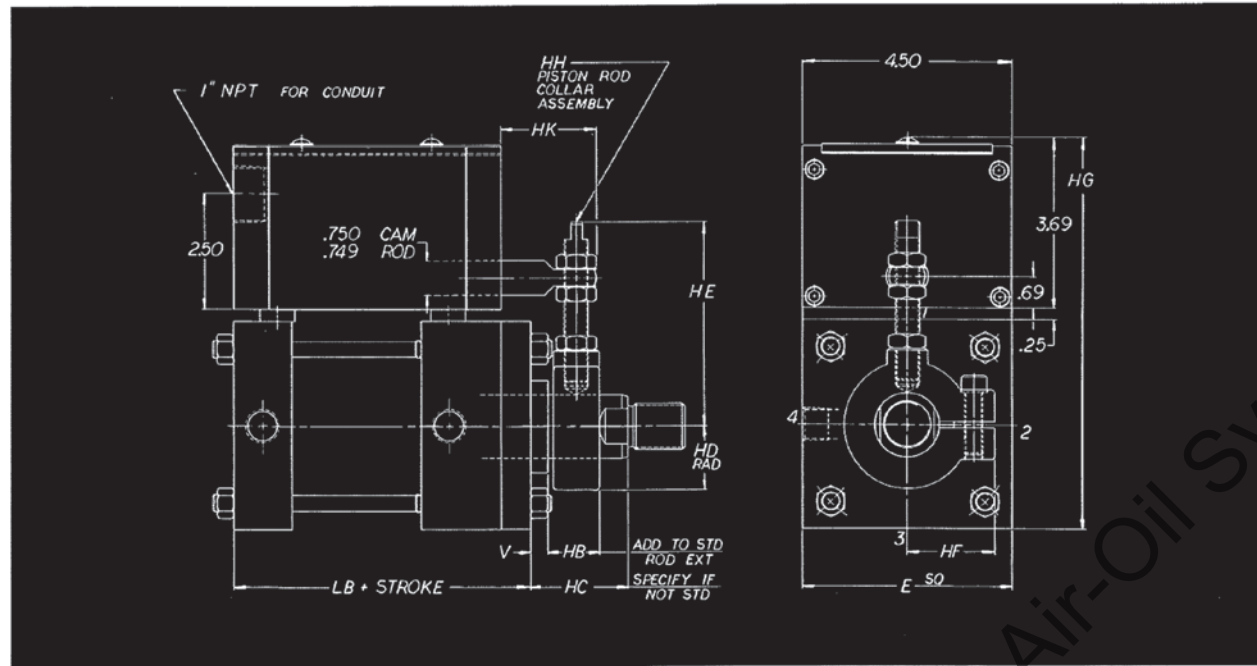


Position location for the Front Head and Blind Head is determined by viewing the cylinder at the Rod End.

DIMENSIONS



LIMIT SWITCH ASSEMBLY INSTALLATION WITH SERIES 3A AND 3AN PNEUMATIC, AND 3L HYDRAULIC CYLINDERS



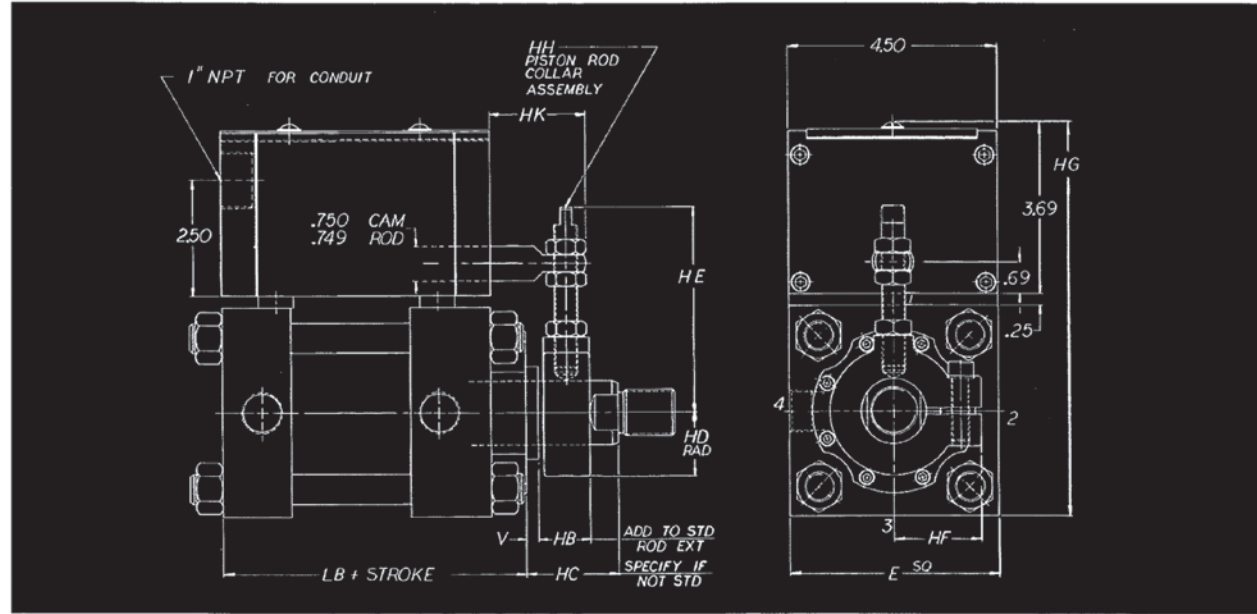
SERIES 3A, 3AN AND 3L CYLINDER DIMENSIONS

CYL. BORE	ROD DIA.	E	HB	HC	HD	HE	HF	HG	HH	HK	LB	V	
1.50	.62	2.00	.88	1.50	.88	3.25	1.50	5.94	-1	1.50	4.00	.25	
	1.00			1.88		3.38			-4	1.75		.50	
2.00	.62	2.50	.88	1.50	.88	3.25	1.50	6.44	-1	1.50	4.00	.25	
	1.00			1.88		3.38			-4	1.75		.50	
	1.38			1.12		2.38			1.38	3.50		1.88	.62
2.50	.62	3.00	.88	1.50	.88	3.25	1.50	6.94	-9	1.50	4.12	.25	
	1.00			1.88		3.38			-10	1.75		.50	
	1.38			1.12		2.38			1.38	3.50		1.88	.62
	1.75			2.62		1.38			3.62	1.88		.75	

SERIES 3A, 3AN AND 3L CYLINDER DIMENSIONS

CYL. BORE	ROD DIA.	E	HB	HC	HD	HE	HF	HG	HH	HK	LB	V	
3.25	1.00	3.75	.88	1.62	.88	4.25	1.50	7.69	-11	1.75	4.88	.25	
	1.38			2.12		4.50			-15	2.00		.38	
	1.75			2.38		4.62			-17	2.12		.50	
	2.00			2.50		4.75			-18	2.25		.62	
4.00	1.00	4.50	.88	1.62	.88	4.25	1.50	8.44	-11	1.75	4.88	.25	
	1.38			2.12		4.50			-15	2.00		.38	
	1.75			2.38		4.62			-17	2.12		.50	
	2.00			2.50		4.75			-18	2.25		.62	
	2.50			2.75		2.12			4.75	2.75		.62	
5.00	1.00	5.50	.88	1.62	.88	4.62	1.50	9.44	-24	1.75	5.12	.25	
	1.38			2.12		4.75			-30	2.00		.38	
	1.75			2.38		1.38			5.00	1.88		.50	
	2.00			2.50		1.12			4.75	2.75		.62	
	2.50			2.75		2.12			4.75	2.75		.62	
	3.00			2.75		2.12			4.75	2.75		.62	
6.00	1.38	6.50	.88	2.00	1.38	5.50	1.88	10.44	-60	2.00	5.75	.25	
	1.75			2.25		5.62			-61	2.12		.38	
	2.00			2.38		5.12			-26	2.25		.50	
	2.50			2.62		2.12			5.62	2.75		.50	
	3.00			2.62		2.12			5.62	2.75		.50	
	3.50			1.38		2.88			3.12	5.25		3.75	.50
	4.00			1.38		2.88			3.12	5.25		3.75	.50
8.00	1.38	8.50	.88	2.00	1.38	6.50	1.88	12.44	-63	2.00	5.88	.25	
	1.75			2.25		7.12			-46	2.12		.38	
	2.00			2.38		6.25			-64	2.25		.50	
	2.50			2.62		2.12			7.00	2.25		.50	
	3.00			2.62		2.12			6.62	2.75		.50	
	3.50			1.38		2.88			3.12	6.50		3.75	.50
	4.00			1.38		2.88			3.12	6.50		3.75	.50
	4.50			1.38		2.88			3.12	6.62		3.75	.50
	5.00			1.38		2.88			3.12	6.62		3.75	.50
	5.50			1.38		2.88			3.12	6.50		3.75	.50
10.00	1.75	10.62	.88	2.25	1.38	7.25	1.88	14.56	-46	2.12	7.12	.38	
	2.00			2.38		7.25			-48	2.25		.50	
	2.50			2.62		2.12			7.62	2.25		.50	
	3.00			2.62		2.12			7.38	2.75		.50	
	3.50			1.38		2.88			3.12	7.50		3.75	.50
	4.00			1.38		2.88			3.12	7.62		3.75	.50
	4.50			1.38		2.88			3.12	7.62		3.75	.50
	5.00			1.38		2.88			3.12	7.88		3.75	.50
12.00	2.00	12.75	.88	2.38	1.38	8.31	1.88	16.69	-48	2.12	7.62	.38	
	2.50			2.62		2.12			8.62	2.25		.50	
	3.00			2.62		2.12			8.62	2.25		.50	
	3.50			1.38		2.88			3.12	9.25		3.75	.50
	4.00			1.38		2.88			3.12	8.50		3.75	.50
	4.50			1.38		2.88			3.12	8.62		3.75	.50
	5.00			1.38		2.88			3.12	8.88		3.75	.50
14.00	2.50	14.75	.88	2.62	1.38	9.31	2.75	18.69	-50	2.25	8.88	.50	
	3.00			2.62		2.12			9.62	2.25		.50	
	3.50			2.62		2.12			9.31	2.25		.50	
	4.00			1.38		2.88			3.12	9.50		3.75	.50
	4.50			1.38		2.88			3.12	9.62		3.75	.50
	5.00			1.38		2.88			3.12	9.62		3.75	.50
	5.50			1.38		2.88			3.12	9.88		3.75	.50

LIMIT SWITCH ASSEMBLY INSTALLATION WITH SERIES 2H HYDRAULIC CYLINDERS



SERIES 2H CYLINDER DIMENSIONS

CYL. BORE	ROD DIA.	E	HB	HC	HD	HE	HF	HG	HH	HK	LB	V
1.50	.62	2.50	.88	1.50	.88	3.44	1.50	6.44	-2	1.50	5.00	.25
	1.00			1.88					-4	1.75		.50
2.00	1.00	3.00	.88	1.62	.88	3.69	1.50	6.94	-7	1.75	5.25	.25
	1.38		2.12	1.38	1.88		-8		2.00	.38		
2.50	1.00	3.50	.88	1.62	.88	3.94	1.50	7.44	-11	1.75	5.38	.25
	1.38		2.12	1.38	1.88		-12		2.00	.38		
3.25	1.75	4.50	1.12	2.00	1.38	4.44	1.88	8.44	-16	2.00	6.25	.25
	2.00			2.38					-17	2.12		.38
4.00	1.75	5.00	1.12	2.12	1.38	4.69	1.88	8.94	-21	2.12	6.62	.25
	2.00		2.50	2.12	2.75		-22		2.25	.38		
5.00	2.00	6.50	1.12	2.25	1.38	5.44	2.75	10.44	-23	2.38	7.12	.25
	2.50			2.12	-26				2.12	.38		
6.00	3.00	7.50	1.38	2.62	2.12	5.94	2.75	11.44	-27	2.38	8.38	.25
	3.50			3.12	-28				2.38	.38		
7.00	3.00	8.50	1.38	2.62	2.12	6.44	3.75	12.44	-32	2.38	9.50	.25
	3.50			3.12	-33				2.38	.38		
8.00	4.00	9.50	1.38	2.62	3.12	6.94	3.75	13.44	-34	2.38	10.50	.25
	4.50			2.12	-35				2.38	.38		

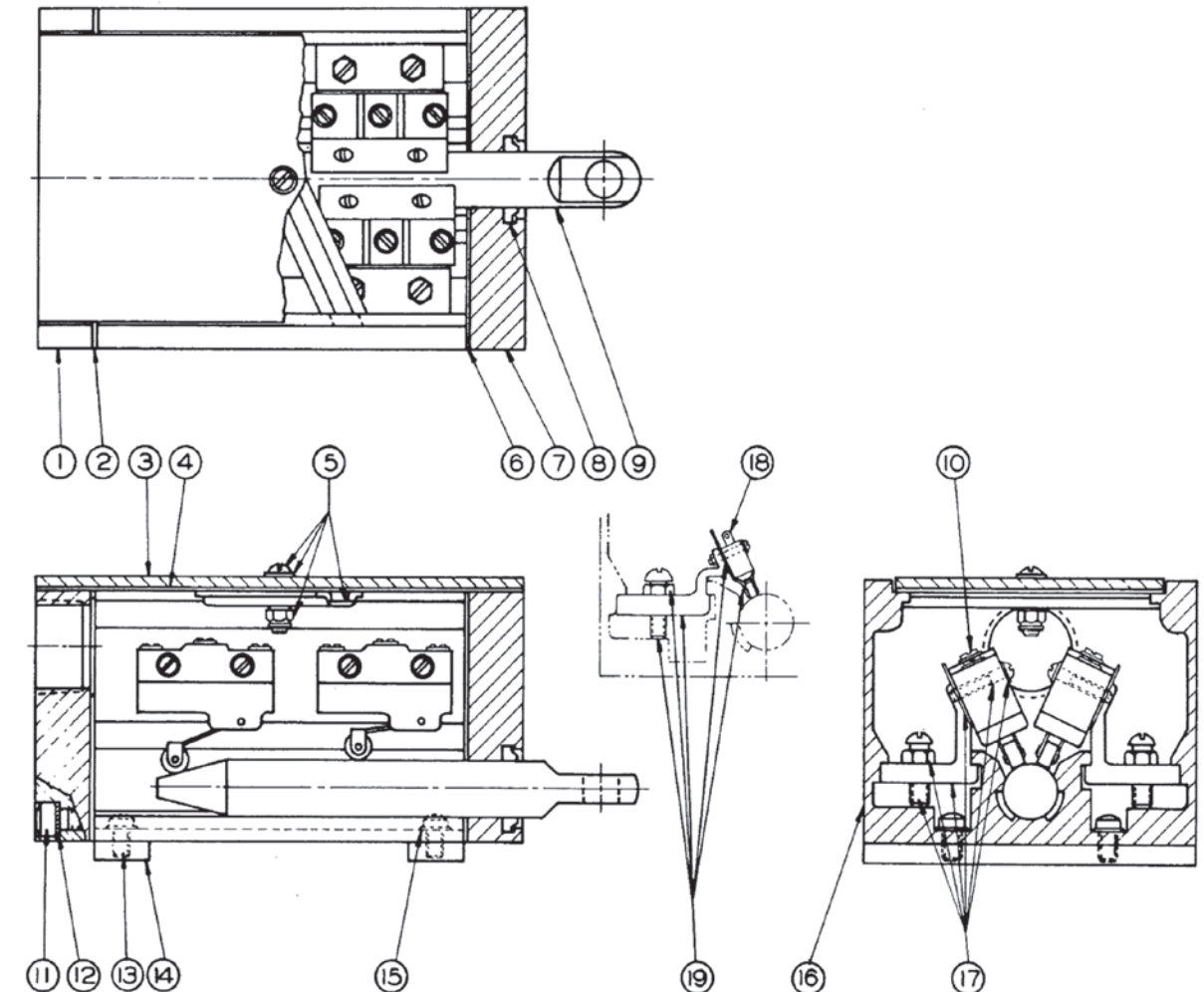
NOTE: 10.00, 12.00 and 14.00 bore dimensions and drawings available from factory upon request.

LIMIT SWITCH ASSEMBLY PARTS LIST

Part No.	Part Nomenclature	Part No.	Part Nomenclature
1	End plate blind end	11	End plate screw
2	Gasket blind end	12	Lock washer
3	Cover plate	13	Mounting screw*
4	Cover plate gasket	14	Mounting bar*
5	Cover clamp assembly	15	Lock washer*
6	Gasket rod end	16	Extrusion housing
7	End plate rod end	17	Switch bracket assembly
8	Rod wiper	18	Switch
9	Cam rod	19	Switch bracket assembly
10	Switch		

*Furnished only when Limit Switch Assembly is mounted to cylinder. When ordering Switch #10 or #18, specify Manufacturer's No.

When ordering parts, include Part No. and Serial No.



OPTIONS

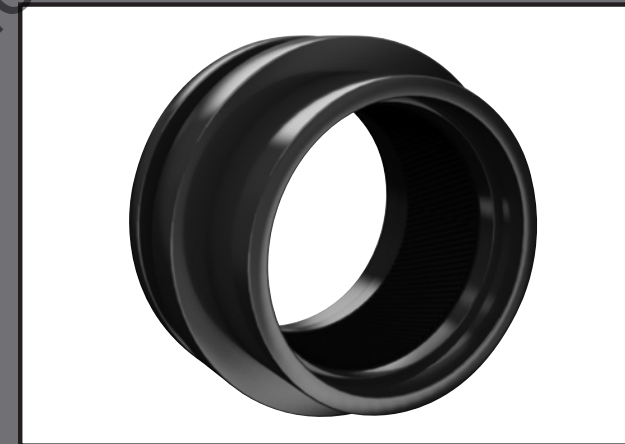
Electronic feedback devices such as MTS, Balluff, Temposonic & Gemco (partial listing).
(Hanna can supply & install upon customer request.)

Protective housings for submersion service.

Intrinsically safe & explosion-proof probes & switches.

Variety of output selections: 4 ~ 20 ma / 0 ~ 10 vDC
(consult factory).

Cable connections per customer requirements (consult factory).



**Duralon® Cylinder
Rod Bearings**

Air-Oil Systems, Inc. www.airoil.com

DURALON® CYLINDER ROD BEARINGS

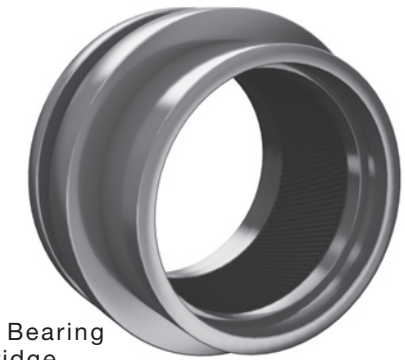
The high-tech Duralon rod bearing is supplied as standard on all Hanna Series 2H and 3L hydraulic cylinders. This state-of-the-art bearing has proven to be superior to all other bearing materials in countless cylinder applications. Here's why:

The useful life of any hydraulic cylinder is determined by the performance of the piston rod bearing. It is responsible for true alignment of the piston to the cylinder bore, and must carry the forces generated by both external and internally-generated eccentric loads.

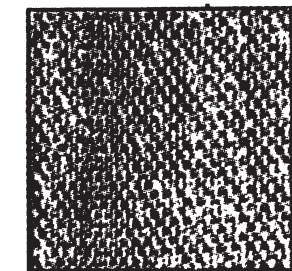
Traditional bronze or cast iron bearings require constant lubrication to help minimize friction and resultant wear. Once the cylinder rod bearing begins to wear, the piston moves off true center of the cylinder bore, thus shortening cylinder life. Additionally, the wear pattern accelerates, causing deterioration in the piston rod wiper, letting contaminants into the cylinder and in the piston rod seal, thereby causing fluid leakage.

Hanna has solved this critical design problem with the unique, non-metallic Duralon bearing. An exact combination of woven Teflon and Dacron fibers bonded to a fiberglass shell, Duralon bearings are capable of sustaining much higher compressive loads than either bronze or cast iron. In addition, Duralon bearings have an extremely low coefficient of friction, and require no lubrication to the bearing surface.

As a result, cylinders with Duralon bearings are ideal for use in heavy-duty applications, and servo



Duralon Rod Bearing in steel cartridge



Enlarged view of Duralon

systems requiring minimal actuator friction. Because of the low coefficient of friction, very little heat generation occurs, thereby prolonging both bearing and seal life.

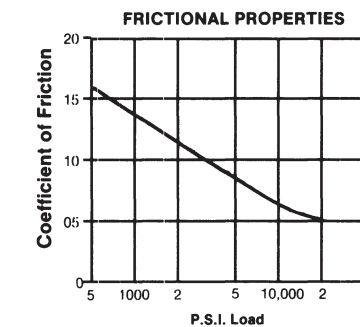
Duralon bearings are compatible with most known fluids, including water, water glycols, standard petroleum-based fluids, phosphate esters and water/oil, oil/water fluids. They can operate in environments ranging from -65°F to +325°F.

DURALON VS. COMPETITIVE BEARING MATERIALS

COMPARISON OF NON-LUBRICATED BEARINGS AND THEIR OPERATING LIMITS	LOAD CAPACITY (PSI)
Porous Bronze	4500
Porous Iron	8000
Reinforced Teflon*	2500
Duralon Bearing*	60,000

*Not to be used for design purposes

Duralon is a Trademark of Rexnord, Inc
Nylon, Teflon and Dacron are Trademarks of DuPont Company



The low friction characteristic of the Duralon bearing is due to the Teflon fabric liner. Increased loading, at constant speed, results in a marked decrease in the coefficient of friction.

COMPARISON OF FRICTION PROPERTIES OF JOURNAL BEARING MATERIALS		
	COEFFICIENT	SLIP/STICK
Steel-on-Steel	.50	Yes
Bronze-on-Steel	.35	Yes
Aluminum		
Bronze-on-Steel	.45	Yes
Sintered Bronze-on-Steel (Mineral Oil)	.13	No
Bronze-on-Steel (Mineral Oil)	.16	No
Copper Film Deposited on Steel	.30	Yes
Teflon®-on-Steel	.04	No
Duralon®-on-Steel	05-16	No

Visit our website at www.hannacylinders.com

You can visit Hanna in cyberspace at the website shown above. This site presents a wealth of information about Hanna, starting with a complete history of our company, dating back to the early 1900s.

In addition, the site enables you to quickly and easily order any or all of our catalogs. What's more, our HannaCAD programs can be downloaded from the site so they are immediately available to you.

The website also presents current news about Hanna with our On-Line Hot-Line. This section is updated periodically, as current news warrants.

And, there's a section that includes some of the most frequently asked questions that are posed.

Furthermore, you can contact our factory direct for information or a cylinder quotation. Our on-line Cylinder Application Checklist is there to help you provide us with the data we need to prepare an accurate, complete quotation. Finally, the website enables you to easily find the Hanna Fluid Power distributor nearest you.

Come see us soon.

WARRANTY

HANNA warrants that products it manufactures or designs are merchantable, are free from defects in material and workmanship, conform to any drawing and/or specifications furnished by purchaser and agreed to by *HANNA* in writing. As to products not manufactured by *HANNA*, *HANNA* will extend the manufacturer's warranty. (We will provide a copy upon request.) This warranty and extended manufacturer's warranty is subject to the remedy clause stated herein. Except for the foregoing, it is agreed that there are no warranties, expressed or implied, which extend beyond the description on the face hereof.

REMEDY: All claims must be made within twelve (12) months of delivery to the original user. Upon satisfactory proof of claim by purchaser, *HANNA* will within a reasonable time, make any necessary repairs or supply replacement parts, or where the foregoing is deemed by *HANNA* to be commercially impractical, refund the purchase price upon return of the products. Repair or replacement parts provided under this remedy will be supplied by *HANNA* free of charge, F.O.B. shipping point, freight prepaid and allowed at the lowest available commercial rate. Purchaser charges for repairs, replacements or returns for credit will not be allowed unless authorized by *HANNA* in writing. *HANNA* will not be liable for any other purchaser costs, damages or expenses that may result from a breach of this contract. The foregoing remedy is sole and exclusive and states the full extent of *HANNA*'s liability. No other remedy will be allowed, whether in contract or tort (including strict liability and negligence).

HANNA
cylinders

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