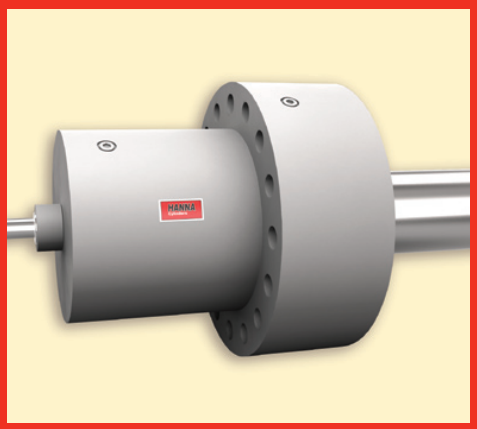
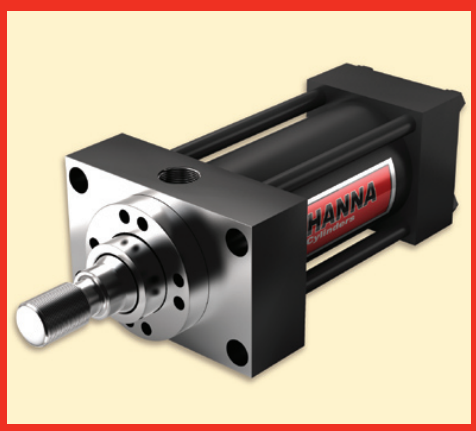
HANNA cylinders





Product Catalog
Catalog #HC-2009-1

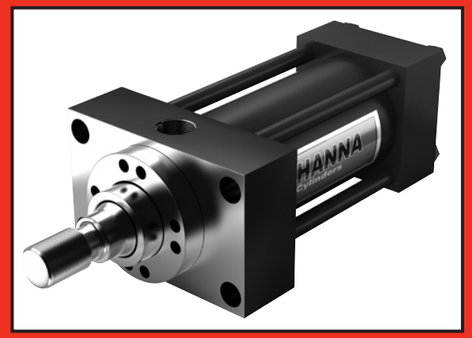
DESIGNING AND MANUFACTURING CUSTOM CYLINDERS FOR OVER 100 YEARS.

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

10.00" thru 14.00" Bores

Series 2H and 3L Hydraulic Cylinders

HANNA cylinders

Series 2H

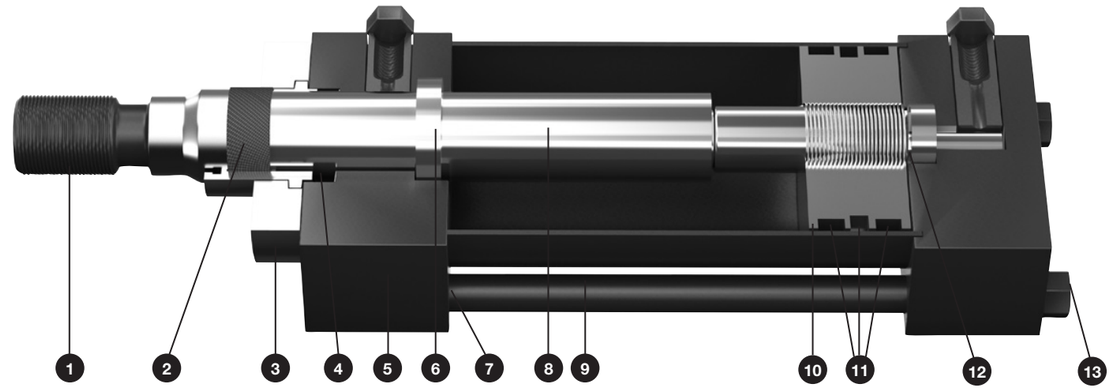
Hydraulic Cylinders for Heavy-Duty Service

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.**



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.

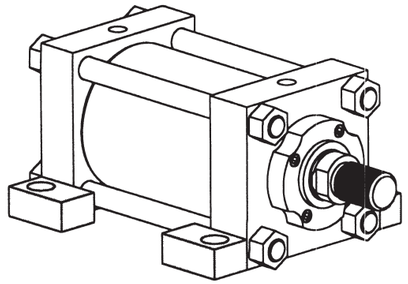
12. Piston-to-Rod Connection
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anerobic adhesive, torqued and pinned.

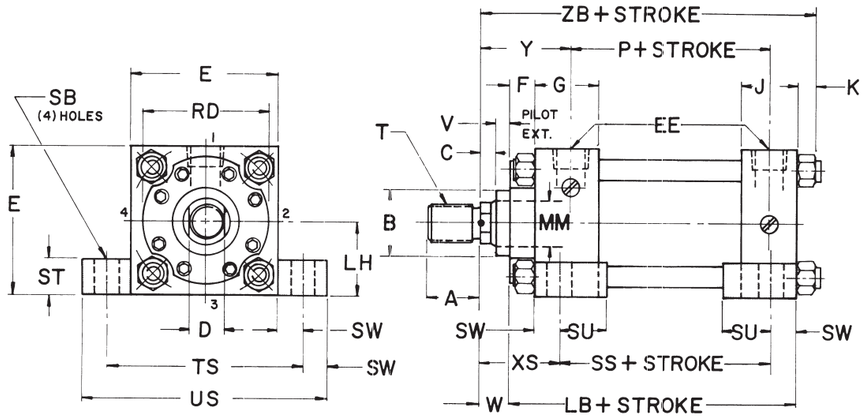
13. Tie Rods
Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P	SB	SS	ST	SU	SW	TS ±.010	US
1.50	2.50	1 250	#8 (750-16)	½	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)	½	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)	½	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)	¾	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)	¾	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)	¾	.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)	1¼	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)	1½	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

Series 2H and 3L Hydraulic Cylinders

Dimensions are Affected by the Rod Diameter

MS2

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	PSI RATING†
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
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
	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
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	3.62	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
	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

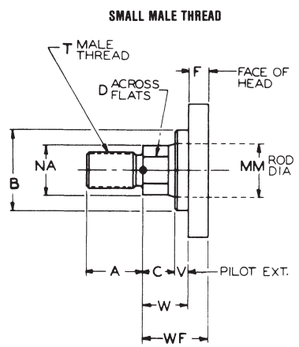
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

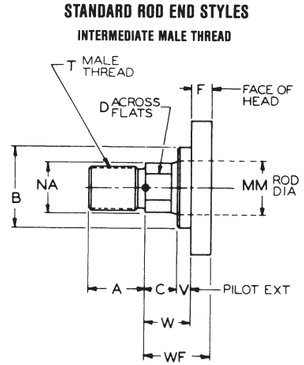
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

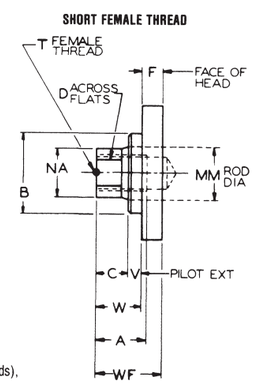
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



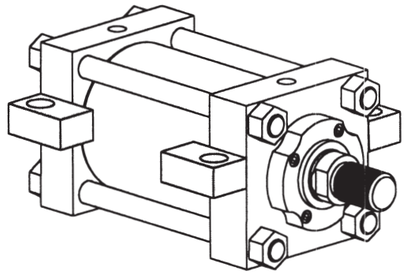
SHORT FEMALE THREAD

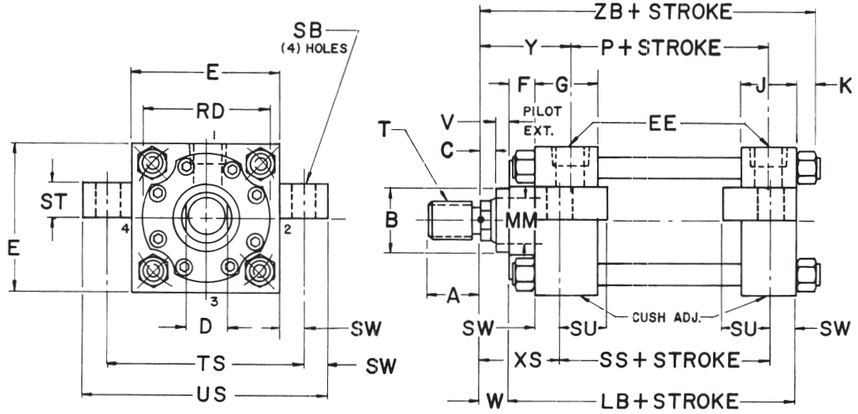


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5 50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P	SB	SS	ST	SU	SW	TS ±.010	US
1.50	2.50	#8 (.750-16)	½	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)	½	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)	½	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 (1 062-12)	¾	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 (1 062-12)	¾	.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	#12 (1.062-12)	¾	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	#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	#20 (1 625-12)	1¼	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	#24 (1 875-12)	1½	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

MS3

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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	PSI RATING†
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
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
	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
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	3.62	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
	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

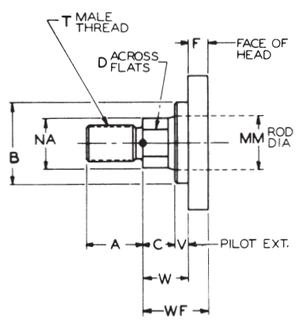
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

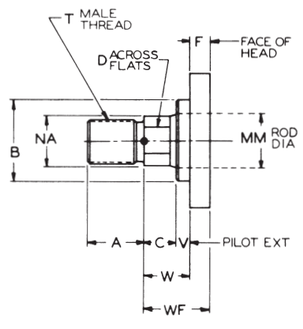
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

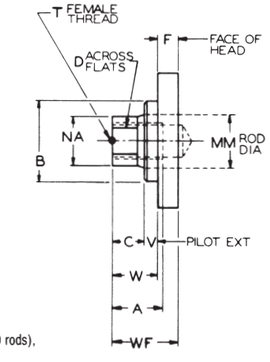
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



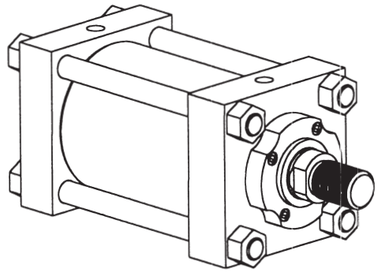
SHORT FEMALE THREAD

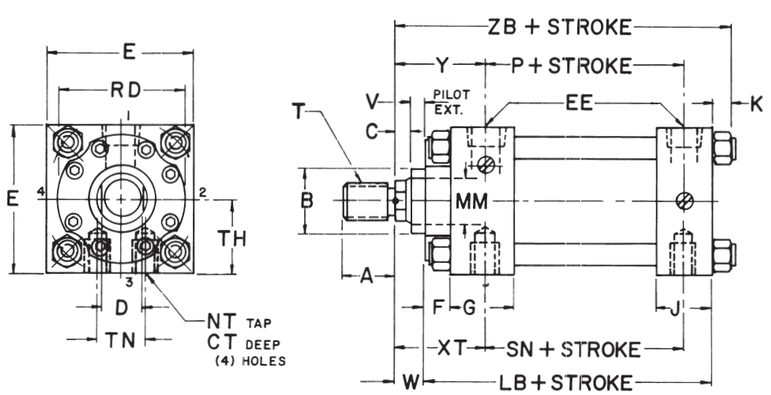


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	NT	P	SN	TN ±.010
1.50	2 50	1 250	#8 (.750-16)	½	.38	1.75	1 50	31	5 00	38-16	2.88	2.88	.75
2.00	3 00	1.500	#8 (750-16)	½	.62	1 75	1 50	44	5.25	50-13	2.88	2.88	.94
2.50	3 50	1 750	#8 (750-16)	½	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)	¾	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)	¾	88	2.00	1.75	56	6 62	1 00-8	3 75	3 75	2.06
5.00	6 50	3 250	#12 (1 062-12)	¾	88	2.00	1 75	75	7 12	1 00-8	4 25	4.25	2 94
6.00	7.50	3.750	#16 (1 312-12)	1	1 00*	2.25	2.25	88	8 38*	1 25-7	4.88	5 12	3.31
7.00	8 50	4 250	#20 (1 625-12)	1¼	1 00	2.75	2.75	1.00	9 50	1 50-6	5 38	5.88	3.75
8.00	9 50	4 750	#24 (1.875-12)	1½	1 00	3 00	3 00	1 06	10 50	1 50-6	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

CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	CT	XT	Y	ZB	PSI RATING†
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	-	1 00-14	1 25-12	1.00-14	.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	-	1 00-14	1.25-12	1.00-14	.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	2 75	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 00	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
	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	.81	3 38	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	1 75	3 50	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	75	3.50	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	.94	3 50	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	94	3 50	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	1 38	3.81	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	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
	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
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	2.00	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
	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

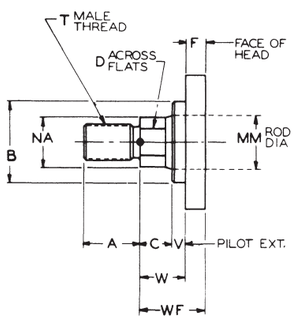
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

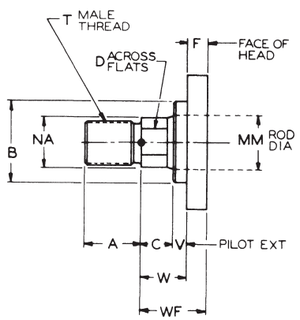
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

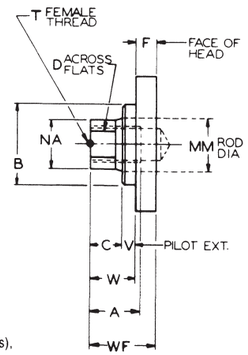
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



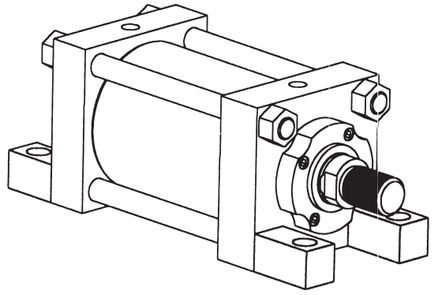
SHORT FEMALE THREAD

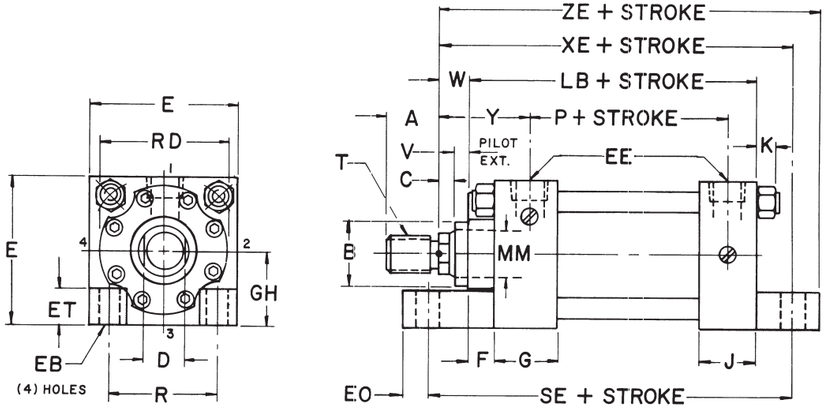


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	EO	ET	F	G	J	K	LB	P	R ±.010	SE
1.50	2.50	1 250	.44	#8 (750-16)	½	.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)	½	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)	½	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)	¾	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)	¾	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)	¾	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)	1¼	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)	1½	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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XE	Y	ZE	PSI RATING†
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
	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
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	13 75	3.94	15.00	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	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
	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

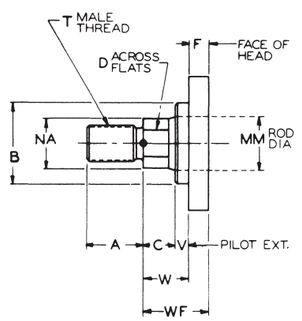
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

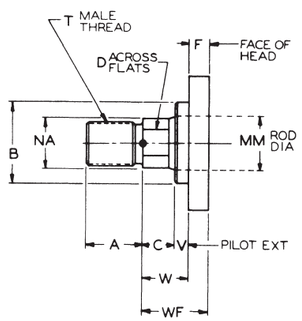
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

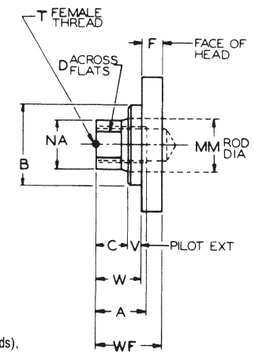
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



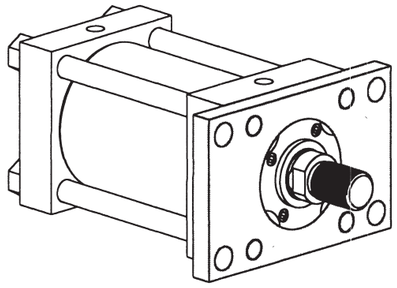
SHORT FEMALE THREAD

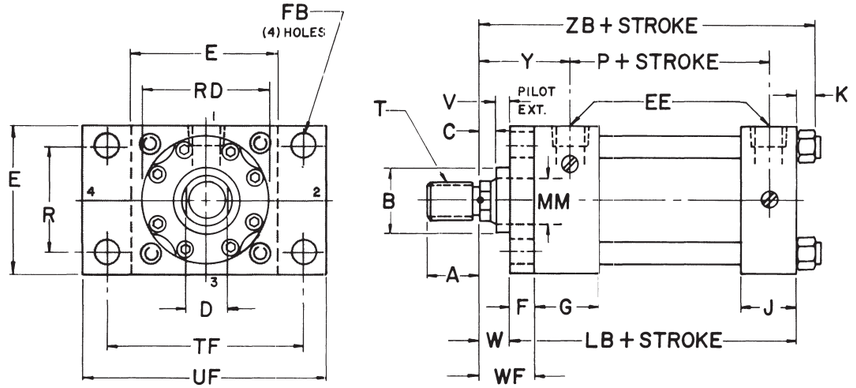


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MF1 Head Rectangular Flange Mount





These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.50	#8 (750-16)	½	38	.438	1.75	1 50	31	5.00	2.88	1.63	3.43	4.25
2.00	3 00	#8 (750-16)	½	62	562	1 75	1.50	.44	5.25	2 88	2.05	4.12	5 12
2.50	3.50	#8 (750-16)	½	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)	¾	.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)	¾	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)	¾	.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)	1¼	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)	1½	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.

MF1

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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	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
3.25	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	1375
	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	1175
	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
	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
5.00	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	1000
	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	5.62	2.25-12	2.75-12	2.25-12	.38	1.38	2.25	3.38	9.25	250
	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	250
6.00	K	2.50	3.00	3.125	1.00	2.06	2.50	-	1.88-12	2 25-12	1.88-12	.25	1 25	2.25	3 50	10.50	900
	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	250
	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	250
	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	250
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	2.25	3.81	11.75	300
	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	300
	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	300
	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	150
	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	150
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	275
	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	275
	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	125
	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	125
	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	125

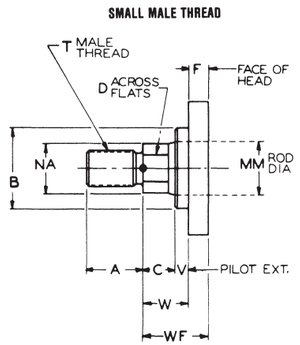
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

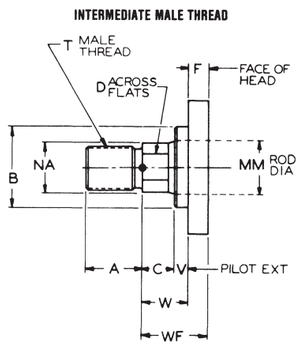
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

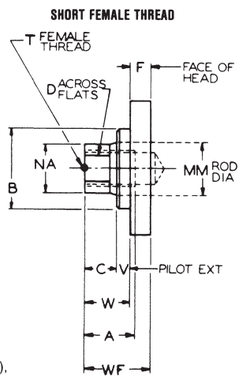
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



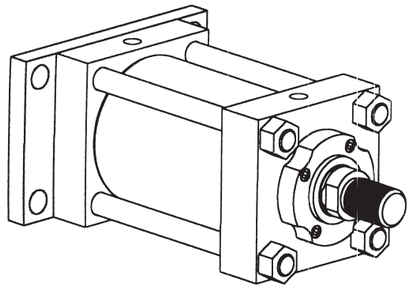
SHORT FEMALE THREAD

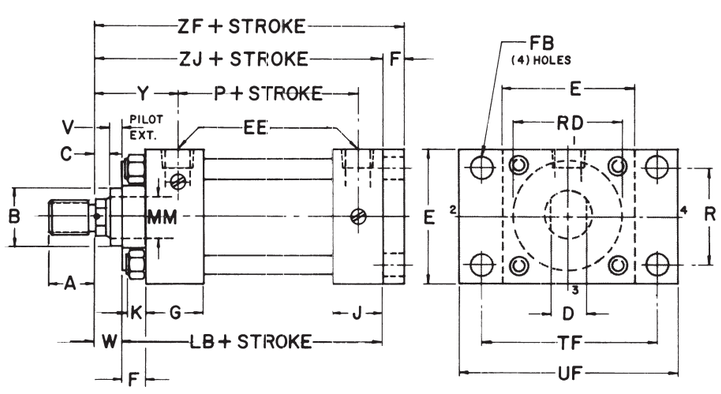


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MF2 Cap Rectangular Flange Mount





These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2 50	#8 (750-16)	½	38	438	1 75	1 50	31	5 00	2 88	1.63	3 43	4 25
2.00	3 00	#8 (750-16)	½	62	.562	1 75	1 50	.44	5.25	2 88	2 05	4 12	5.12
2.50	3 50	#8 (.750-16)	½	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)	¾	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)	¾	.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)	¾	.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)	1¼	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)	1½	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.

Dimensions are Affected by the Rod Diameter

MF2

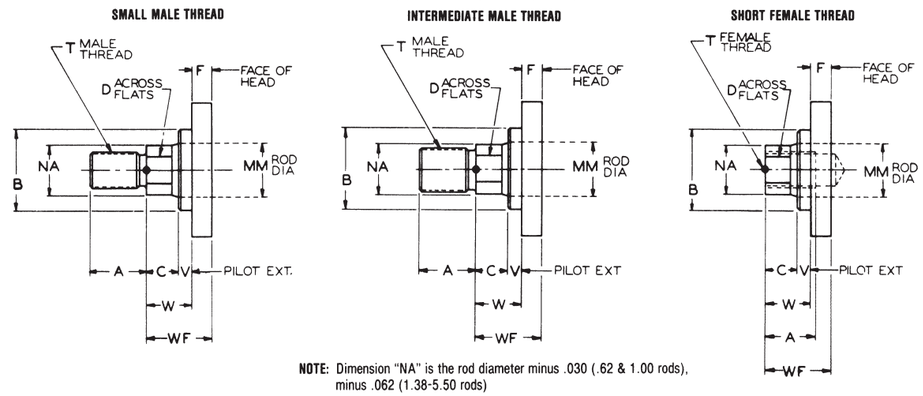
BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZF	ZJ	PSI RATING†
1.50	D	62	.75	1 125	38	.50	62	-	44-20	.50-20	44-20	25	62	2 00	6 00	5 62	1650
	F	1.00	1 12	1.500	50	88	1.00	-	75-16	.88-14	.75-16	.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
	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
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	12.75	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
	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.

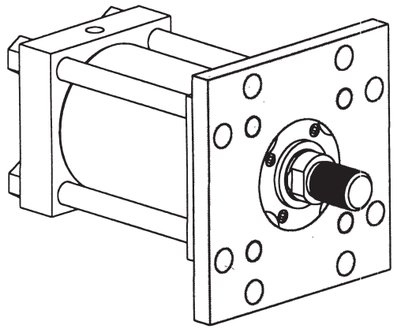
STANDARD ROD END STYLES

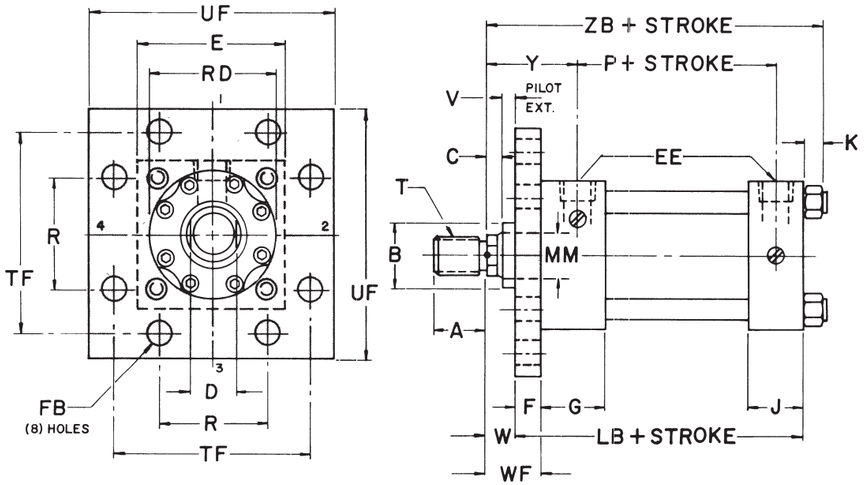


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MF5 Head Square Flange Mount





These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2 50	#8 (.750-16)	½	38	438	1 75	1 50	31	5 00	2.88	1.63	3.43	4.25
2.00	3.00	#8 (.750-16)	½	62	562	1 75	1 50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (750-16)	½	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)	¾	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)	¾	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)	¾	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)	1¼	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)	1½	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.

Dimensions are Affected by the Rod Diameter

MF5

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	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
3.25	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
	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
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	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
	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
5.00	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
	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
	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	1050
6.00	K	2.50	3.00	3.125	1.00	2 06	2.50	-	1.88-12	2.25-12	1.88-12	.25	1 25	2.25	3.50	10.50	1650
	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
	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	1000
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	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
	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
	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
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	650
	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
	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

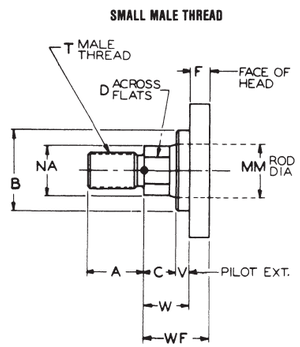
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

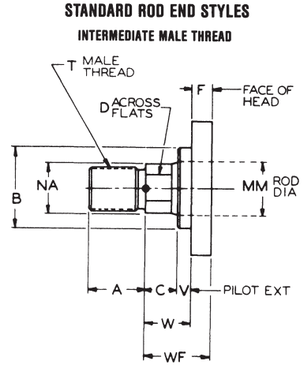
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

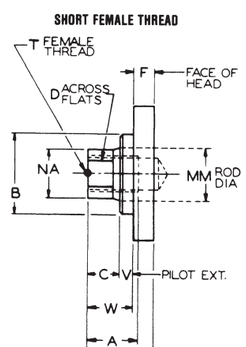
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



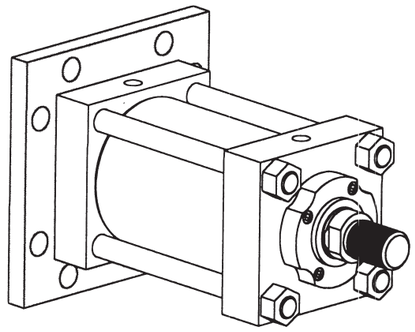
SHORT FEMALE THREAD

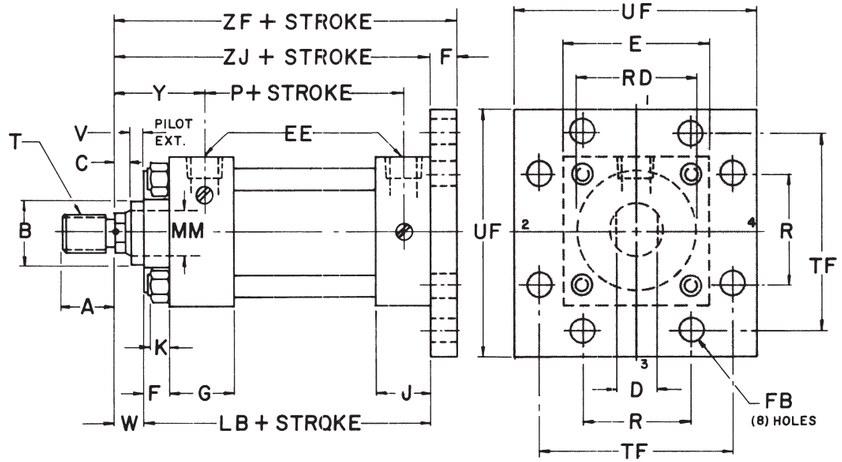


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MF6 Cap Square Flange Mount





These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2 50	#8 (750-16)	½	38	438	1 75	1 50	31	5.00	2 88	1.63	3.43	4.25
2.00	3 00	#8 (750-16)	½	62	.562	1 75	1.50	44	5.25	2 88	2.05	4.12	5.12
2.50	3.50	#8 (750-16)	½	.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)	¾	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)	¾	.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)	¾	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)	1¼	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)	1½	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.

Dimensions are Affected by the Rod Diameter

MF6

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZJ	ZF	PSI RATING†
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	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	7.12	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	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	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	4.00	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	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	4.00	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	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
	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	10.75	11.75	1475
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	11.75	12.75	1200
	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	11.75	12.75	1200
	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	11.75	12.75	1200
	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	11.75	12.75	1200
	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	11.75	12.75	1200

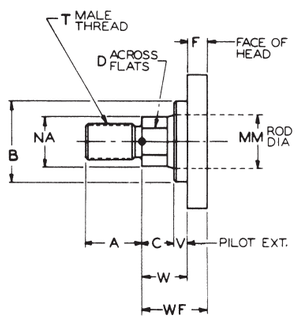
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

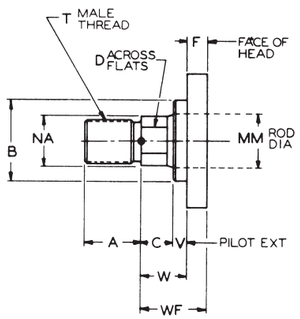
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

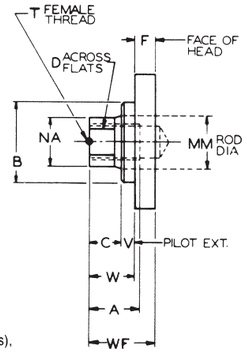
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

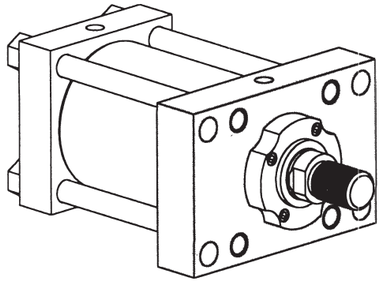


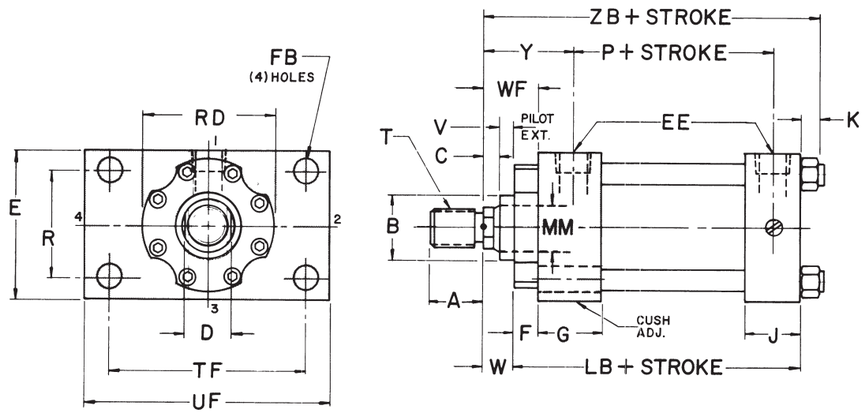
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

ME5 Head Flange Mount

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





These Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.50	#8 (750-16)	½	38	.438	1.75	1.50	.31	5.00	2 88	1.63	3.43	4.25
2.00	3 00	#8 (.750-16)	½	.62	562	1 75	1 50	.44	5 25	2 88	2 05	4.12	5 12
2.50	3 50	#8 (750-16)	½	.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)	¾	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)	¾	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)	¾	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)	1¼	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)	1½	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

ME5

Dimensions are Affected by the Rod Diameter

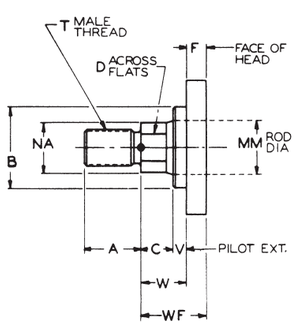
BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
1.50	D	.62	75	1 125	.38	50	62	2.00	.44-20	50-20	.44-20	25	.62	1.00	2 00	5.94	3000
	F	1 00	1 12	1.500	.50	88	1.00	2.38	75-16	.88-14	.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
	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
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	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 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	2.25	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	2.25	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	2.25	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	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.

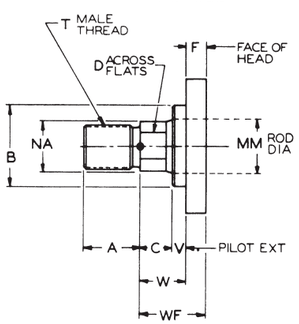
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

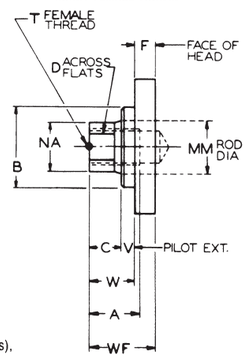
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

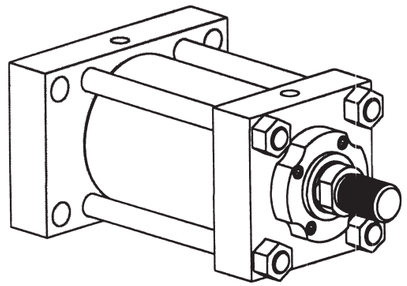


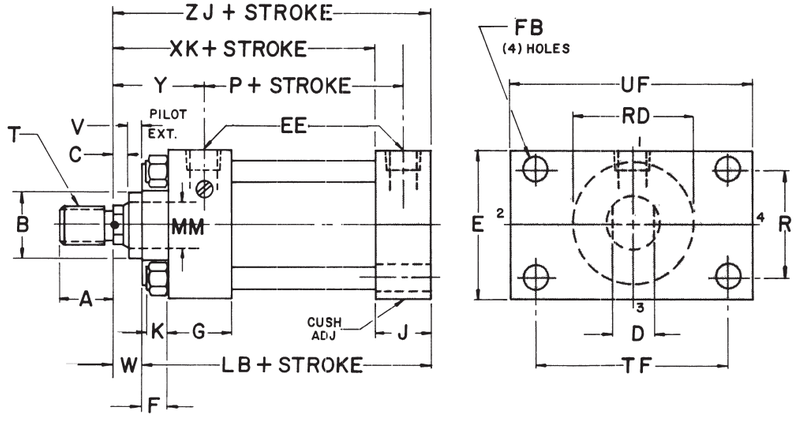
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	FB	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.50	#8 (750-16)	½	.38	.438	1 75	1 50	.31	5.00	2.88	1.63	3.43	4.25
2.00	3 00	#8 (750-16)	½	62	.562	1.75	1 50	.44	5.25	2.88	2.05	4.12	5.12
2.50	3.50	#8 (.750-16)	½	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)	¾	.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)	¾	.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)	¾	.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)	1¼	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)	1½	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.

Dimensions are Affected by the Rod Diameter

ME6

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	XK	ZJ	PSI RATING†
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
	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
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	5.88	7.62	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	6.00	7.75	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
	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	6 75	8.50	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	7.38	9 62	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	7 38	9 62	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	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
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	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
	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
	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	8.00	10.75	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	3.94	8.75	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	3.94	8.75	11.75	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	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

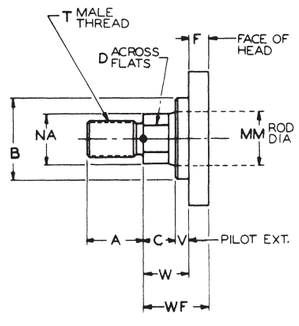
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

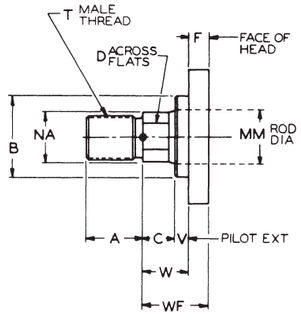
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

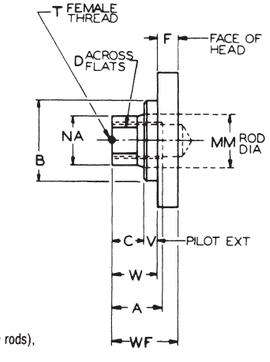
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



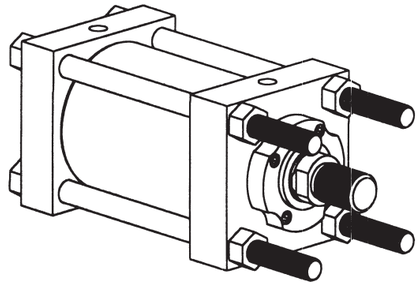
SHORT FEMALE THREAD

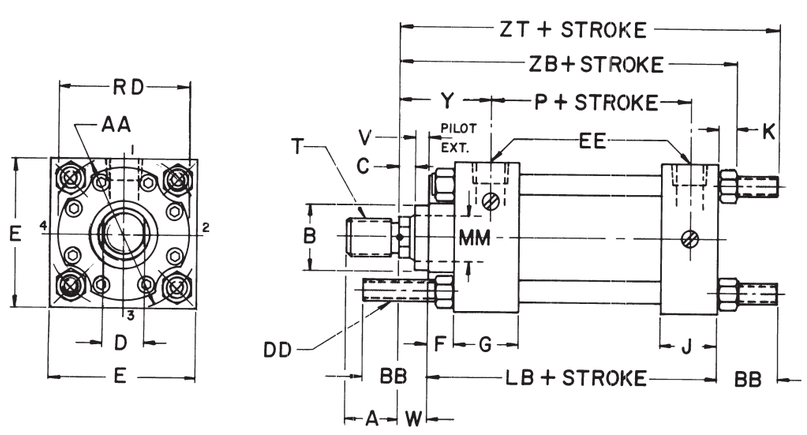


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MX0, MX1, MX2, MX3, MX4 Tie Rod Mounts





These Dimensions are Constant Regardless of Rod Diameter

BORE	AA	BB	DD	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P
1.50	2 30	1 38	38-24	2 50	#8 (.750-16)	½	.38	1.75	1.50	31	5.00	2.88
2.00	2 90	1 81	.50-20	3.00	#8 (750-16)	½	.62	1 75	1.50	44	5.25	2.88
2.50	3.60	1 81	50-20	3.50	#8 (.750-16)	½	.62	1.75	1.50	.44	5 38	3.00
3.25	4.60	2.31	.62-18	4 50	#12 (1 062-12)	¾	75	2 00	1.75	.56	6.25	3.50
4.00	5.40	2 31	.62-18	5 00	#12 (1.062-12)	¾	88	2.00	1.75	.56	6 62	3.75
5.00	7 00	3 19	88-14	6 50	#12 (1.062-12)	¾	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)	1¼	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)	1½	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

Series 2H and 3L Hydraulic Cylinders

Dimensions are Affected by the Rod Diameter

MX0, MX1, MX2, MX3, MX4

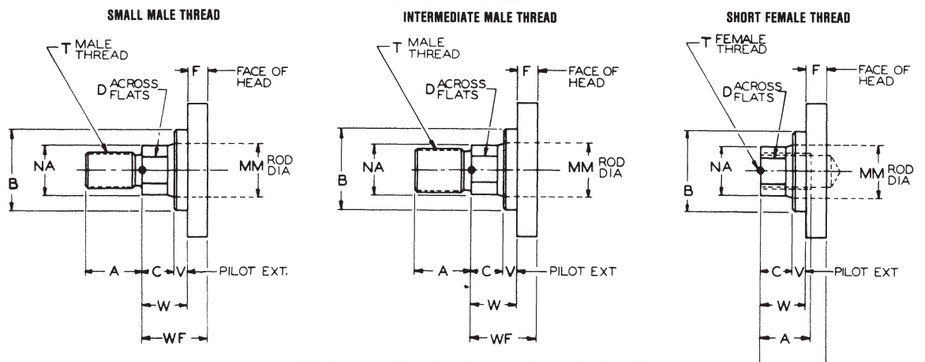
CYLINDER BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZB	ZT	PSI RATING†
1.50	D	62	.75	1 125	.38	50	.62	-	.44-20	50-20	.44-20	.25	.62	2.00	5.94	7.00	3000
	F	1.00	1 12	1 500	.50	.88	1 00	-	.75-16	.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
	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
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	7.69	9 44	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	7.94	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
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	8.19	9.94	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	8.31	10.06	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	8.56	10.31	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	9.00	11.44	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	9.25	11.69	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	9.25	11.69	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	3.38	9.25	11.69	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	13.25	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
	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 50	10.50	13.25	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	3.81	11.75	14.87	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	11.75	14.87	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
	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	7 50	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
	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
	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	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 toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

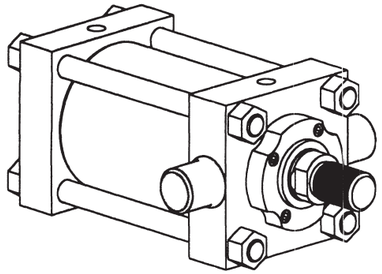


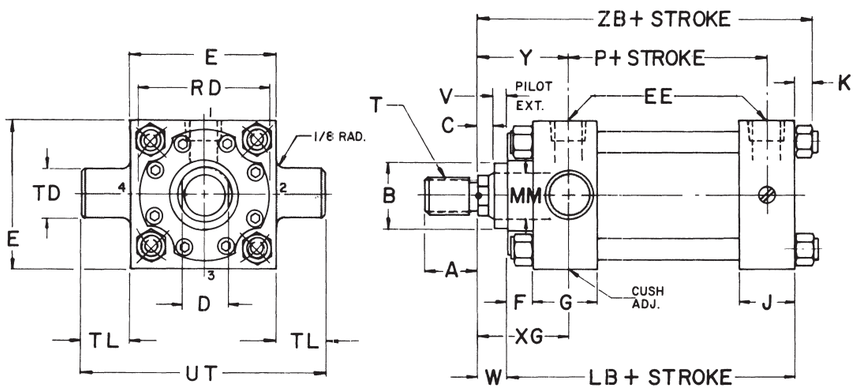
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P	TD +.000 -.002	TL	UT
1.50	2 50	#8 (750-16)	½	.38	1.75	1.50	.31	5 00	2.88	1.000	1.00	4 50
2.00	3.00	#8 (750-16)	½	.62	1.75	1.50	.44	5.25	2.88	1.375	1.38	5 75
2.50	3.50	#8 (.750-16)	½	62	1 75	1.50	.44	5.38	3.00	1.375	1.38	6.25
3.25	4.50	#12 (1 062-12)	¾	75	2 00	1 75	56	6 25	3 50	1.750	1.75	8 00
4.00	5.00	#12 (1.062-12)	¾	88	2 00	1 75	56	6.62	3.75	1.750	1.75	8.50
5.00	6.50	#12 (1 062-12)	¾	.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)	1¼	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)	1½	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

Dimensions are Affected by the Rod Diameter

MT1

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XG	Y	ZB	PSI RATING†
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
	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
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	2.62	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	2.88	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	3.00	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	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
	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
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	3.00	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	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
	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	3.25	3.38	9.25	1365
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	1250
	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	1250
	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	1250
	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	1250
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	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	3.62	3.81	11.75	1425
	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	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	3.62	3.81	11.75	1425
	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	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	3.75	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	3.75	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	3.75	3.94	12.81	1575
	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	3.75	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	3 75	3.94	12.81	1575

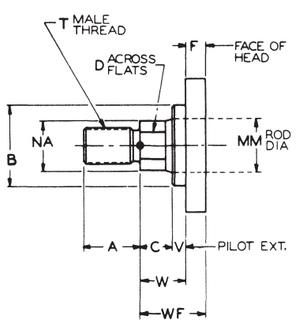
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

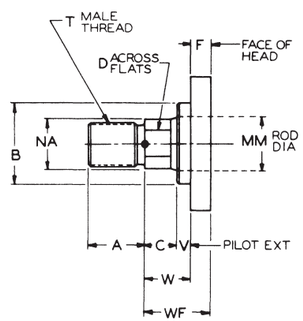
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

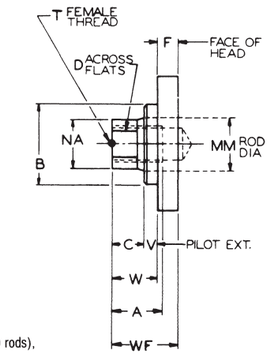
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



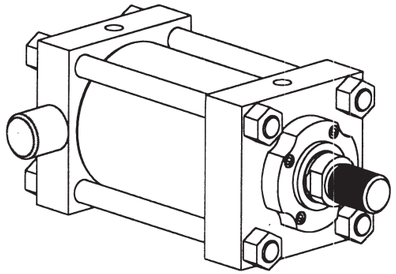
SHORT FEMALE THREAD

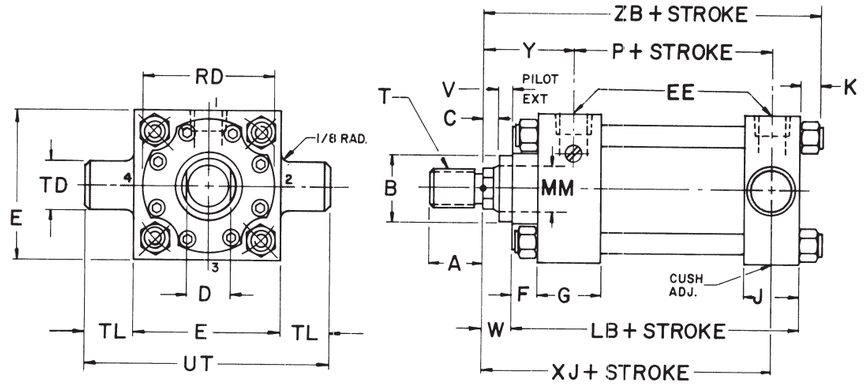


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1 38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P	TD +.000 -.002	TL	UT
1.50	2 50	#8 (750-16)	½	38	1 75	1 50	.31	5.00	2 88	1.000	1.00	4.50
2.00	3.00	#8 (.750-16)	½	62	1 75	1 50	44	5 25	2.88	1.375	1.38	5.75
2.50	3.50	#8 (.750-16)	½	62	1.75	1 50	.44	5.38	3.00	1 375	1.38	6.25
3.25	4.50	#12 (1 062-12)	¾	.75	2.00	1 75	56	6.25	3.50	1.750	1.75	8.00
4.00	5.00	#12 (1.062-12)	¾	88	2 00	1 75	.56	6.62	3.75	1.750	1.75	8.50
5.00	6 50	#12 (1.062-12)	¾	.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)	1¼	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)	1½	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

Dimensions are Affected by the Rod Diameter

MT2

BORE	ROD DIA. CODE	ROD DIA.	A	B -.001 -.003	C	D	MM ROD DIA.	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XJ	Y	ZB	PSI RATING†
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
	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	7.12	3.38	8.56	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
	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	7.62	3.38	9.25	1365
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	8.38	3.50	10.50	1250
	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	8.38	3.50	10.50	1250
	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	8.38	3.50	10.50	1250
	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
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	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
	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	7.50	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
	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

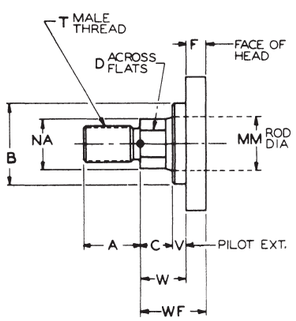
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

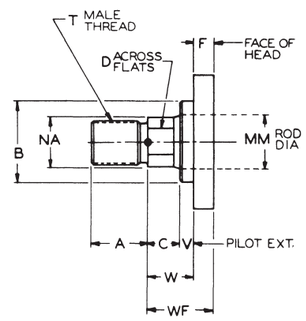
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

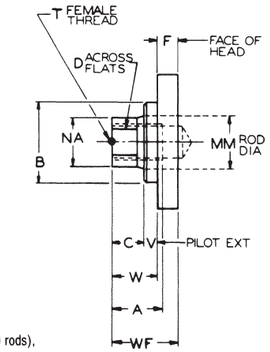
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

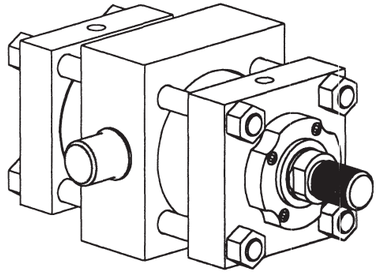


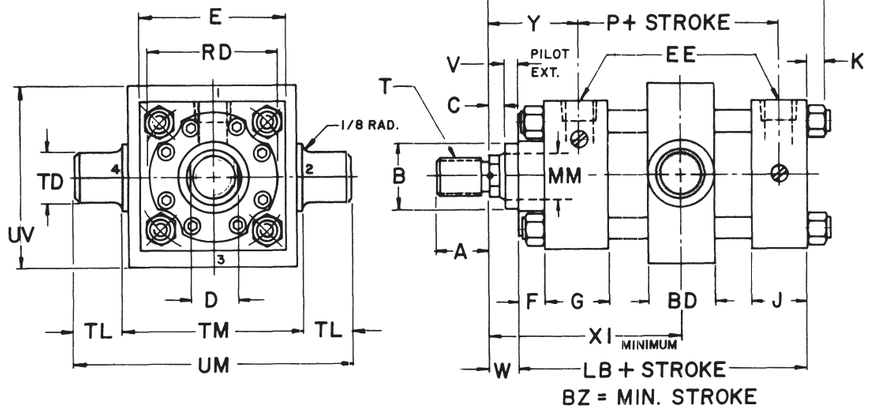
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	LB	P	TD +.000 −.002	TL	TM	UM	UV
1.50	1 25	.25	2.50	#8 (.750-16)	½	.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)	½	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)	½	.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)	¾	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)	¾	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)	¾	.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)	1¼	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)	1½	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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XI (MIN)	Y	ZB	PSI RATING†
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
	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
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	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
	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

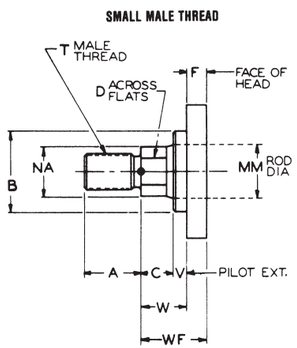
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

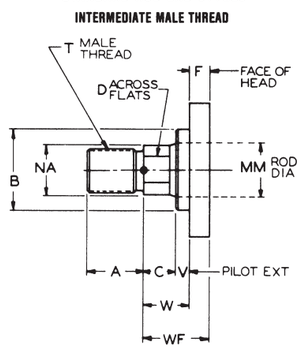
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

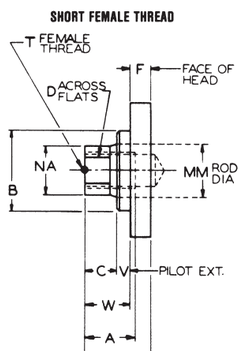
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

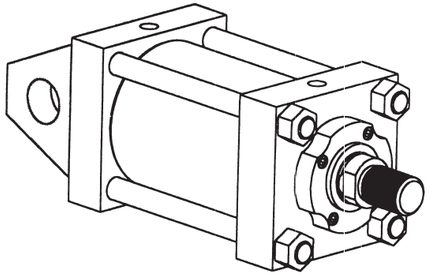


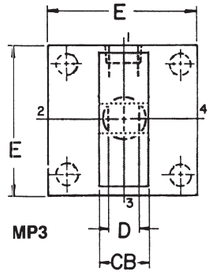
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

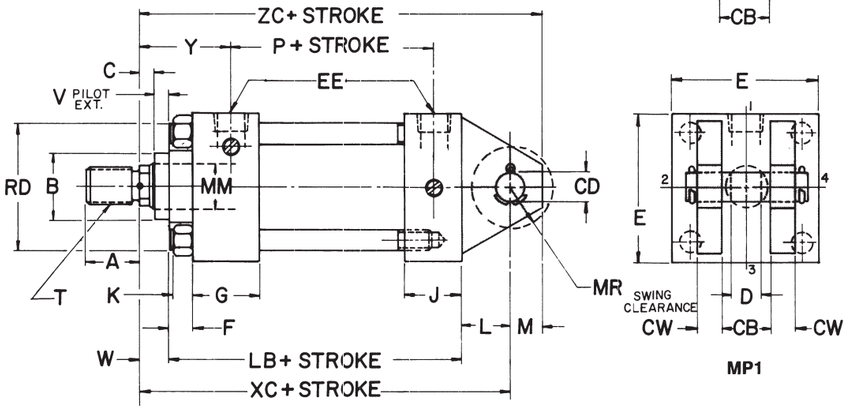
SERIES 2H 1.50"-8.00" Bores

MP1 Fixed Double Ear Clevis Mount
MP3 Fixed Single Ear Clevis Mount

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







MP1

These Dimensions are Constant Regardless of Rod Diameter

BORE	CB†	CD††	CW	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	G	J	K	L	LB	M	MR	P
1.50	75	50	50	2.50	#8 (.750-16)	½	.38	1.75	1 50	.31	.75	5.00	50	.62	2.88
2.00	1.25	75	.62	3.00	#8 (.750-16)	½	.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)	½	.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)	¾	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)	¾	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)	¾	.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)	1¼	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)	1½	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.

Series 2H and 3L Hydraulic Cylinders

MP1, MP3

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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XC	Y	ZC	PSI RATING†
1.50	D	.62	.75	1.125	.38	.50	.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	-	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	-	.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	-	1.00-14	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	-	.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	-	1.00-14	1.25-12	1.00-14	38	1.00	7.62	2.62	8.38	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	7.88	2.88	8.62	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	8.62	2.75	9.62	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	8.88	3.00	9.88	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	9.00	3.12	10.00	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	9.75	3.00	11.12	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	9.88	3.12	11.25	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	10.12	3.38	11.50	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	10.50	3.12	12.25	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	10.75	3.38	12.50	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	10.75	3.38	12.50	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	10.75	3.38	12.50	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	12.12	3.50	14.12	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	12.12	3.50	14.12	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	12.12	3.50	14.12	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	12.12	3.50	14 12	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	13.75	3.81	16.25	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	3.81	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	13.75	3.81	16.25	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	13.75	3.81	16.25	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	13.75	3.81	16.25	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	15.00	3.94	17 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	15.00	3.94	17.75	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	15.00	3.94	17.75	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	15.00	3.94	17 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	15.00	3.94	17 75	3000

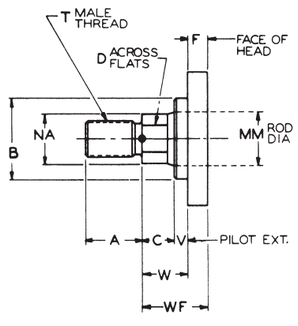
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

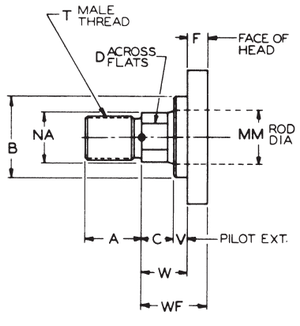
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

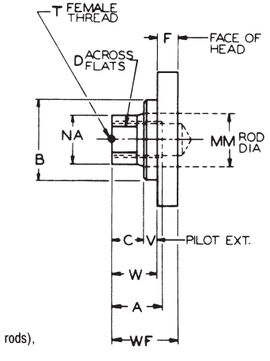
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



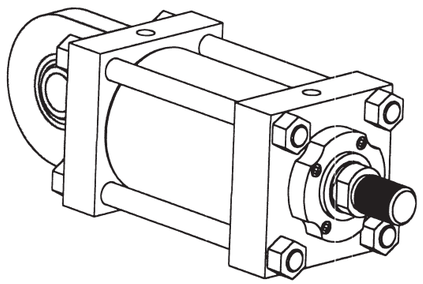
SHORT FEMALE THREAD

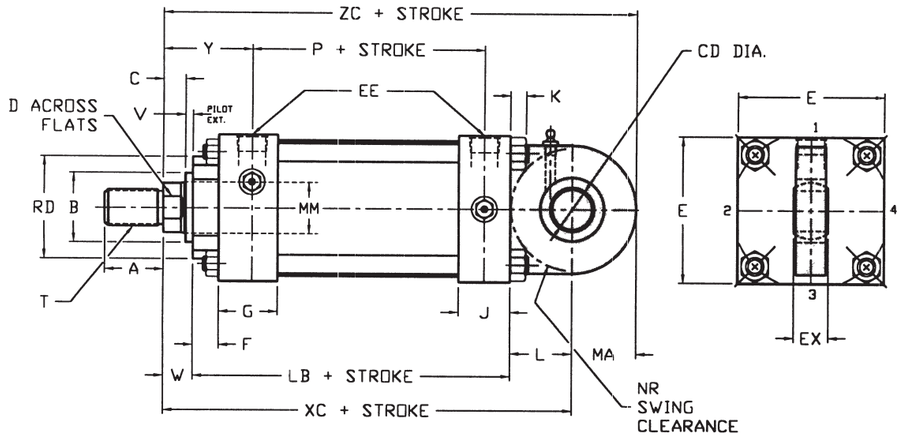


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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 SAE STRAIGHT THREAD	EE NPTF**	EX	F	G	J	K	L	LB	MA	NR	P
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	8.38*	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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XC	Y	ZC	PSI RATING†
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
	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
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 62	2.75	10 25	1500
	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
	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
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	10.50	3.12	13.31	2000
	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
	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
	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

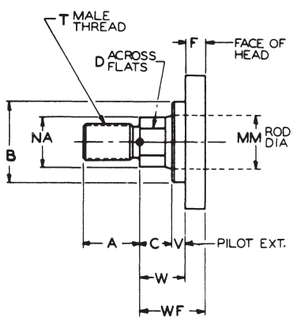
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

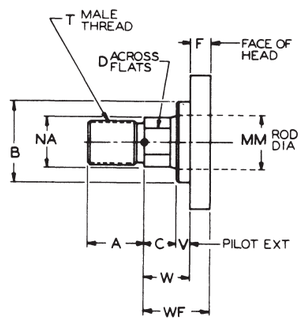
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

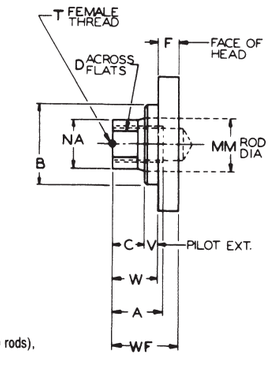
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



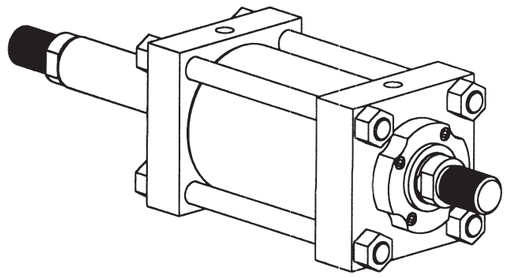
SHORT FEMALE THREAD

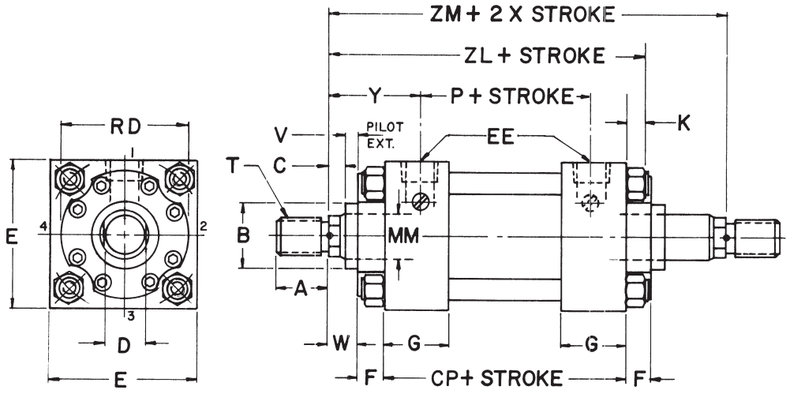


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

SERIES 2H 1.50″-8.00″ Bores

MXO-D Double Rod End†





These Dimensions are Constant Regardless of Rod Diameter

BORE	CP	E	EE SAE STRAIGHT THREAD	EE NPTF**	F	G	K	P
1.50	4 88	2 50	#8 (750-16)	½	.38	1.75	.31	2.88
2.00	4 88	3 00	#8 (.750-16)	½	.62	1 75	44	2 88
2.50	5.00	3 50	#8 (750-16)	½	62	1 75	.44	3.00
3.25	5.75	4 50	#12 (1.062-12)	¾	.75	2.00	56	3.50
4.00	6 00	5 00	#12 (1 062-12)	¾	.88	2 00	.56	3 75
5.00	6 50	6.50	#12 (1.062-12)	¾	.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)	1¼	1.00	2.75	1 00	5.38
8.00	9 50	9 50	#24 (1 875-12)	1½	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."

Series 2H and 3L Hydraulic Cylinders

MXO-D

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) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZL	ZM	PSI RATING†
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
	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	9.50	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
	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	10.50	11.88	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	3.81	11.75	13.00	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	3.81	11.75	13.00	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	3.81	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

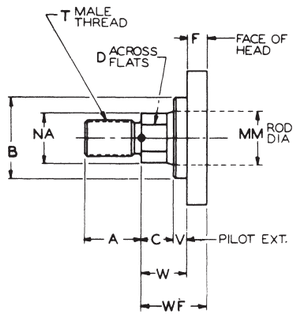
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

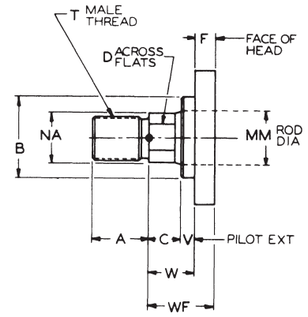
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

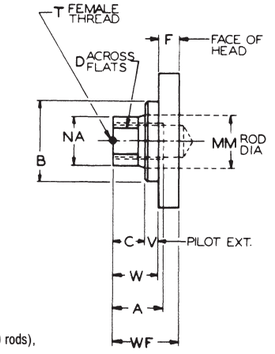
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



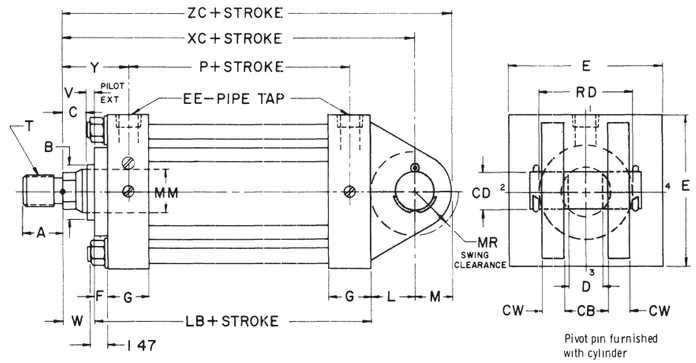
SHORT FEMALE THREAD



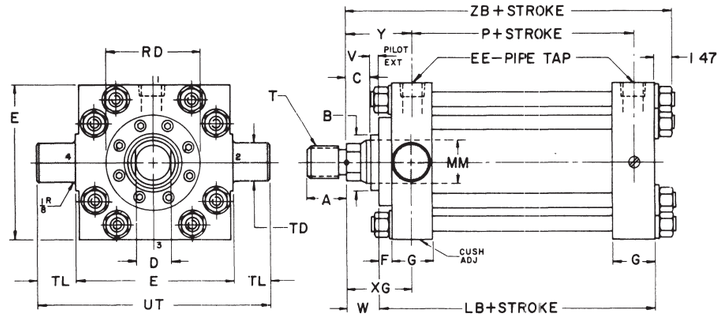
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1.38-5.50 rods)

SERIES 2H 10.00"-14.00" Bores

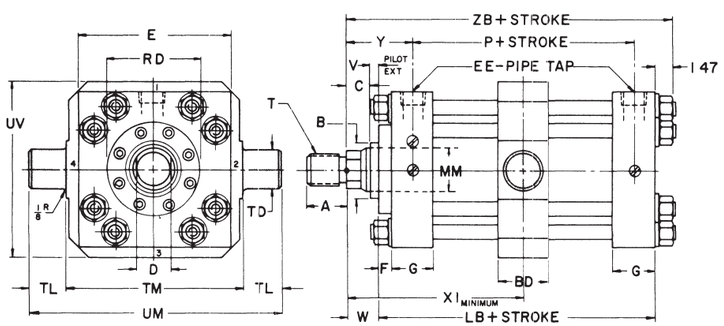
MP1 Fixed Clevis Mount



MT1 Head Trunnion Mount



MT4 Intermediate Fixed Trunnion Mount



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

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

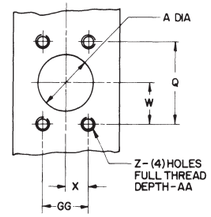
MP1, MT1, MT4

These Dimensions are Constant Regardless of Rod Diameter

BORE	BD	CB +.016 +.047	CD	CW	E	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	G	L	M	MR	P	TD +.000 -.002	TL	TM	UM	UT	UV
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

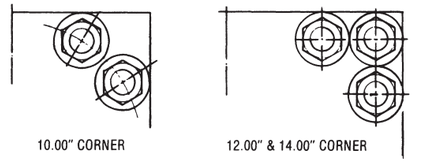
* N.P.T.F. Ports are furnished as standard.
** Optional S.A.E. Flange Ports may be specified—Flange furnished by customer.

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

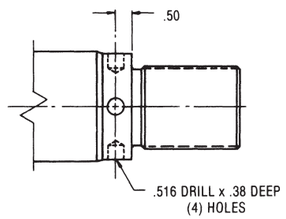


NOM. FLANGE SIZE	A	Q	GG	W	X	Z-THD. UNC-2B	AA MIN.
1-1/2	1 50	2 750	1 406	1.38	0.70	1/2-13	1.06
2	2.00	3 062	1.688	1 53	0 84	1/2-13	1.06
2-1/2	2 50	3 500	2.000	1.75	1.00	1/2-13	1.19

TIE ROD CONSTRUCTION



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



Dimensions are Affected by the Rod Diameter

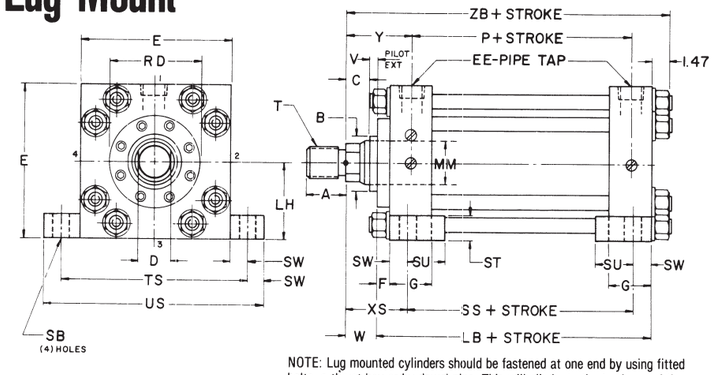
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	XC	XG	XI MIN.	Y	ZB	ZC	PSI RATING† MP1	MT1 MT2	MT4
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	19.06	4.75	8.94	4.75	16.53	22.56	3000	1365	1825
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	19.31	5.00	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	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	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	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	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	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	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 toleranced. 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

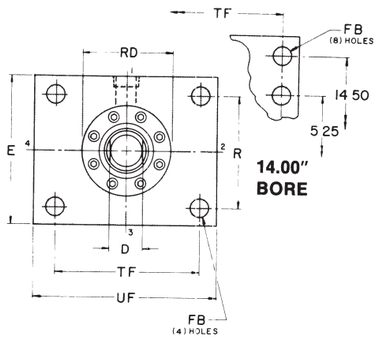
MS2 Side Lug Mount



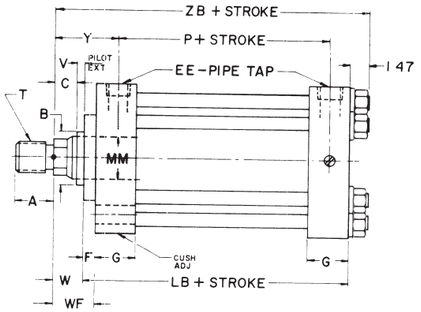
NOTE: Lug mounted cylinders should be fastened at one end by using fitted bolts, a thrust key or by dowel pins. This will eliminate the tendency of the cylinder to shift when pushing or pulling

ME5 Head Flange Mount

10.00" & 12.00" BORE

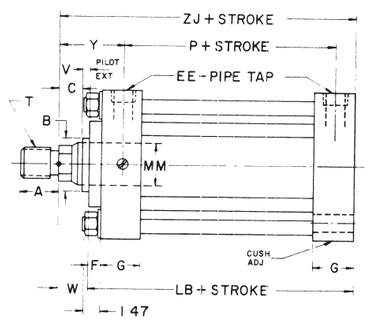


14.00" BORE

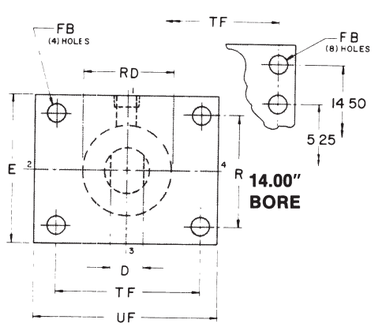


ME6 Cap Flange Mount

10.00" & 12.00" BORE



14.00" BORE



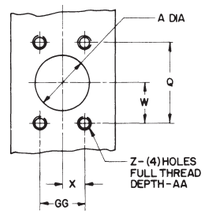
MS2, ME5, ME6

These Dimensions are Constant Regardless of Rod Diameter

BORE	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	E	FB	G	LH -.006 -.008	P	R	SB	SS	ST	SU	SW	TF	TS	UF	US
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

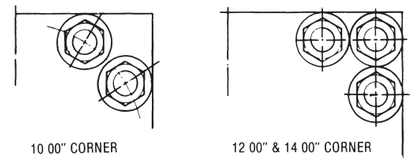
* N.P T.F. Ports are furnished as standard
** Optional S A E Flange Ports may be specified—Flange furnished by customer

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

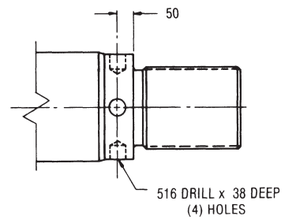
TIE ROD CONSTRUCTION



10 00" CORNER

12 00" & 14 00" CORNER

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 toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

HOW TO ORDER

SERIES 3L MEDIUM-DUTY HYDRAULIC CYLINDERS

MF1 * -3L-CC-2.00"-9.00"-FSM1G

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
- 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
Hydraulic 3L

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 —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 Viton Expander, Viton Tube Seals ..... H

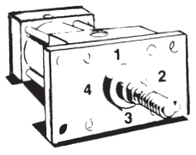
NOTE: Cushion needles furnished with viton seals.

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

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.



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

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.

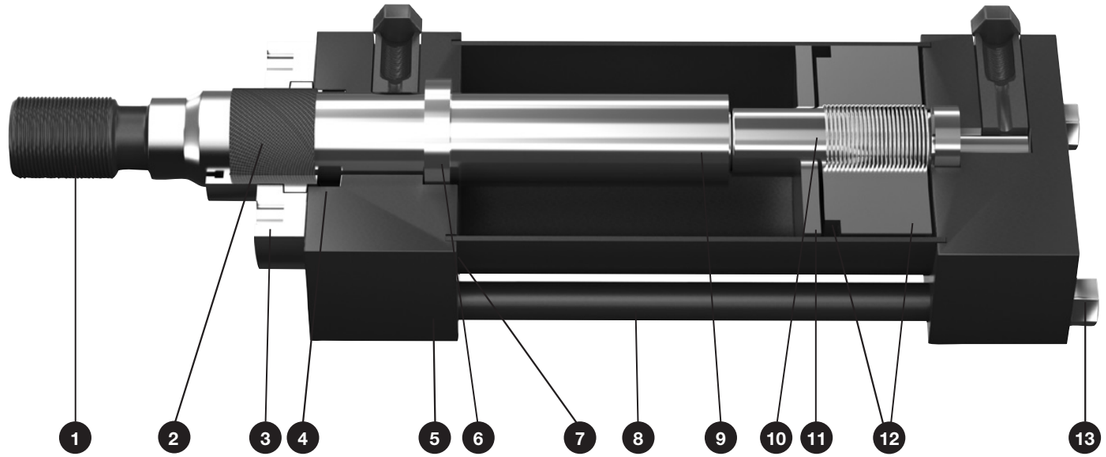
Extensive laboratory testing and countless field applications have proved conclusively that 3L cylinders provide millions of maintenance-free cycles. The reason: the combination of Hanna's unique Duralon® rod bearing and our glass-filled Teflon® piston seal with a bronze-impregnated bearing strip completely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

Series 2H and 3L Hydraulic Cylinders

Series 2H and 3L Hydraulic Cylinders



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 anerobic adhesive, torqued and pinned.

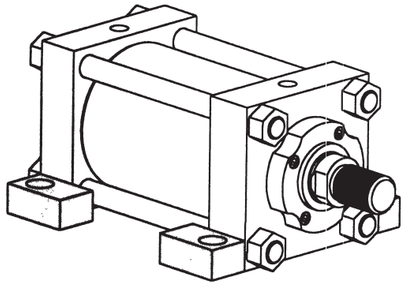
11. Piston
One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

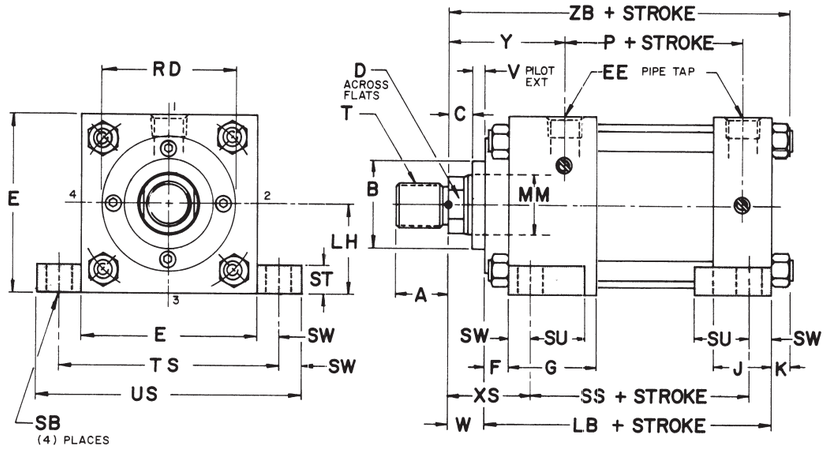
12. Piston Sealing System
Hanna's glass-filled, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with U-cup type seals. A bronze-filled Teflon bearing strip provides a non-metallic bearing point on the piston, assuring long life 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	2.00 2.50	3/8 3/8	.38 .38	1.50 1.50	1.00 1.00	.25 .31	4.00 4.00	1.000 1.250	2.31 2.31	.438 .438	2.88 2.88	.50 .50	.94 .94	.38 38	2.75 3.25	3.50 4.00
2.50 3.25	3.00 3.75	3/8 1/2	.38 62	1.50 1.75	1 00 1.25	.31 .38	4.12 4.88	1.500 1.875	2.44 2.69	.438 562	3.00 3.25	.50 75	.94 1.25	.38 .50	3.75 4.75	4.50 5.75
4.00 5.00	4 50 5.50	1/2 1/2	.62 .62	1.75 1.75	1.25 1.25	.38 .44	4.88 5.12	2.250 2.750	2.69 2.94	.562 .812	3.25 3.12	.75 1 00	1.25 1.56	.50 69	5.50 6.88	6.50 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

Dimensions are Affected by the Rod Diameter

MS2

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B −.001 −.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	PSI RATING†
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[1]	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
	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
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
	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
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	2.31	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
	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

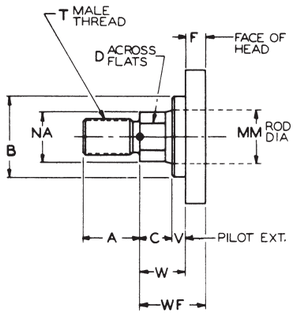
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

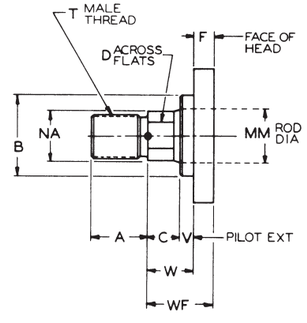
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

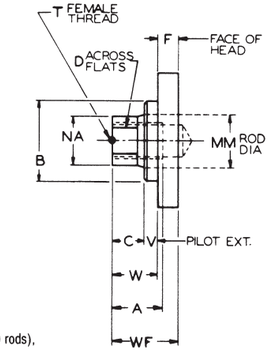
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



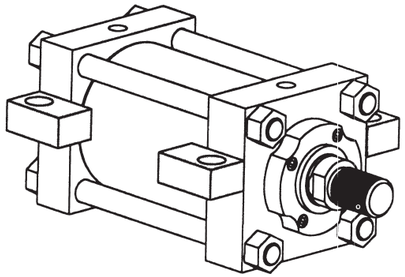
SHORT FEMALE THREAD

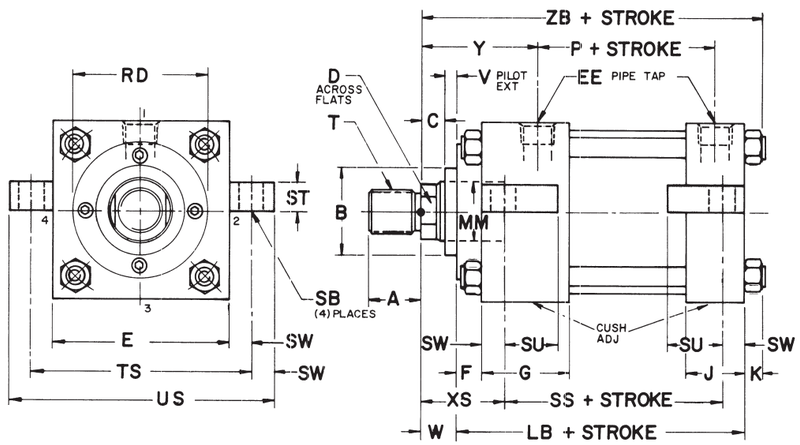


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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	2 00 2 50	3/8 3/8	.38 .38	1.50 1 50	1 00 1.00	.25 31	4.00 4 00	2 31 2 31	438 .438	2.88 2 88	50 50	94 .94	.38 38	2 75 3.25	3 50 4.00
2.50 3.25	3 00 3 75	3/8 1/2	38 62	1 50 1.75	1.00 1.25	31 .38	4 12 4.88	2 44 2 69	438 562	3.00 3.25	.50 .75	94 1 25	.38 .50	3.75 4.75	4.50 5.75
4.00 5.00	4 50 5.50	1/2 1/2	62 62	1 75 1 75	1 25 1 25	38 44	4 88 5 12	2 69 2 94	562 .812	3 25 3 12	.75 1 00	1 25 1.56	50 69	5 50 6.88	6.50 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

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	PSI RATING†
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
	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
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
	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
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	2.31	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
	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

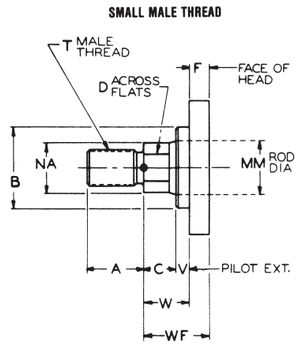
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

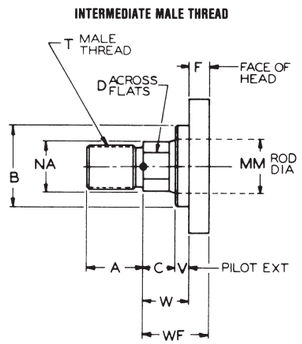
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

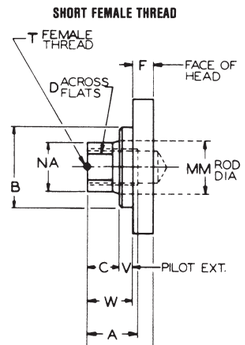
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



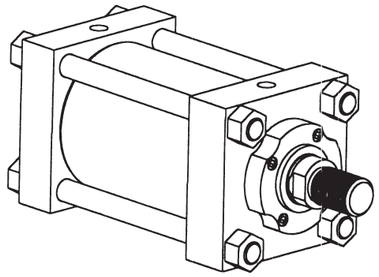
SHORT FEMALE THREAD

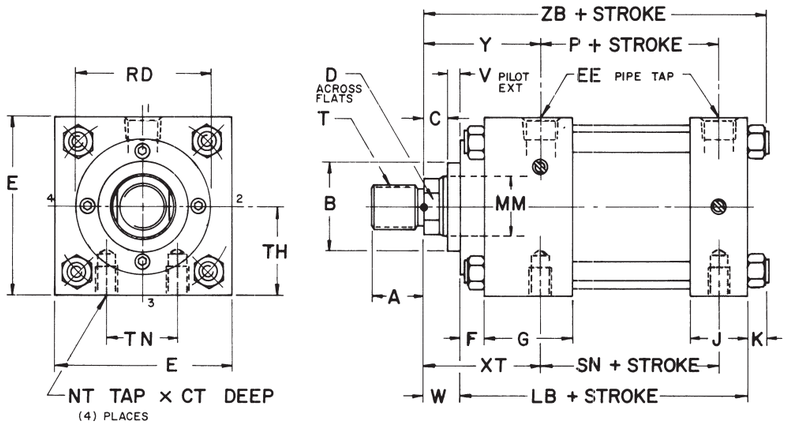


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5 50 rods)

SERIES 3L 1.50"-6.00" Bores

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

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	*CT	XT	Y	ZB	PSI RATING†
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	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	-	-	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	.50	3.06	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	2.44	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
	K	2 50	3.00	3.125	1.00	2.06	-	1.88-12	2.25-12	1.88-12	62	.75	3.31	3.25	6.88	900
5.00	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
	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	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
6.00	G	1.38	1.62	2.000	.62	1.12	4.00	1.00-14	1.25-12	1.00-14	25	1.12	2.81	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	3.06	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	1.12	3.19	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 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

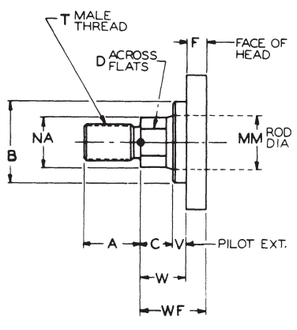
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

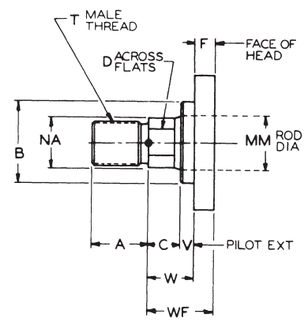
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

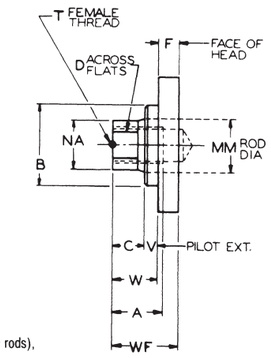
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



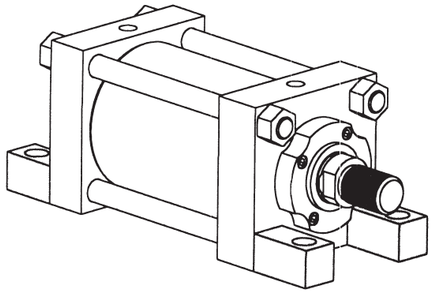
SHORT FEMALE THREAD

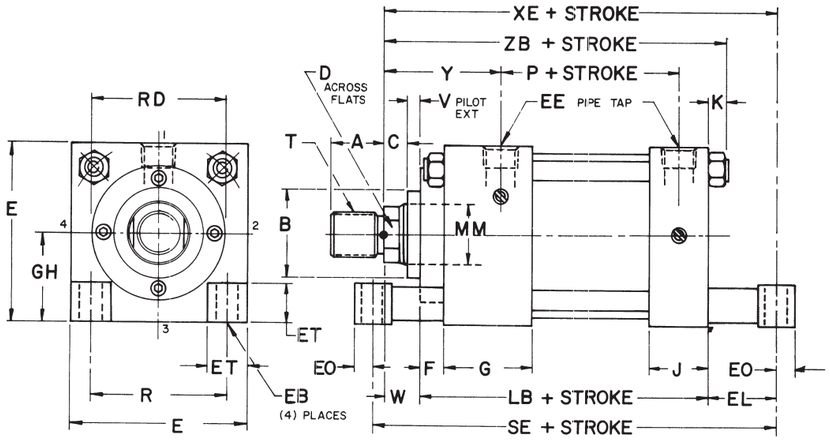


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XE	Y	ZB	PSI RATING†
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
	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	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

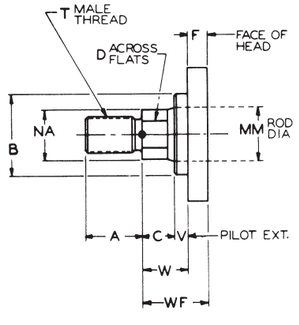
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

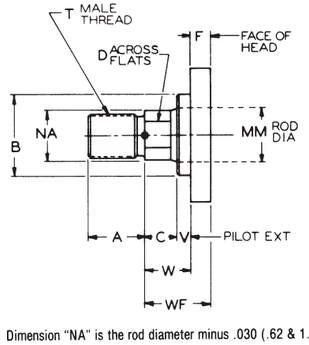
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

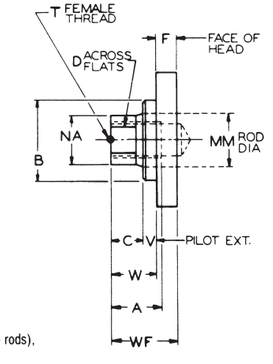
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



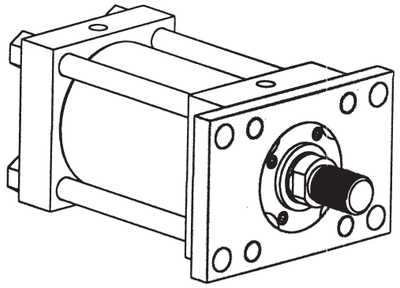
SHORT FEMALE THREAD

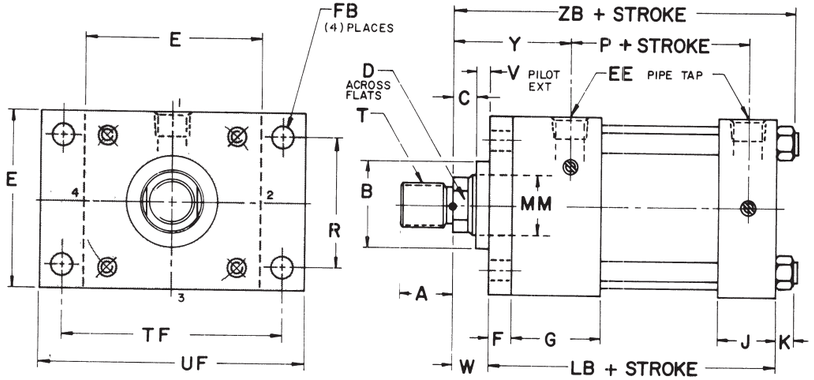


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5 50 rods)

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

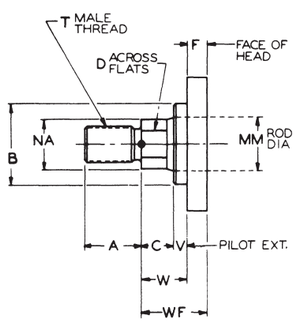
BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
1.50	D	62	75	1.125	.38	.50	44-20	.50-20	44-20	.25	.62	1.00	1.88	4.88	1100
	F	1.00	1 12	1 500	.50	.88	.75-16	88-14	.75-16	50	1 00	1 38	2 25	5 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
	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	800
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	750
	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	650
	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
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	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
	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
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	700
	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.

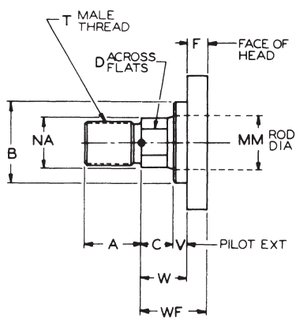
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

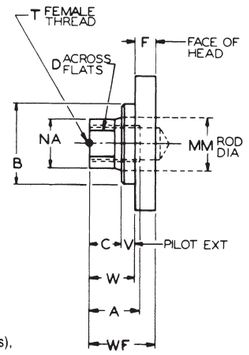
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



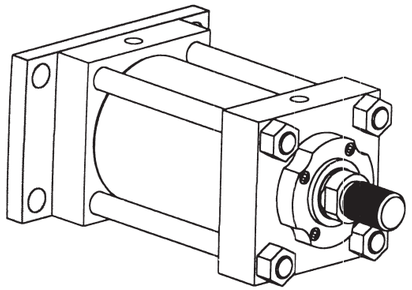
SHORT FEMALE THREAD

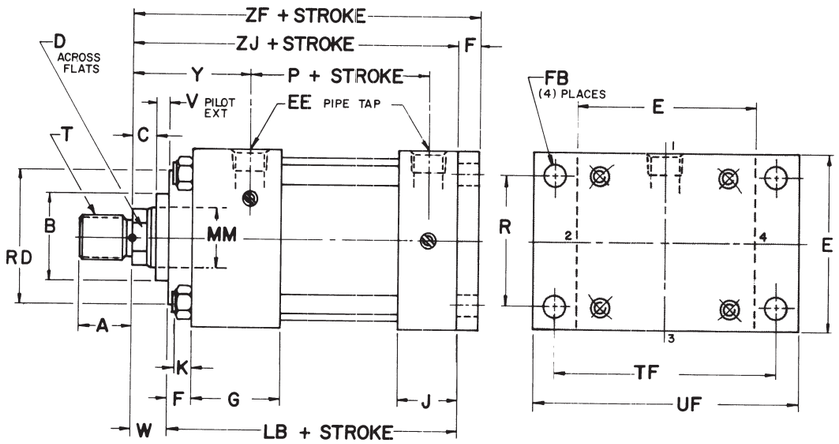


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5 50 rods)

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

Dimensions are Affected by the Rod Diameter

MF2

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZF	ZJ	PSI RATING†
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	-	1.00-14	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
	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
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	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
	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

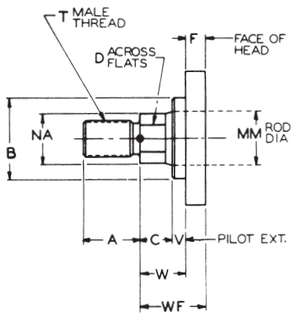
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

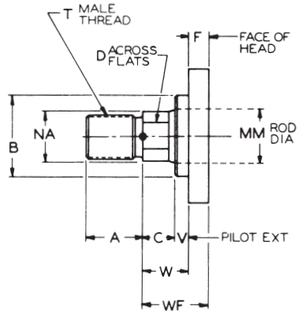
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

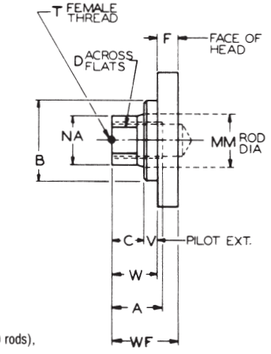
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



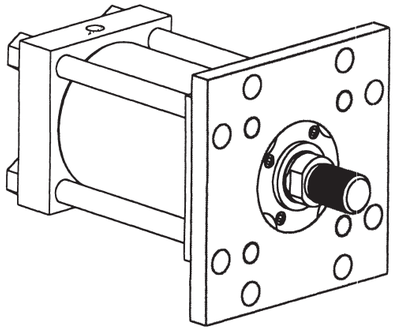
SHORT FEMALE THREAD

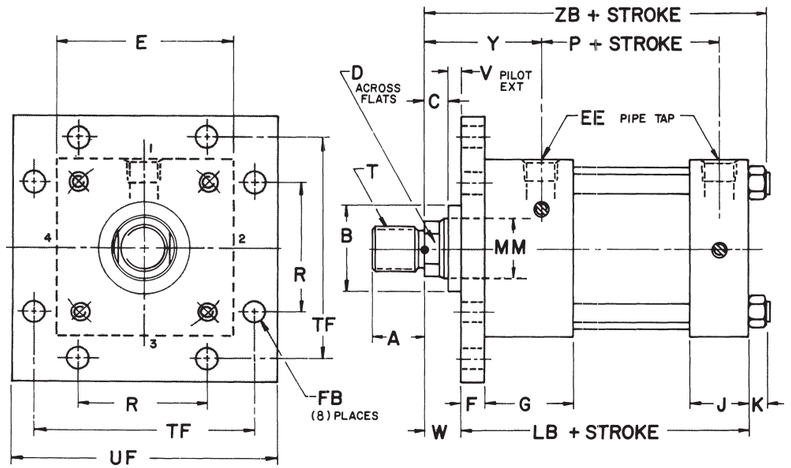


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1.38-5.50 rods)

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

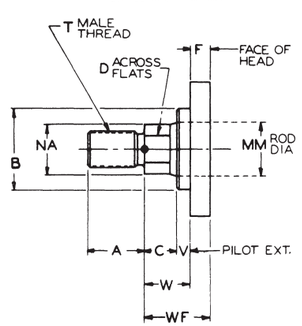
CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	4.88	1800
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	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
	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	.44-20	.50-20	.44-20	.25	.62	1.00	1.88	5.06	1000
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	1.38	2.25	5.44	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
	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	900
	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	900
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	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
	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	3.00	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	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	550
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	750
	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	750
	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	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	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	600
	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	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.

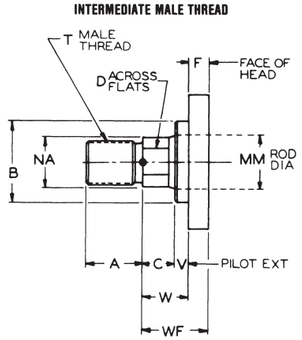
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

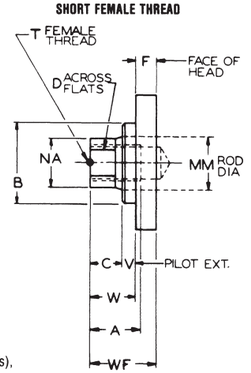
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



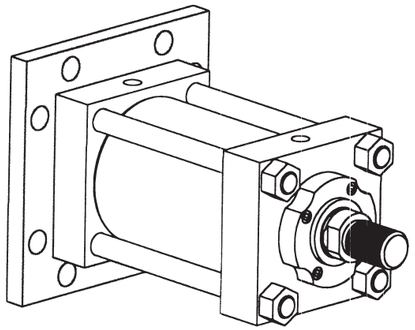
SHORT FEMALE THREAD

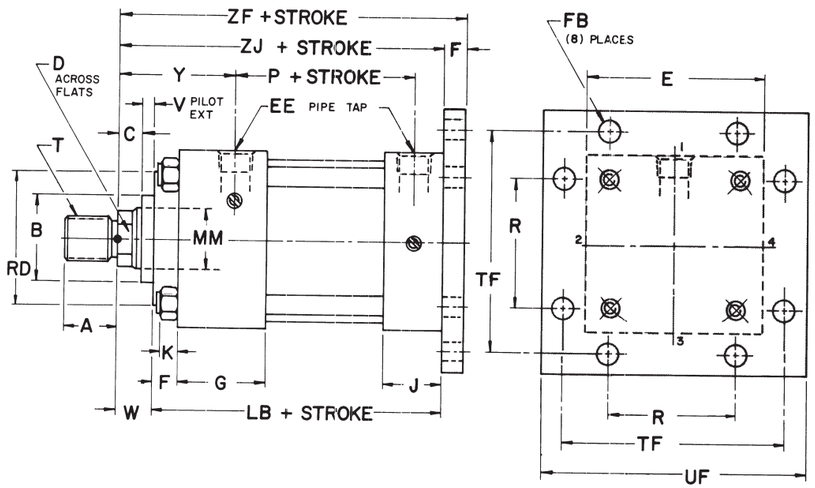


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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	552	2.00	1 50	44	5 75	3.19	4.88	7 62	8 62

Dimensions are Affected by the Rod Diameter

MF6

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZF	ZJ	PSI RATING†
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
	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	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	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
	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

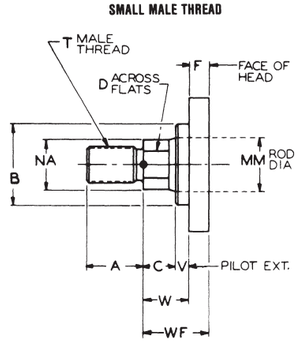
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

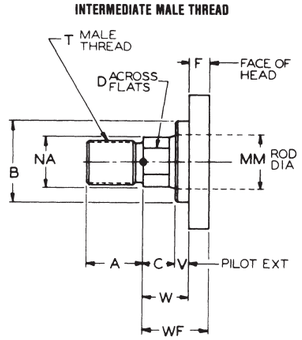
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

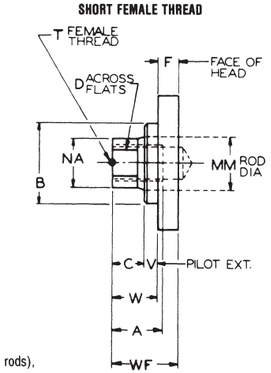
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



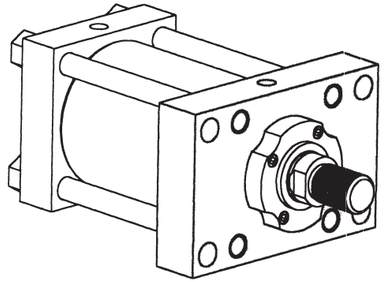
SHORT FEMALE THREAD

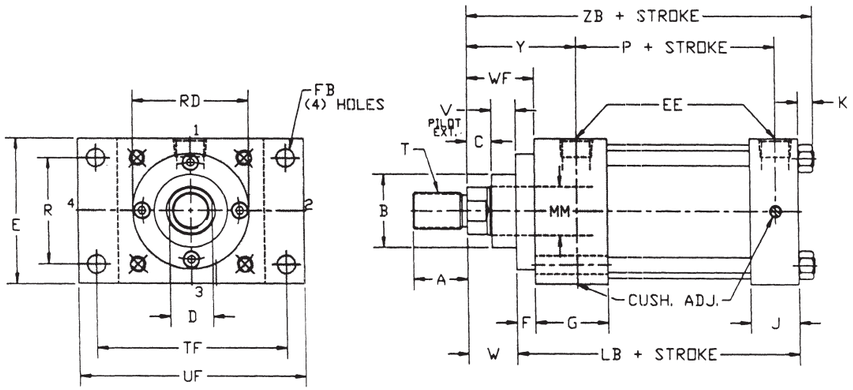


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1.38-5.50 rods)

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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD* ±.005	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	M	3 50	3.50	4.250	1.00	3.00	5.38	2.50-12	3.25-12	2.50-12	.62	1 62	2.25	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	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
	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	750
	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

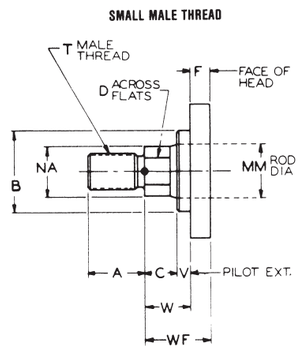
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

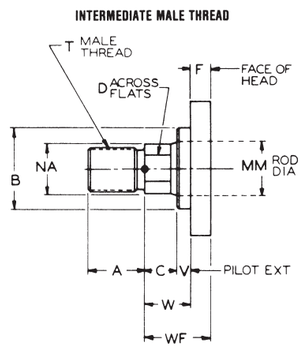
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

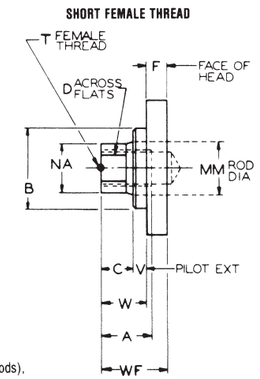
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



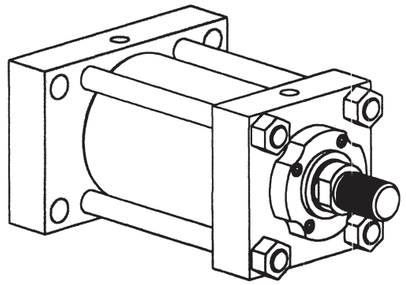
SHORT FEMALE THREAD

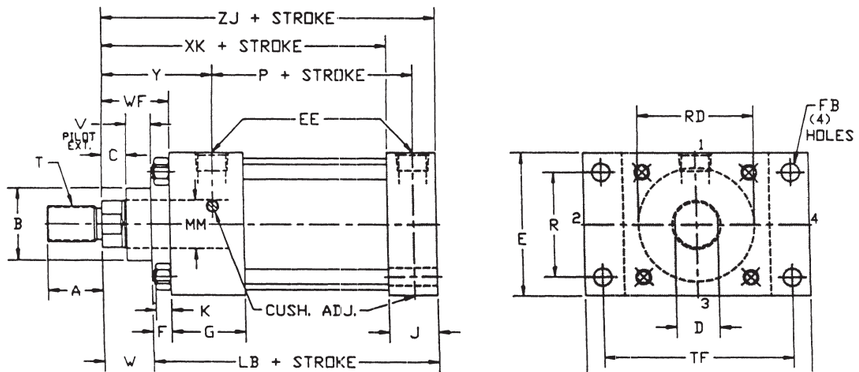


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5 50 rods)

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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	XK	ZJ	PSI RATING†
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
	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	1800
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	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
	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	4.62	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	4.38	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	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
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	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	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
	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	3.50	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
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
	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	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	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	5.75	7.25	750

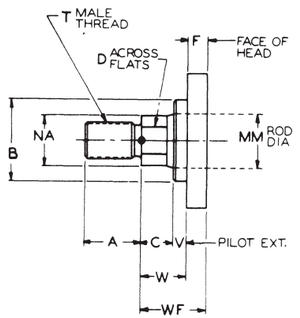
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

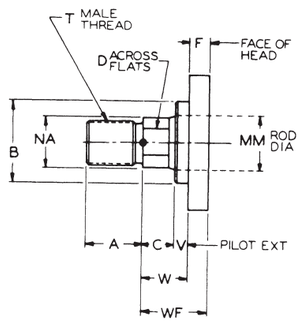
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

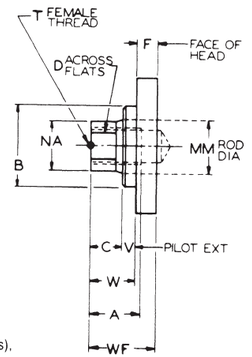
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



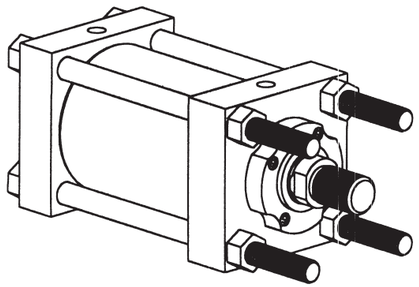
SHORT FEMALE THREAD

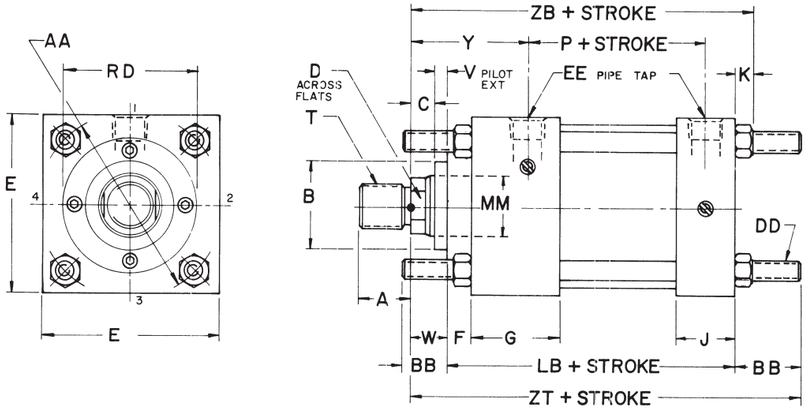


NOTE: Dimension "NA" is the rod diameter minus ,030 (62 & 1.00 rods), minus 062 (1 38-5.50 rods)

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

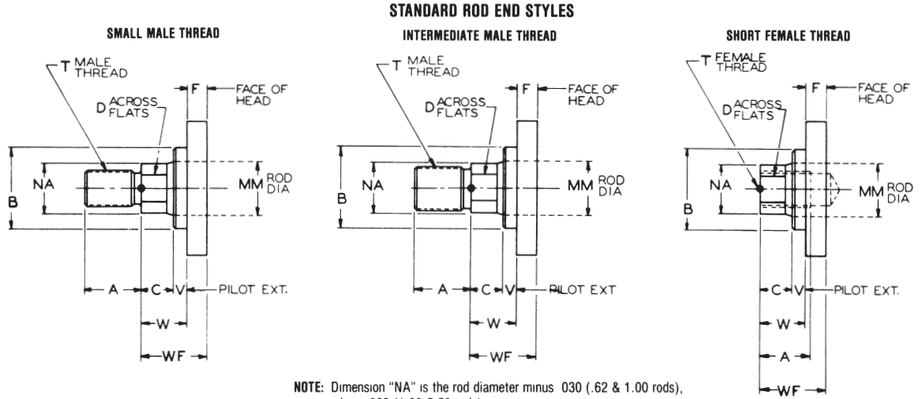
CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZB	ZT	PSI RATING†
1.50	D	62	75	1 125	.38	50	-	.44-20	50-20	44-20	25	.62	1 88	4.88	5 62	1800
	F	1.00	1 12	1 500	.50	.88	-	75-16	88-14	75-16	50	1 00	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	50	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	.62	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	.50	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	.62	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	75	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	50	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	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	50	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	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	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	.50	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	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	.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	.62	1 62	3 25	7 19	8.56	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 25	7.19	8 56	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	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
	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 toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

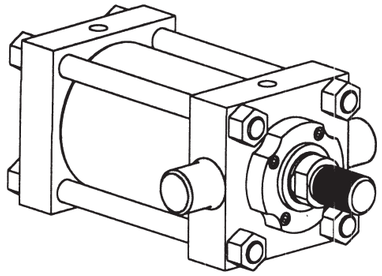
STANDARD ROD END STYLES

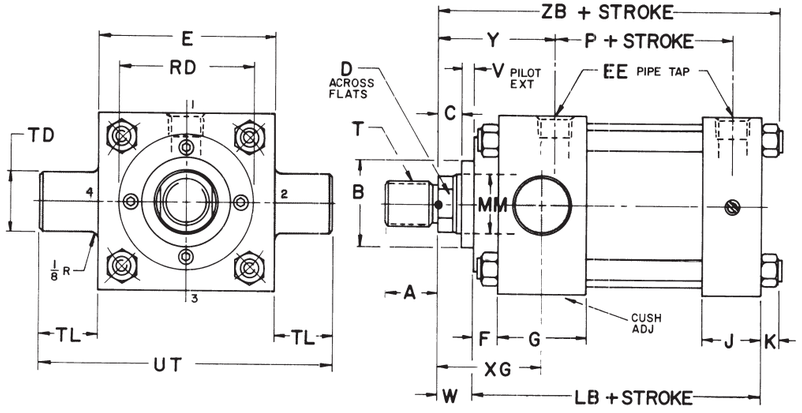


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5.50 rods)

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

Dimensions are Affected by the Rod Diameter

MT1

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XG	Y	ZB	PSI RATING†
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
	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
5.00	F	1 00	1 12	1 500	.50	88	3.00	.75-16	.88-14	75-16	25	.75	2.25	2.38	6.31	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
	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
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	2.62	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
	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 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	3.25	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	3.25	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	3 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	3.25	3.38	7.69	750

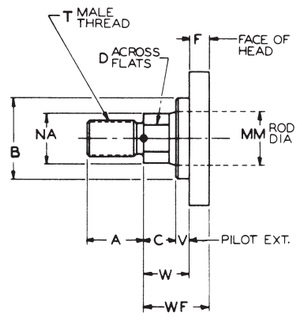
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

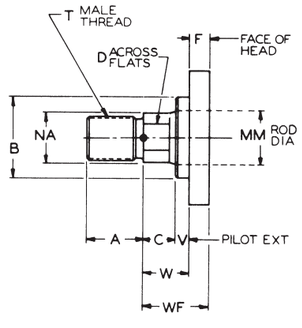
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

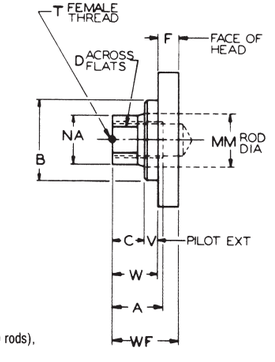
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



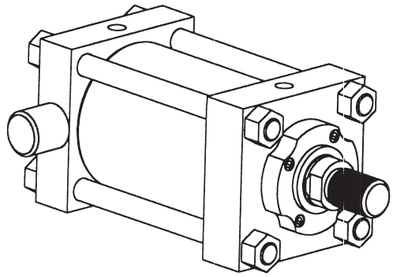
SHORT FEMALE THREAD

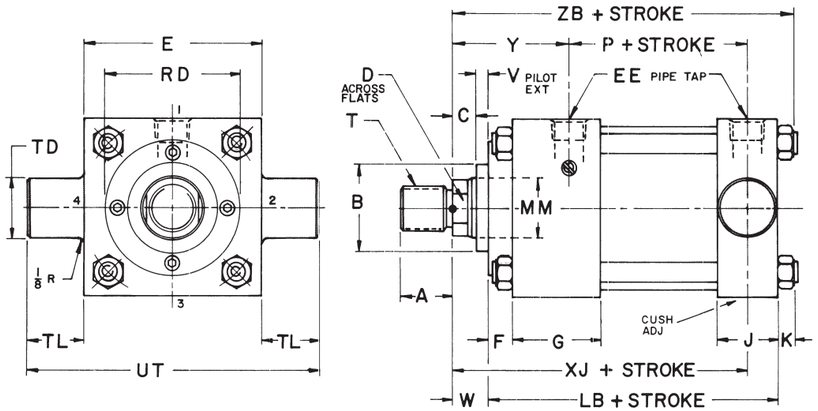


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5.50 rods)

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

Dimensions are Affected by the Rod Diameter

MT2

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XJ	Y	ZB	PSI RATING†
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
	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	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
	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
3.25	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	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	5.25	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	5.50	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	5 62	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	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
	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	900
	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	900
	K	2 50	3 00	3 125	1 00	2 06	-	1 88-12	2 25-12	1 88-12	62	1 62	5 88	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	5 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	5 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	5 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	5 88	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	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
	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
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	5.88	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	6 12	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	6 25	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	6 50	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	6 50	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	6 50	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	6 50	3 38	7 69	750

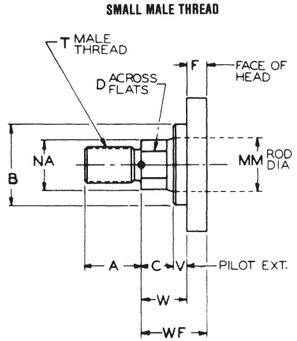
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

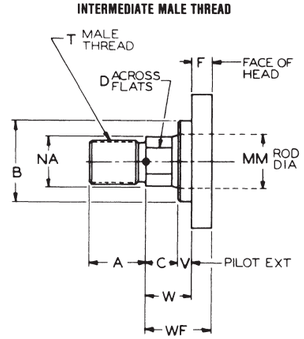
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

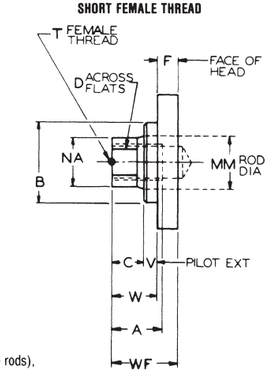
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



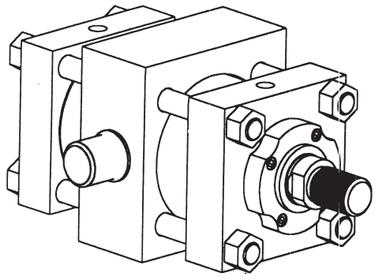
SHORT FEMALE THREAD



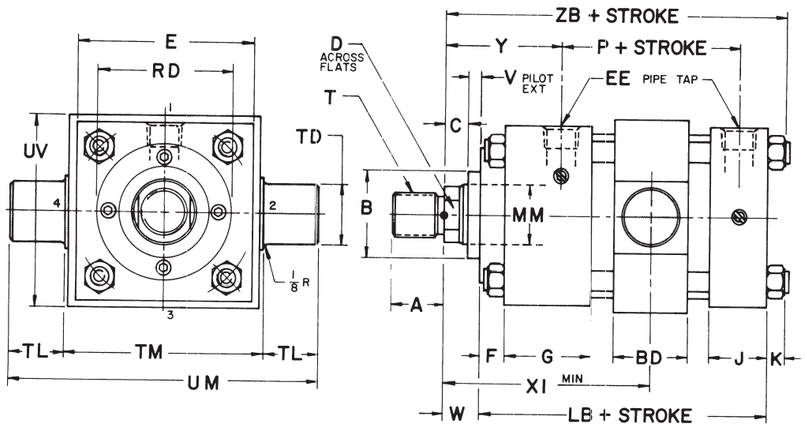
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5 50 rods)

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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XI (MIN)	Y	ZB	PSI RATING†
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
	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	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
	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
3.25	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	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	4 38	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	4.62	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	4 75	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	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
	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
	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
5.00	F	1.00	1 12	1 500	.50	.88	3.00	75-16	.88-14	75-16	.25	75	4 12	2.38	6.31	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	4 38	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	4 62	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	4 75	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	5 00	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	5 00	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	5 00	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	4.88	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	5.12	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	5 25	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	5.50	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	5 50	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	5 50	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	5.50	3 38	7 69	750

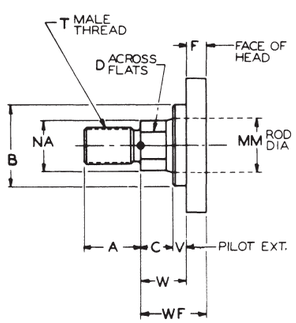
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

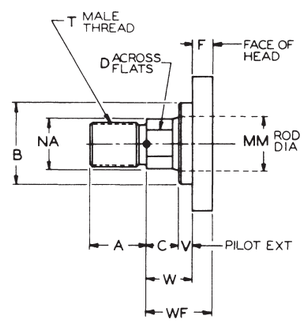
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

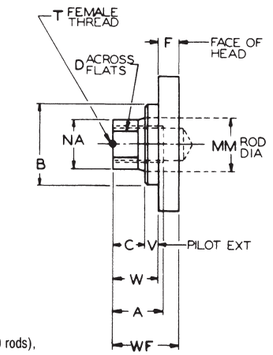
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



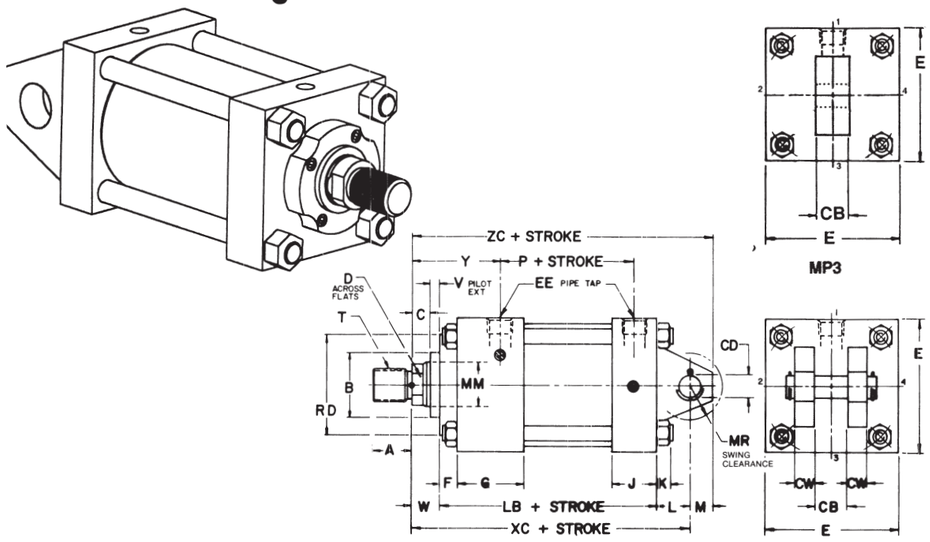
SHORT FEMALE THREAD



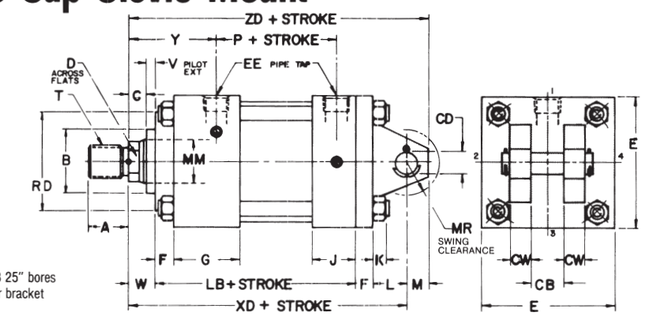
NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1.38-5.50 rods)

SERIES 3L 1.50″-6.00″ Bores

MP1 Fixed Double Ear Clevis Mount
MP3 Fixed Single Ear Clevis Mount



MP2 Detachable Cap Clevis Mount



NOTE: 1.50″, 2 00″ and 3 25″ bores have tapped cap or bracket

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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XC	XD	Y	ZC	ZD	PSI RATING†
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
	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	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
	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	1400
	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	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
	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
4.00	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	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	7 12	7 75	2 62	7 88	8.50	900
	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	900
	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	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 75	8 38	3 25	8 50	9.12	900
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
	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
	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
	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
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	8.12	8.88	2 75	9 12	9.88	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	8.38	9 12	3.00	9 38	10 12	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	8.50	9 25	3 12	9 50	10.25	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 75	9 50	3.38	9.75	10 50	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 75	9.50	3 38	9.75	10 50	750
	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	9 50	3.38	9.75	10.50	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 75	9 50	3 38	9 75	10 50	750

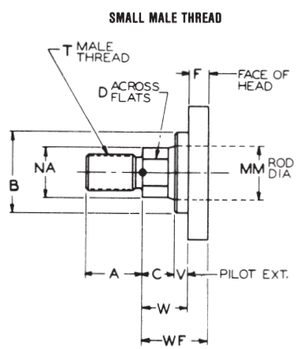
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

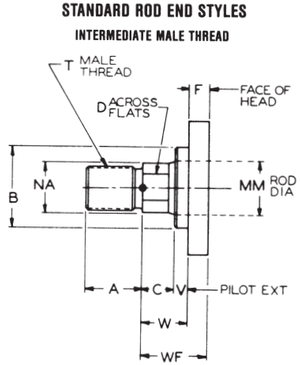
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

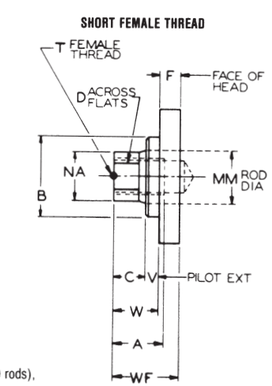
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



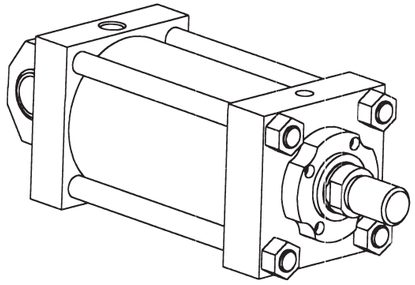
SHORT FEMALE THREAD

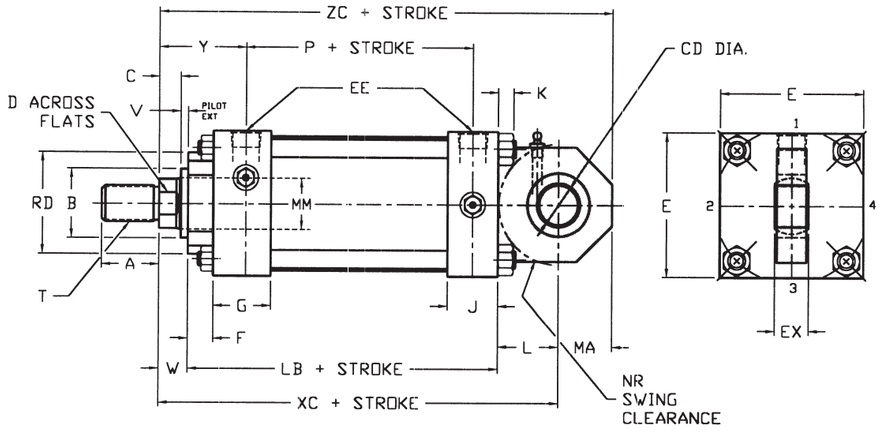


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus 062 (1 38-5 50 rods)

SERIES 3L 1.50"-6.00" Bores

MPU3 Spherical Bearing Mount





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

MPU3

Dimensions Are Affected by Rod Diameter

CYLINDER BORE	ROD DIA CODE	ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE	T (THREAD) SHORT FEMALE SF IM	V	W	XC	Y	ZC	PSI RATING†
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	1.62	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	1 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	-	1.25-12	1.50-12	1.25-12	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	1 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	1.62	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	1 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
	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	3.25	9 25	350
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	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

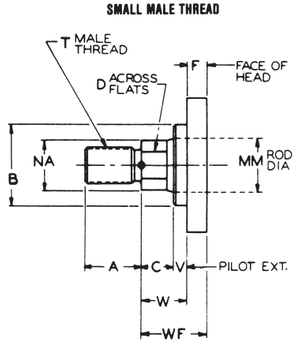
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

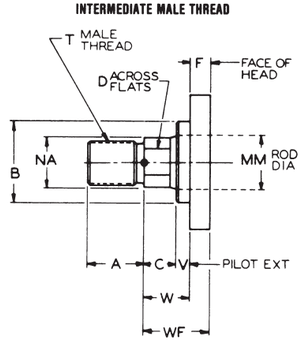
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

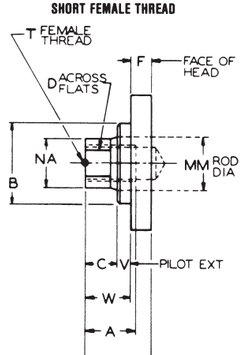
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



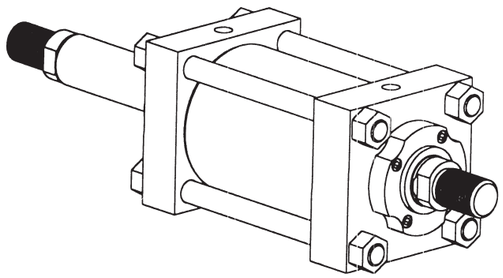
SHORT FEMALE THREAD

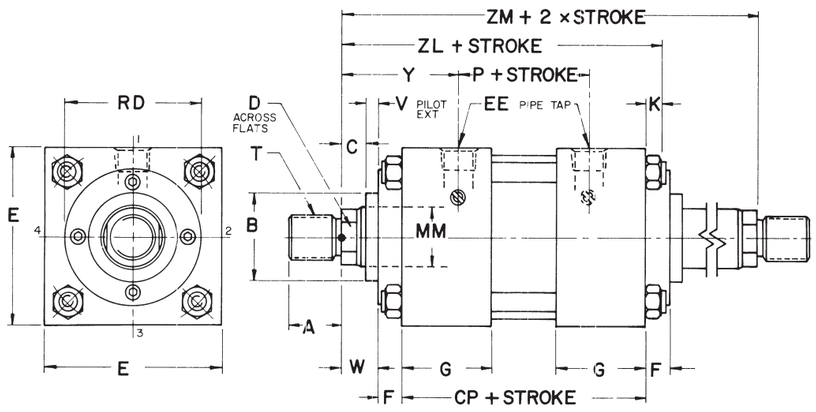


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5 50 rods)

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

CYLINDER								T (THREAD)							
BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF	V	W	Y	ZL	ZM	PSI RATING†
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
	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 44	7 38	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
	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
3.25	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	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 75	8 00	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	7 62	8 50	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	7 75	8 75	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 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
	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
	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 00	9 25	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 81	7 75	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	7 06	8 25	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 94	8 75	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	8 06	9 00	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	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
	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
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	7 56	8 75	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 81	9 25	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 94	9 50	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 94	10 00	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 94	10 00	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 94	10 00	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 94	10 00	750

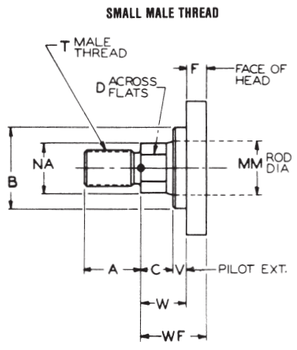
* Where RD is not shown, square retainer is used. See RETAINER PLATE CONSTRUCTION in INSTALLATION, OPERATION AND MAINTENANCE DATA section.

† **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.

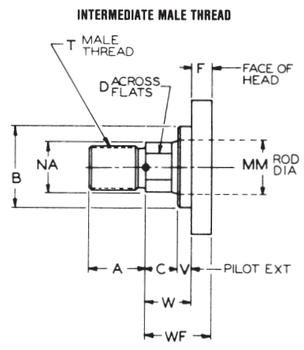
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

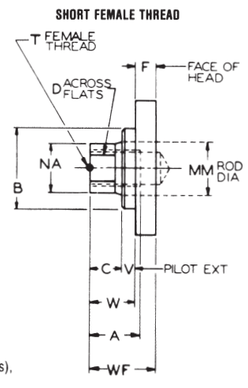
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD



NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), minus .062 (1 38-5 50 rods)

DESCRIPTION **PAGE**

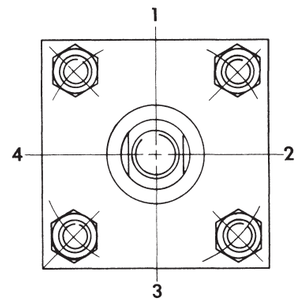
PORT LOCATION

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.

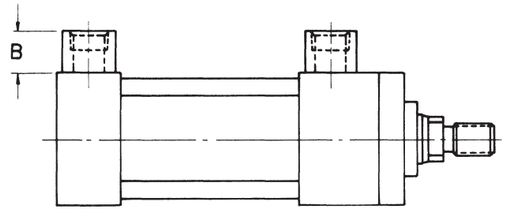
PORT SIZE

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.

NOTE: SEE APPLICATION FIGURES ON NEXT PAGE.

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"

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		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	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".

Series 2H and 3L Hydraulic Cylinders

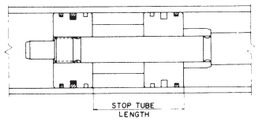
STOP TUBE DATA

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.

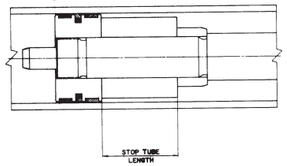
All cylinders cushioned and non-cushioned are supplied with the double piston construction. General construction of cylinder stop tube is illustrated below.

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.

2H CONSTRUCTION

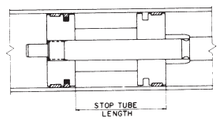


OPTIONAL SINGLE PISTON CONSTRUCTION



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.

3L CONSTRUCTION



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":

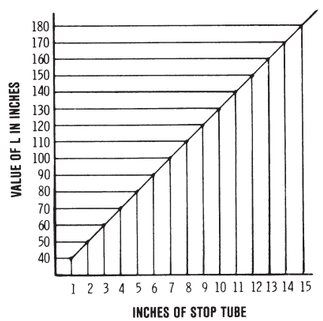
ADD:	MP1	"XC" Dimension	7-3/4"
	V-6	"CE" Dimension	5-1/2"
	Two times stroke (2 x 27)		54"
	Total Value of "L"		67-1/4"

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.

ROD END CONNECTION	
FIXED & WELL GUIDED	FIG 1 D "L" = 0.5 X D
PIVOTED AND WELL GUIDED	FIG. 2 D "L" = 0.7 X D
SUPPORTED NOT WELL GUIDED	FIG 3 D "L" = 2 X D
PIVOTED AND WELL GUIDED	FIG 4 D "L" = 0.7 X D FOR LONG STROKE SUPPORT HEAD HEAD NOT SUPPORTED D "L" = D
	FIG 5 D "L" = 0.7 X D
	FIG 6 D "L" = D
	FIG 7 D "L" = D
	FIG 8 D D "L" = D

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 X 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 x 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 x 1250 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 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	Gallons of Oil Consumed Per Inch of Travel
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

Force (pounds) = Cylinder Piston Area (in square inches) X 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 X 1000
F = 12,560 lbs.

Series 2H and 3L Hydraulic Cylinders

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. 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	Gallons of Oil Consumed Per Inch of Travel
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.)**

SERIES 2H

Bore	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

SERIES 3L

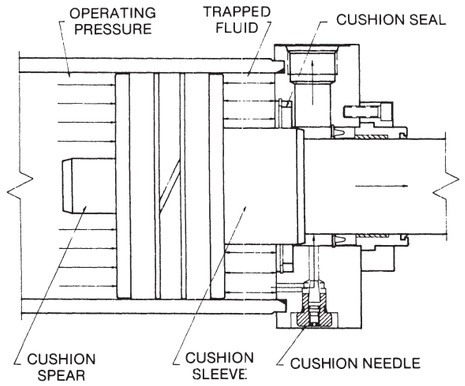
Bore	3:1 Factor of Safety	4:1 Factor of Safety
1 50	1915	1435
2 00	1200	900
2 50	750	560
3.25	1180	885
4 00	790	595
5.00	600	460
6.00	650	490

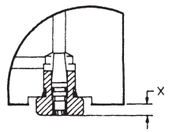
Models MF1, MF2, MF5 and MF6 may carry lower Pressure Ratings in some cases. Refer to the appropriate catalog pages for exact ratings on these Models.

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.

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

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

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 alsc 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.

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.

DETERMINING ENERGY OF THE APPLICATION

Things to consider:
1. Kinetic energy.
2. Propelling energy (including gravity).

I. To solve for kinetic energy:
0.1865 x W x V² = 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 x 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 x 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 ± 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.

Series 2H and 3L Hydraulic Cylinders

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 1 00	73 .84	4,840 3,250	74	6,310
2 00	1 00 1.38	73 73	7,845 5,545	74	10,900
2.50	1 00 1.38 1 75	73 73 73	11,990 8,510 8,510	74	17,430
3 25	1.38 1.75 2.00	.77 77 77	17,470 17,470 13,970	83	32,280
4.00	1 75 2.00 2.50	77 .77 .77	33,910 28,525 28,525	83	50,190
5 00	2.00 2.50 3.00 3 50	77 77 77 77	47,230 47,230 25,690 25,690	77	71,760
6 00	2 50 3.00 3 50 4.00	88 88 .88 88	91,995 48,475 48,475 47,475	96	127,930
7.00	3.00 3.50 4.00 4.50 5.00	1.25 1 25 1.25 1.22 1.22	132,670 132,670 132,670 79,780 79,780	1 39	249,570
8.00	3.50 4.00 4.50 5.00 5 50	1.38 1.38 1.35 1 35 1 35	227,750 227,750 136,320 136,320 136,320	1 46	339,515
10.00	4 50 5.00 5.50 7.00	1 83 1.83 1.83 1 83	438,100 438,100 438,100 341,110	1 84	677,440
12 00	5.50 7.00 8.00	2.58 2.58 2.58	1,063,430 926,710 769,700	2.09	1,130,050
14 00	7 00 8 00 10.00	2 58 2.58 2 58	1,453,540 1,296,550 921,750	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 1 00	62 N/A	2,050 N/A	.50	2,130
2 00	.62 1 00 1.38	62 62 N/A	3,495 3,495 N/A	50	3,850
2.50	62 1.00 1.38 1.75	.62 .62 62 N/A	3,740 3,740 3,050 N/A	50	3,635
3 25	1.00 1.38 1.75 2.00	.81 .81 .81 .81	10,810 10,810 7,350 7,350	61	9,730
4 00	1 00 1.38 1 75 2.00 2.50	81 81 81 .81 .81	8,865 8,865 7,140 7,140 5,800	61	7,470
5.00	1.00 1.38 1.75 2.00 2.50 3 00 3.50	.81 .81 .81 .81 .81 .81 .81	11,670 11,670 10,290 10 290 9,216 6,035 6,035	.61	9,425
6 00	1 38 1.75 2.00 2 50 3.00 3.50 4 00	.81 81 81 81 81 81 .81	19,430 17,875 17,875 16,670 13,350 13,350 11,164	73	18,180

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 x 4000 lbs. x (3)²
746 x 9 = 6714 in. lbs.
Propelling Energy:
8.29 x 1000 x .77 = 6383
Total Application Energy:
6714 + 6383 = 13097 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.

INSTALLATION, OPERATION AND MAINTENANCE DATA

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.

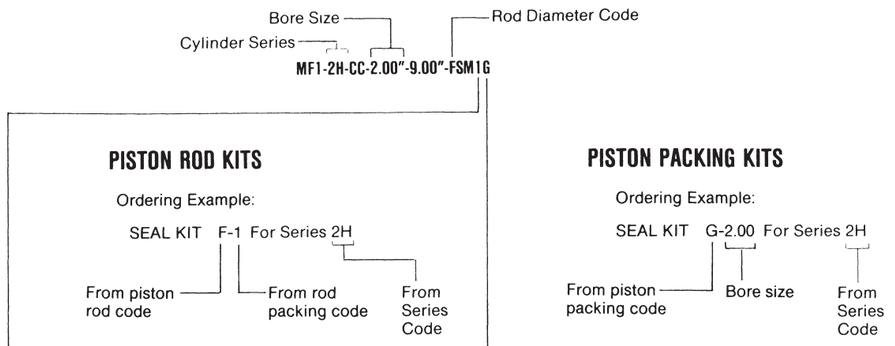
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned 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



PISTON ROD KITS

Ordering Example:

SEAL KIT F-1 For Series 2H

- F-1: From piston rod code
- From rod packing code
- For Series 2H: 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.

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.

PISTON PACKING KITS

Ordering Example:

SEAL KIT G-2.00 For Series 2H

- From piston packing code
- G-2.00: Bore size
- For Series 2H: 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.

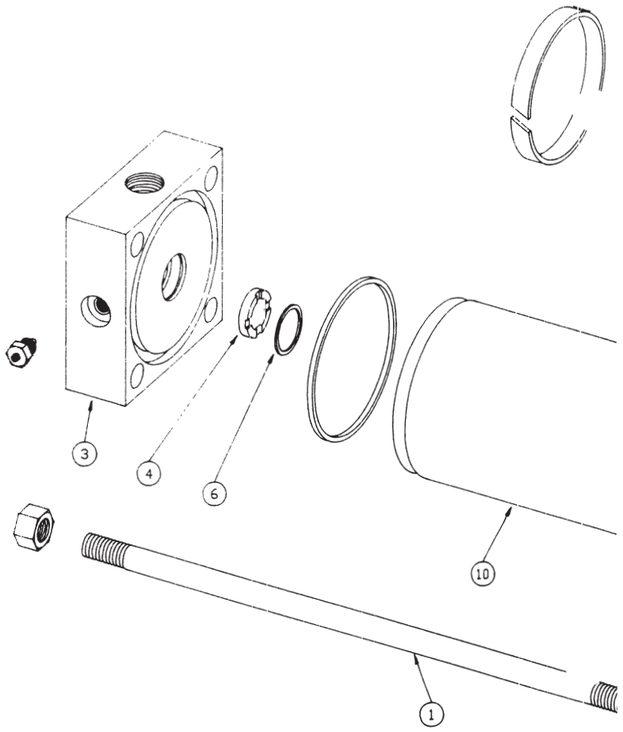
H Temperature Range -20° F to +400° F
Piston Wear Strip(s), Filled Teflon Seal w/Viton Expander, Viton Tube Seals.

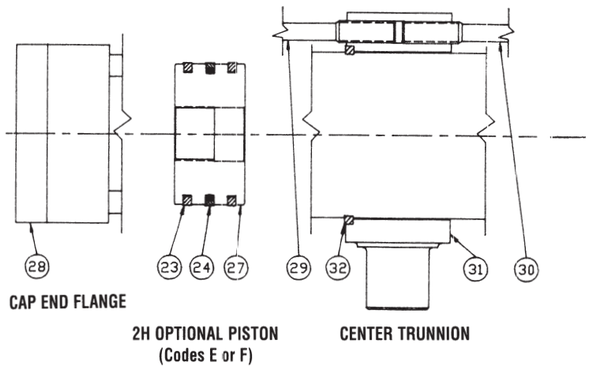
PARTS LIST

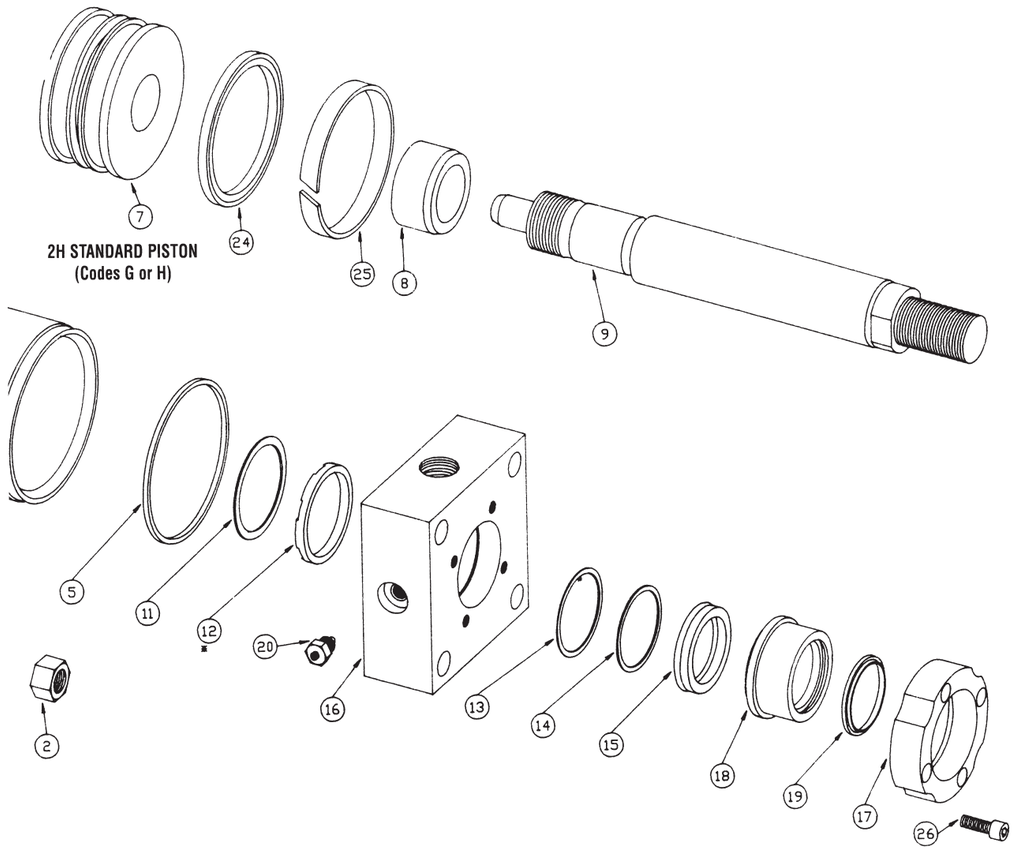
When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

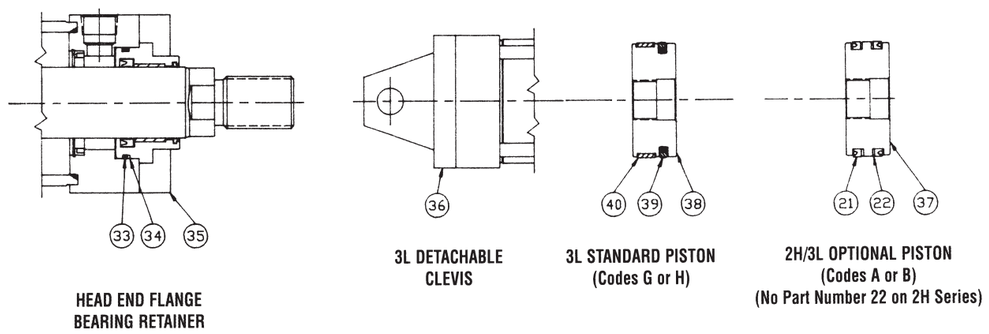
PART NO.	NO. REQ'D.	DESCRIPTION
1	**	Tie Rod
2	**	Tie Rod Nut
3	1	Cap
4	1	Cap Cushion Float
5	2	O-Ring (Tube)
6	1	Cap Retaining Ring
7	1	2H Standard Piston
8	1	Cushion Sleeve
9	1	Piston Rod
10	1	Tube
11*	1	Head Cushion Retaining Ring
12*	1	Head Cushion Float
13	1	Packing Retaining Ring
14	1	Rod Washer
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.



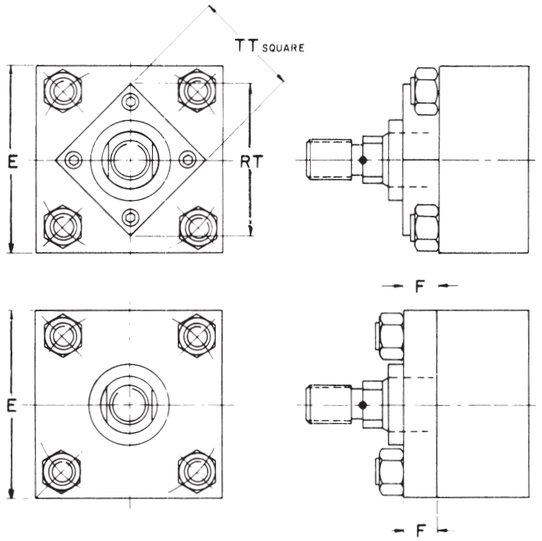






RETAINER PLATE CONSTRUCTION

SQUARE RETAINER CONSTRUCTION SERIES 2H

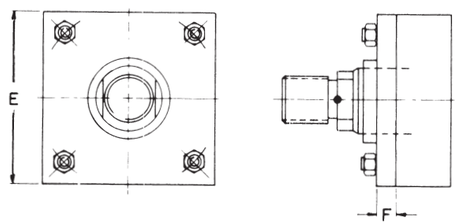


BORE	ROD	TT	RT
1.50	D	1.50	2.13
2.00	F	2.00	2.84
2.50	F	2.00	2.84

For all mounts except **ME5.**

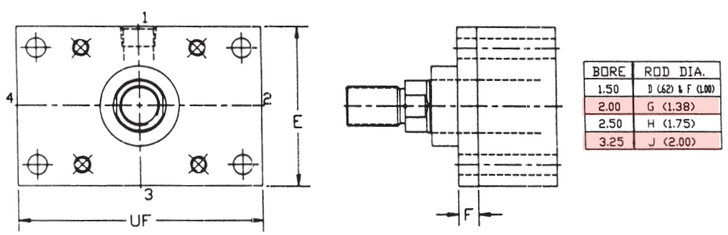
BORE	ROD
1.50	F
2.00	G
2.50	G,H

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 (1.00)
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	1.12-12	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

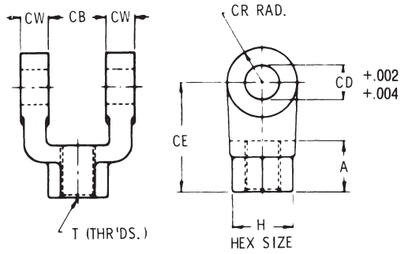
3L SERIES

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.

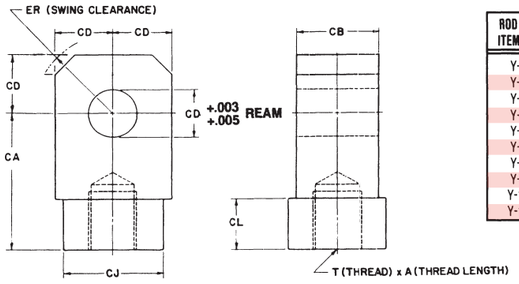
***CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended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

Rod Clevis



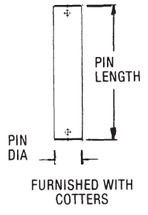
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-1	D	75	.75	50	1.50	62	.50	1.00	.44-20	5,360
V-2	F	1.12	1 25	.75	2.38	88	.62	1.25	.75-16	14,000
V-3	G	1 62	1.50	1.00	3 12	1 12	.75	1.75	1 00-14	22,500
V-4	H	2.00	2.00	1 37	4.12	1.62	1.00	2.00	1.25-12	41,250
V-5	J	2.25	2.50	1.75	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



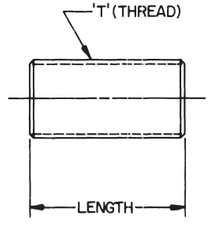
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-1	D	.75	1.50	.75	.50	-	-	.75	.44-20	5,060
Y-2	F	1.12	2.06	1.25	.75	-	-	1.12	.75-16	12,500
Y-3	G	1.62	2.81	1.50	1.00	-	-	1.44	1.00-14	20,250
Y-4	H	2.00	3.44	2.00	1.37	-	-	2.00	1.25-12	37,000
Y-5	J	2.25	4.00	2.50	1.75	-	-	2.50	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



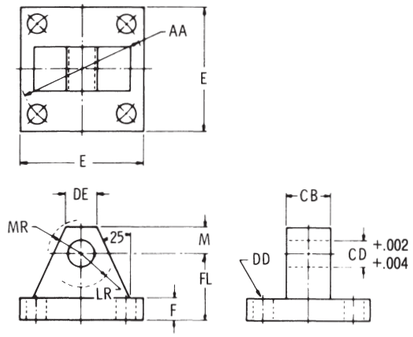
PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P1	2.28	.50	6,125
P2	3.09	.75	13,800
P3	3.60	1.00	24,500
P4	4.66	1.37	46,500
P5	5.66	1.75	75,150
P6	5 72	2.00	98,150
P7	6.94	2.50	153,400
P8	7.19	3.00	220,900
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

Piston Rod Stud



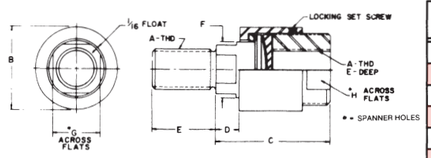
ITEM NO.	T	LENGTH
Stud 1	.44-20	1.50
Stud 2	.75-16	2.25
Stud 3	1.00-14	3.25
Stud 4	1.25-12	4.00
Stud 5	1.50-12	4.50

Brackets



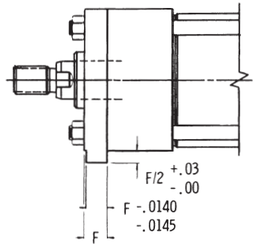
2H SERIES BORE DIA.	3L SERIES BORE DIA.	BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
1.50	1.50, 2 00 2.50	B-1	2.30	.75	.500	44	.56	2.50	.38	1.12	.62	.50	.62	2,500
2.00 2.50	3.25, 4.00 5.00	B-2	3.60	1 25	750	.56	.88	3.50	62	1.88	.88	.75	.88	6,300
3.25	6.00	B-3	4.60	1.50	1.000	69	1.38	4.50	.75	2.25	1.25	1 00	1.25	10,000
4.00		B-4	5 40	2.00	1.375	.69	1.75	5.00	.88	3.00	1.75	1 38	1 75	19,250
5.00		B-5	7.00	2.50	1.750	94	2.25	6.50	88	3 12	2.12	1 75	2 12	21,200
6.00		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
7 00	—	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
8.00	—	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
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

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

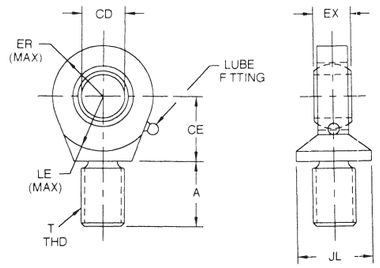
Thrust Key



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

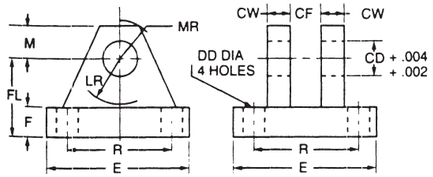
Order to fit Piston Rod thread size.



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

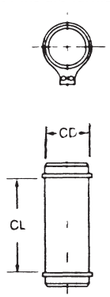
Order to fit Mounting Plate or Rod Eye.



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.

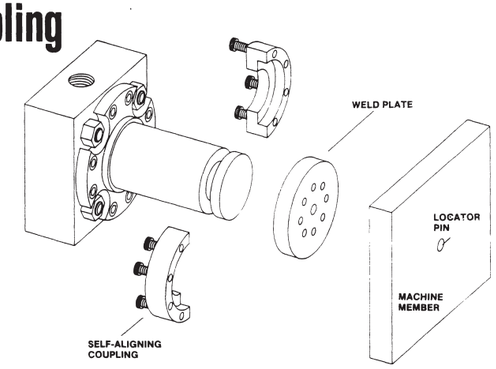
Self-Aligning Rod End Coupling

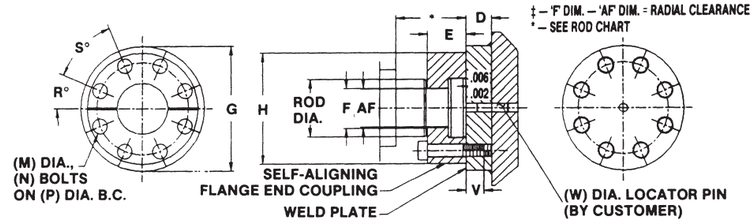
Hanna's Self-Aligning Rod End Coupling permits fast, easy assembly, disassembly, installation and servicing. Precision-machined, two-piece steel construction provides close radial alignment between piston rod end and machine member.

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.

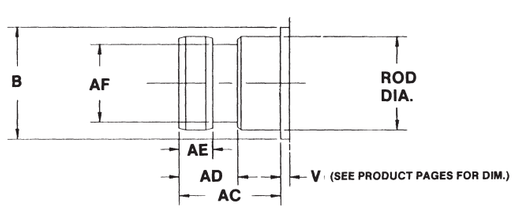
A Weld Plate is an accessory for use with the Self-Aligning Rod End Coupling. It eliminates lay-out, drilling and tapping each hole to match the coupling on your machine. The hole in the center of the Weld Plate is accurately drilled for a locating pin for fast, close positioning to the machine prior 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	1 000-8	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	1 000-8	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



OPTIONS

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 Sroke 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 Sroke Tolerance
- Full Face Retainer Plates
- MS1 Mount
- Tandem Mounted Cylinders

Contact factory for other special options.

HOW TO ORDER

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

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 (Specify only if required)	D

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.**

BORE SIZE
(Specify)

STROKE
(Specify)

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

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

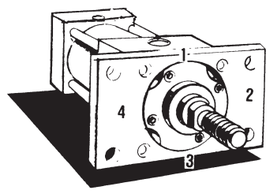
PISTON PACKING AND TUBE SEALS

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

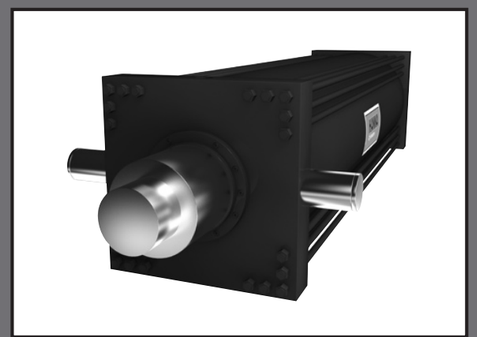
NOTE: Cushion needles furnished with viton seals.

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.



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

Series 3H Hydraulic Cylinders

HANNA cylinders

Series 3H

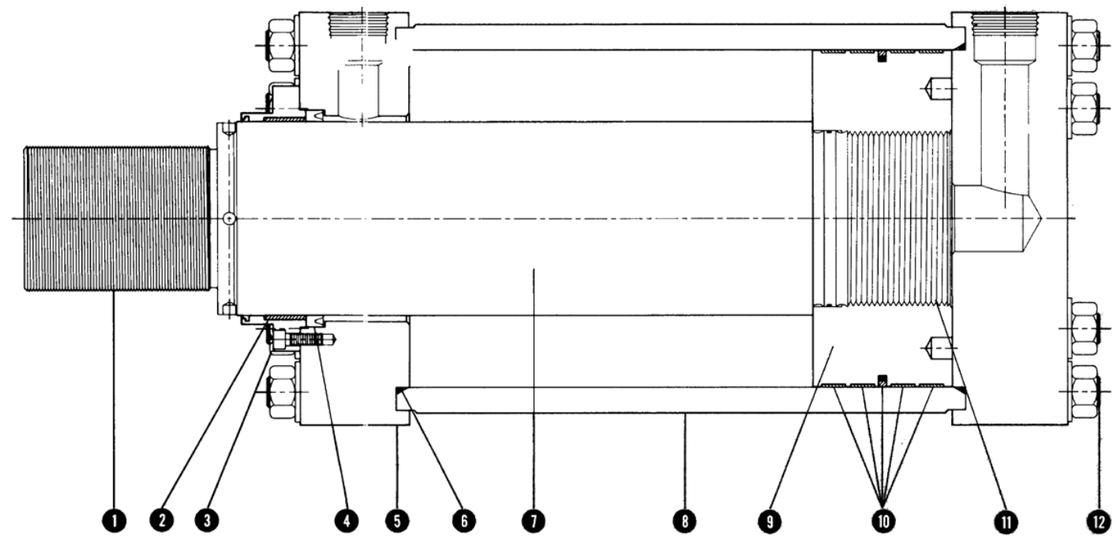
Large Bore Hydraulic Cylinders for Heavy-Duty Service

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.



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.

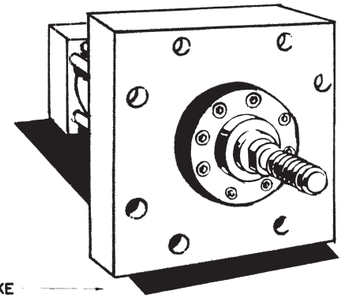
10. Piston Sealing System
Hanna's glass-filled Teflon, O-ring energized piston seal provides a positive seal without problems such as rollover or extrusion that are associated with other type seals. Bronze-filled bearing strips provide non-metallic bearing points on the piston, assuring long life and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

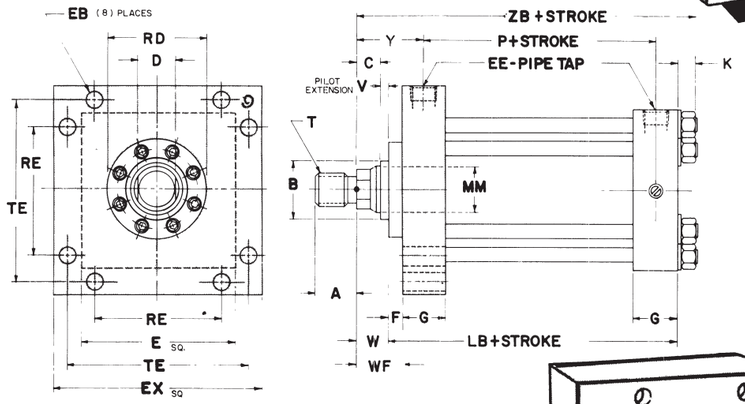
11. Piston-to-Rod Connection
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anerobic adhesive, torqued and pinned.

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

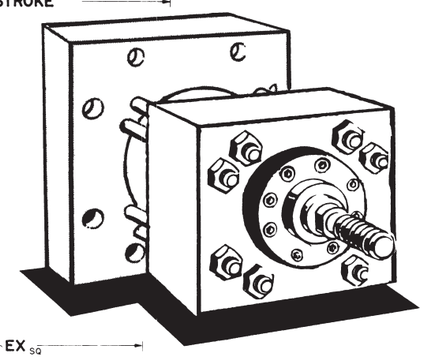
SERIES 3H 10.00"-24.00" Bores

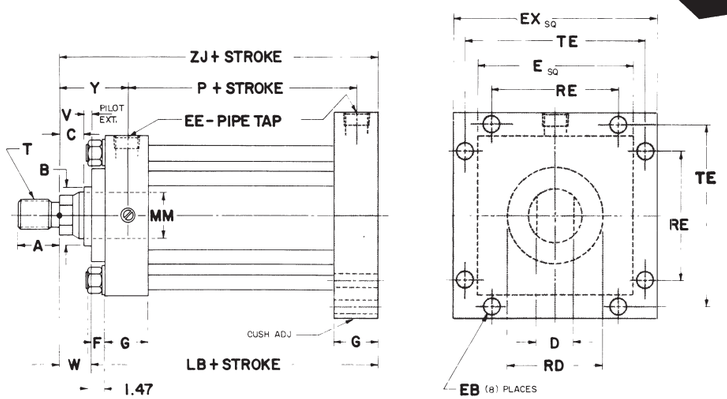
ME3 Head Square Mount





ME4 Cap Square Mount





Dimensions are Constant Regardless of Rod Diameter

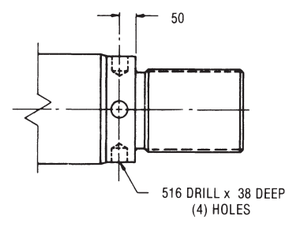
ME3, ME4

BORE	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	E	EB	EX	G	K	P	RE	TE
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

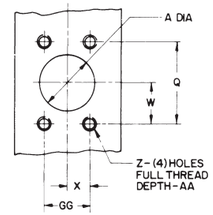
CAUTION:
Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. **Fluid velocities in the supply line in excess of 15 feet per second are not recommended.**

* 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

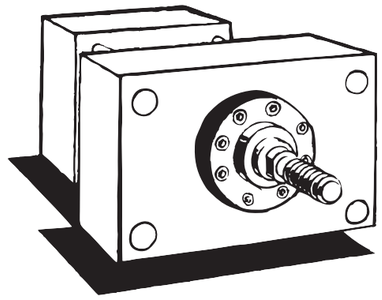
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4 50	P	4.50	5 250	1.69	3 88	1.00	13 12	8 00	3 25-12	25	1 94	2.94	4.75	16.53	15 06	3000
10.00	5 00	R	5 00	5 750	1 94	4.25	1 00	13.12	8 00	3.50-12	.25	2 19	3.19	5.00	16.78	15.31	3000
10.00	5 50	S	5.50	6 250	1 94	4 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

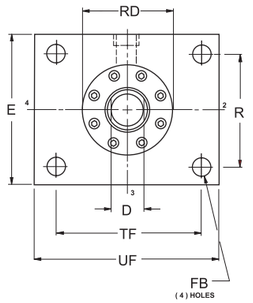
† **CAUTION:** PSI ratings shown are **HANNA CYLINDERS** recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

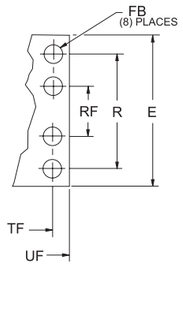
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression

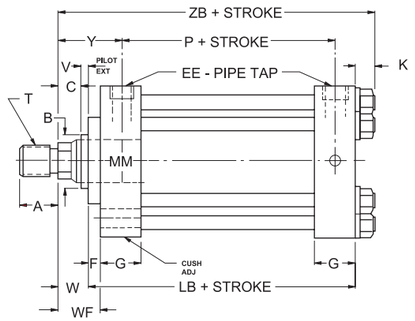
SERIES 3H 10.00"-24.00" Bores

ME5 Head Rectangular Flange Mount

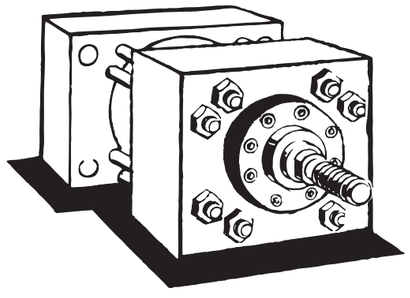


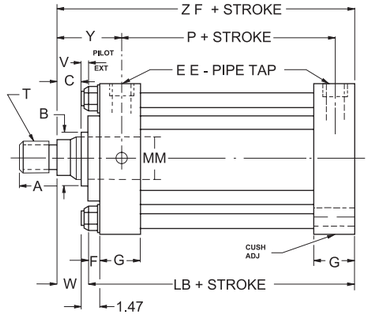


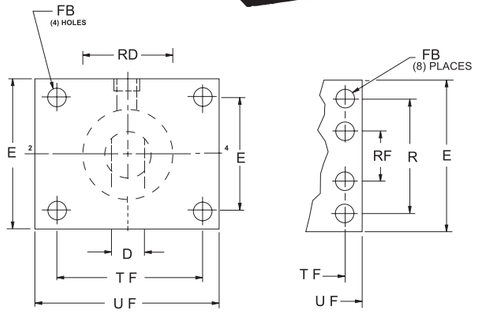




ME6 Cap Rectangular Flange Mount







Dimensions are Constant Regardless of Rod Diameter

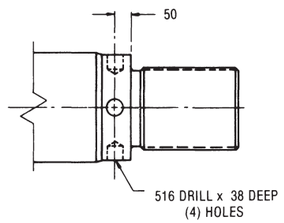
ME5, ME6

BORE	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	E	FB	G	K	P -.006	R	RF	TF	UF
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

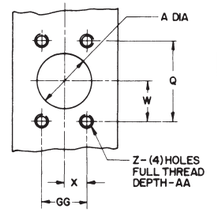
* N.P T F Ports are furnished as standard.
** Optional S A.E. Flange Ports may be specified—Flange furnished by customer
*** Specify port size when ordering.

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.**

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

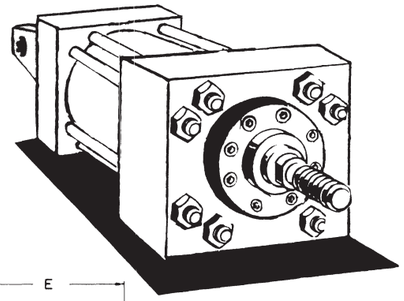
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4 50	P	4.50	5.250	1.69	3.88	1.00	13 12	8.00	3.25-12	.25	1.94	2.94	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1 94	4.25	1 00	13.12	8.00	3.50-12	25	2 19	3.19	5.00	16.78	15.31	3000
10.00	5 50	S	5 50	6 250	1 94	4 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

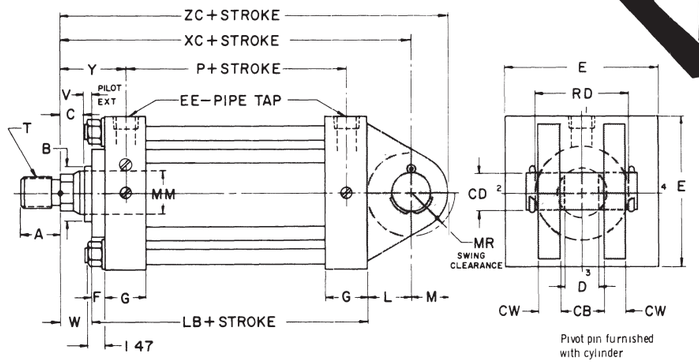
† **CAUTION:** PSI ratings shown are **HANNA CYLINDERS** recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

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.

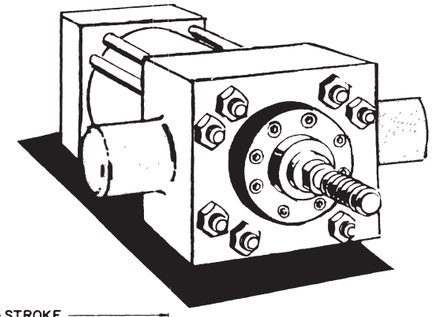
SERIES 3H 10.00"-24.00" Bores

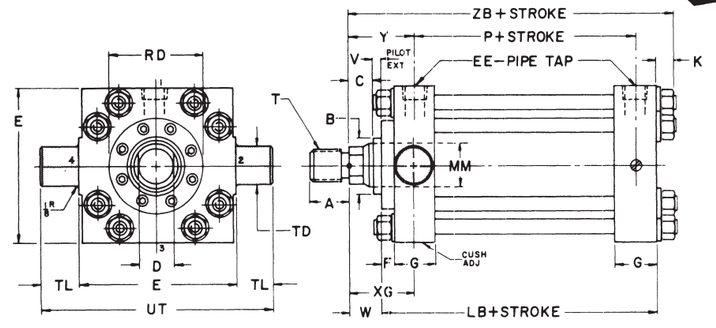
MP1 Fixed Clevis Mount





MT1 Head Trunnion Mount





MP1, MT1

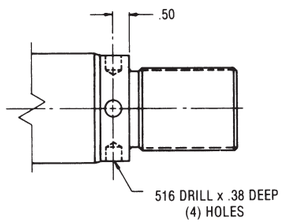
Dimensions are Constant Regardless of Rod Diameter

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.**

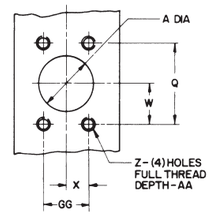
BORE	CB +.016 +.047	CD	CW	E	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	G	K	L	M	MR	P	TD +.000 −.002	TL	UT
10.00	4.00	3 50	2.00	12.62	2	2	3.69	1.09	4.00	3 50	3.62	8.50	3.50	3.50	19.62
12.00	4.50	4.00	2.25	14.88	2½	2½	4.44	1.09	4.50	4.00	4.12	9.88	4.00	4.00	22.88
14.00	6 00	5.00	3.00	17.12	2½	2½	4.88	1.19	5.75	5.00	5.12	10.38	5.00	5.00	26.12
16.00	7.00	6.00	3.50	19.25	2½	2½	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	2½	2½	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	2½	2½	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

* 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

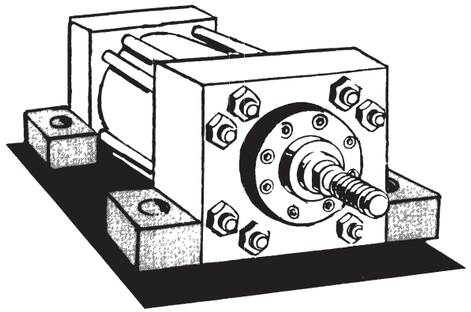
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	XC	XG	Y	ZB	ZC	PSI RATING† MP1	PSI RATING† MT1
10.00	4.50	P	4.50	5.250	1.69	3 88	1.00	13.12	8.00	3.25-12	25	1.94	19.06	4.75	4.75	16.53	22.56	3000	1365
10.00	5.00	R	5.00	5 750	1.94	4.25	1.00	13 12	8 00	3.50-12	25	2 19	19.31	5 00	5.00	16.78	22.81	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

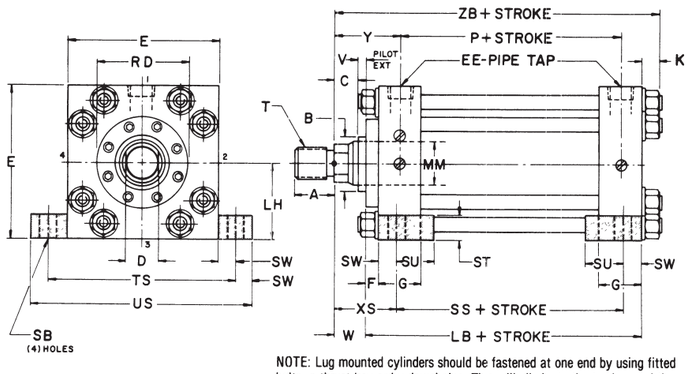
† **CAUTION:** PSI ratings shown are **HANNA CYLINDERS** recommended operating pressures. Check stroke limitation data (Page 14) which may reduce maximum operating pressure. Check stop tube data (Page 113) to determine if stop tube is required.

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.

MS2

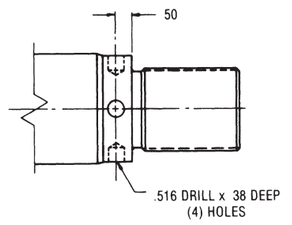
Dimensions are Constant Regardless of Rod Diameter

BORE	E	EE* N.P.T.F.	EE** S.A.E. FLANGE PORT	G	K	LH -.000 -.006	P	SB	SS	ST	SU	SW	TS	US
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	2.75	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	3.25	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

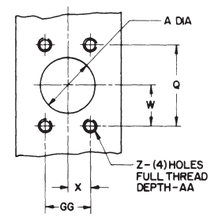
CAUTION:
Cylinders are intended for operation with standard ports. Oversize or additional ports may result in unacceptable fluid velocities within the cylinder. **Fluid velocities in the supply line in excess of 15 feet per second are not recommended.**

* 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.

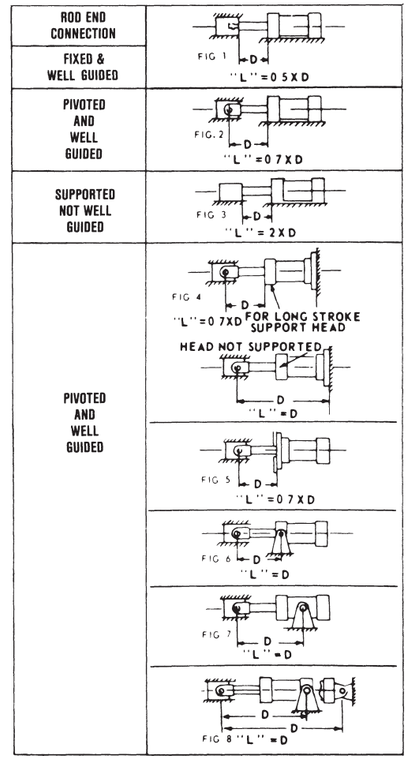
EXAMPLE PROBLEM:
Cylinder Model MP1-3H-NC-10.00 x 27.00 - PSM-1G
Accessory - V-10 Clevis
Pressure - 2000 PSI
Clevis Mount - Horizontal

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

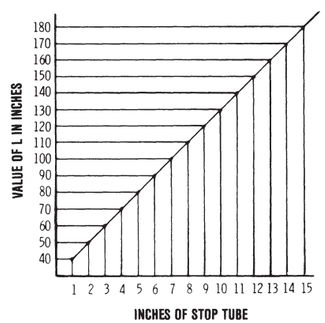
ADD:	MP1	"XC" Dimension	19.06"
	V-10	"CE" Dimension	8.50"
	Two times stroke (2 x 27)		54"
	Total Value of "L"		81.56"

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:

(1) 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.

(2) 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 X 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 given (F = A X PSI). An example of this formula is provided.

Chart C1 **HYDRAULIC CYLINDER FORCE CHART***

Cyl. Bore	Piston Area Sq. In.	PUSH STROKE Values are Pounds of Force 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	Gallons of Oil Consumed Per Inch of Travel
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

Force (pounds) = Cylinder Piston Area (in square inches) X 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 X 1000 F = 153940

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. 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	Gallons of Oil Consumed Per Inch of Travel
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

Series 3H Hydraulic Cylinders

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

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

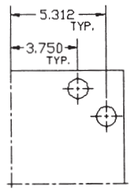
BORE	ROD	SCREW SIZE	TORQUE
10.00	P, R, S	500-20	75 ft-lbs
10 00	T	438-20	50 ft-lbs
12 00	S, U	500-20	75 ft-lbs
12 00	T	438-20	50 ft-lbs
14 00	T	438-20	50 ft-lbs
14 00	U, V	500-20	75 ft-lbs
16 00	U	500-20	75 ft-lbs
16 00	Z, V	500-20	75 ft-lbs
18.00	Z	500-20	75 ft-lbs
18.00	V	625-18	100 ft-lbs
20 00	V	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

CYLINDER WEIGHTS

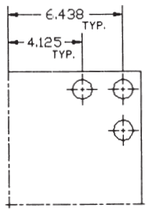
3H SERIES

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

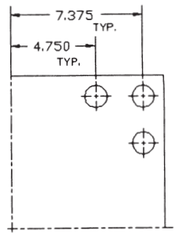
TIE ROD LAYOUT



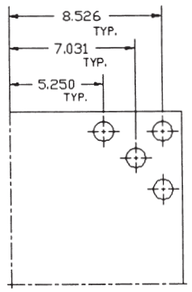
10.00 BORE
1⅛" TIE RODS



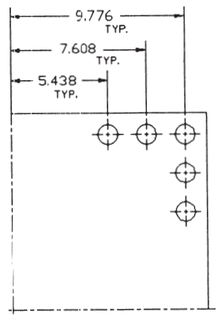
12.00 BORE
1⅛" TIE RODS



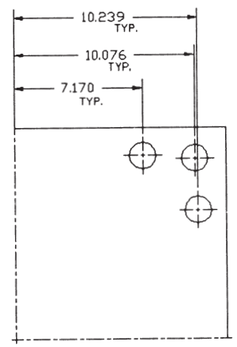
14.00 BORE
1¼" TIE RODS



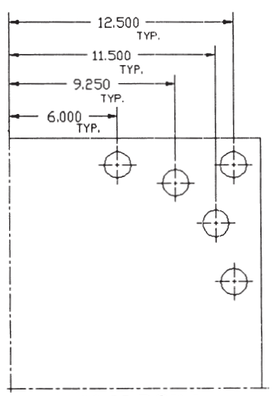
16.00 BORE
1⅛" TIE RODS



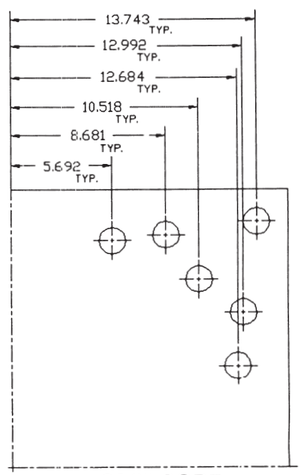
18.00 BORE
1⅛" TIE RODS



20.00 BORE
1½" TIE RODS



22.00 BORE
1½" TIE RODS



24.00 BORE
1½" TIE RODS

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 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.

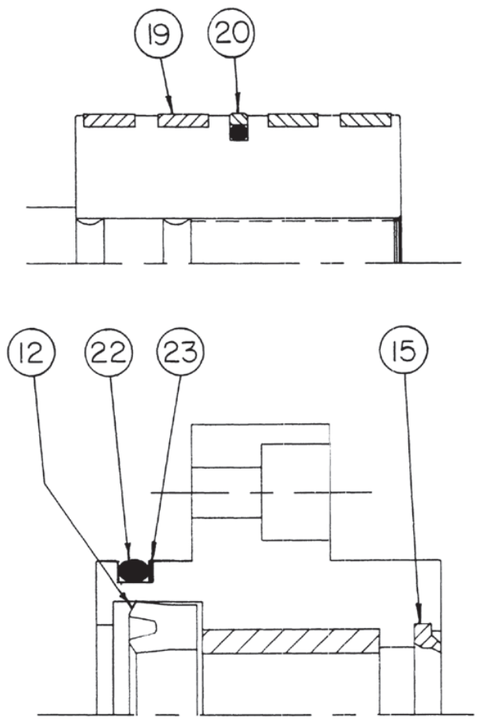
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned 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.

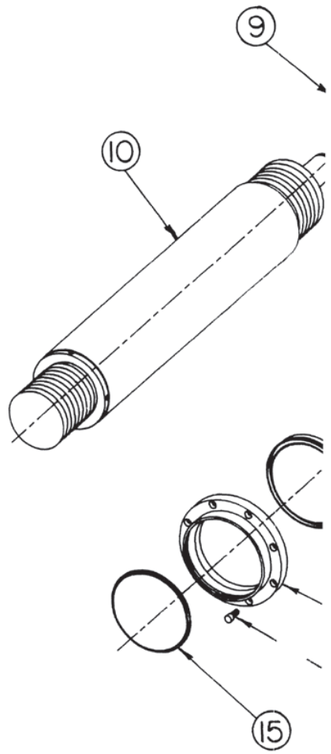
Replacement packings can be furnished quickly, if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number, as shown. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

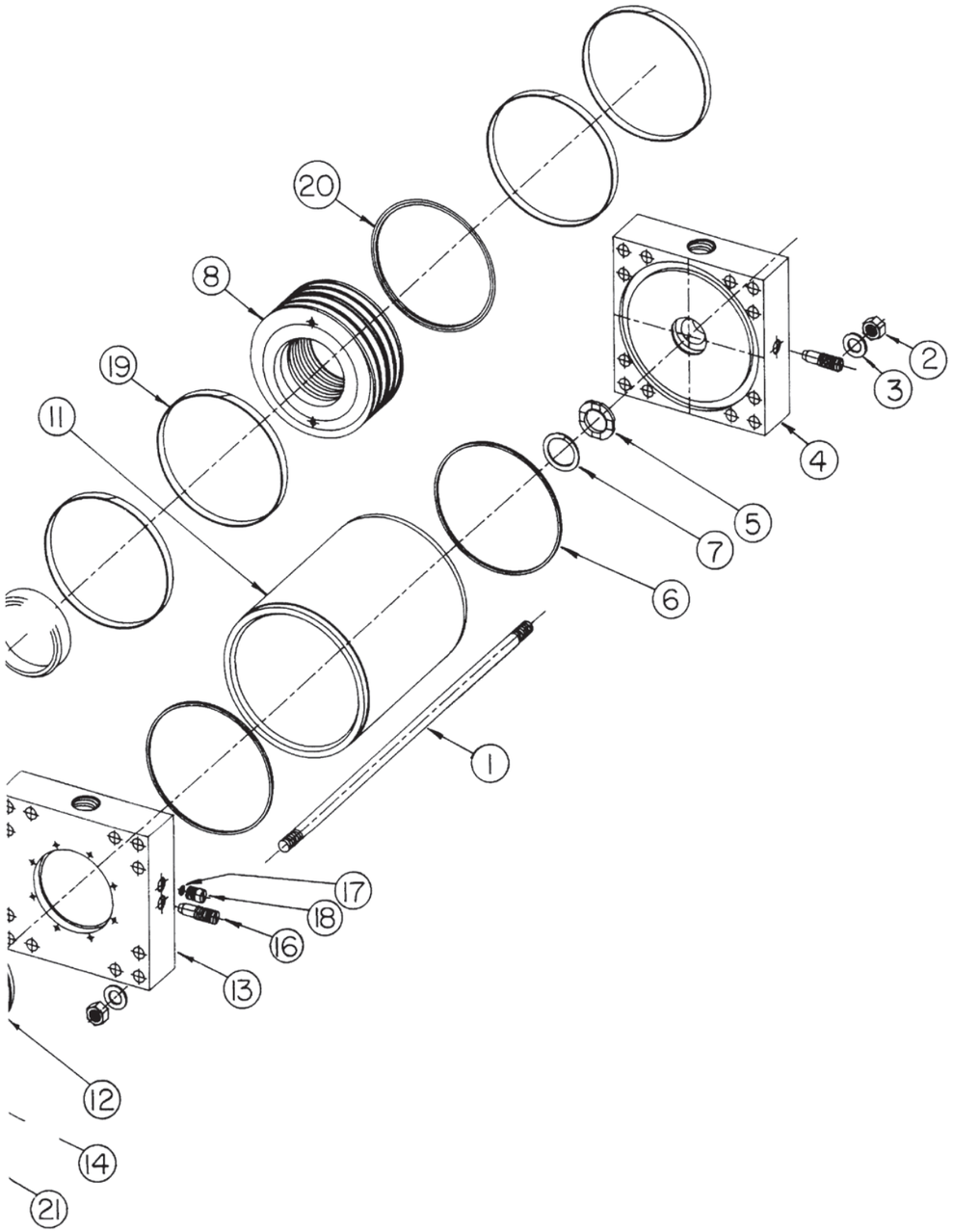
PARTS LIST

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		





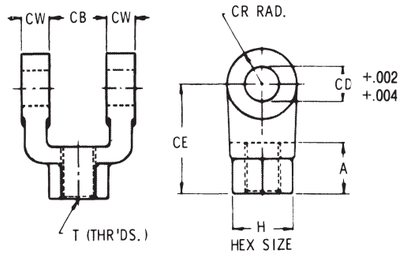


MOUNTING ACCESSORIES

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 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.

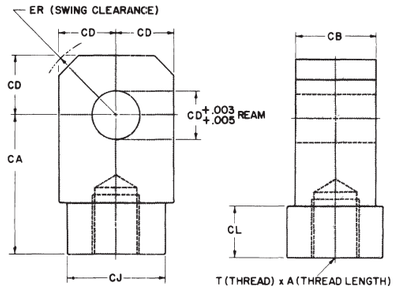
*** CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended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

Rod Clevis



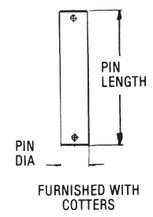
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-10	P	4.50	4.00	3 50	8 50	3.88	2.00	5 00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4 38	2.25	6.19	4.00-12	270,000

Rod Eye



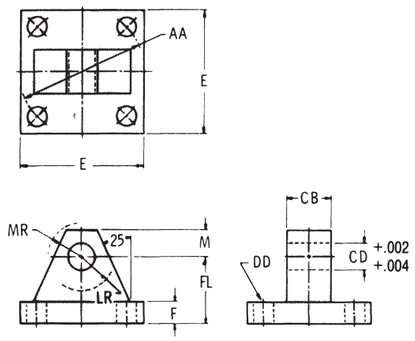
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-10	P	4.50	7.62	4 00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5 50	9 12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

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

HOW TO ORDER

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

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.

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

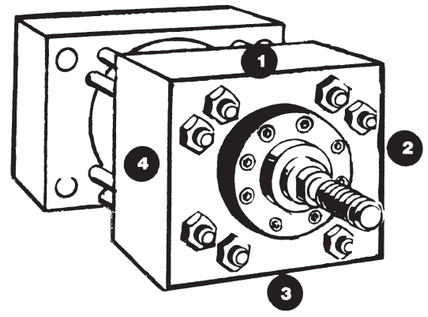
STANDARD—Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals ..... **G**
OPTIONAL —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals ..... **H**

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

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.**



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

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

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.

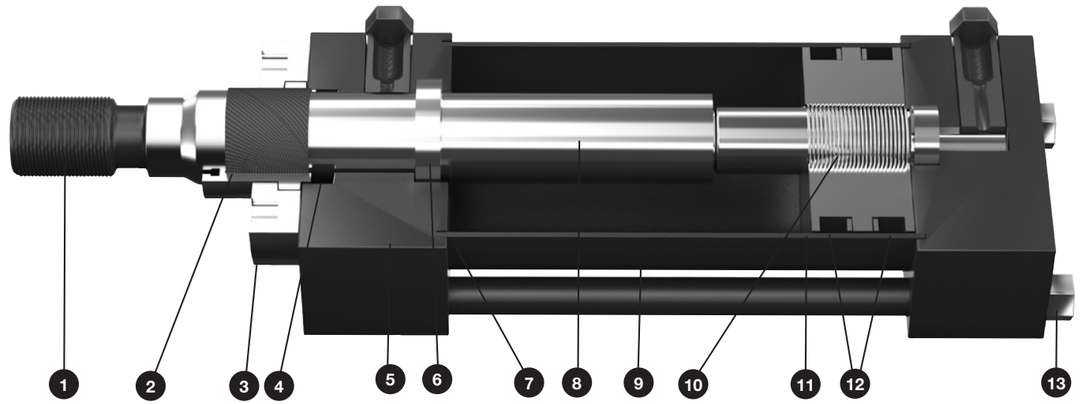
Extensive laboratory testing and countless field applications have proven conclusively that 3AN cylinders provide millions of maintenance and lubrication-free cycles. The reason: the combination of Hanna's unique Duralon® rod bearing and our glass-filled Teflon® piston seal with a bronze-impregnated 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.

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

Series 3A and 3AN Pneumatic Cylinders



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 anerobic adhesive, torqued and pinned.

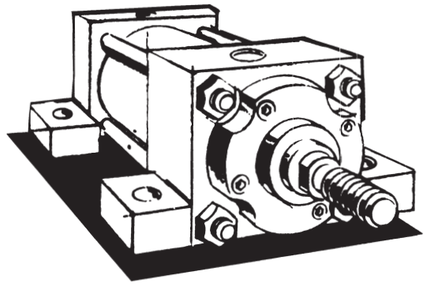
11. Piston
One-piece piston of high impact-resistant ductile iron threaded to piston rod, and furnished with breakaway spirals on each side.

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 and 3AN Pneumatic Cylinders

Series 3A and 3AN Pneumatic Cylinders



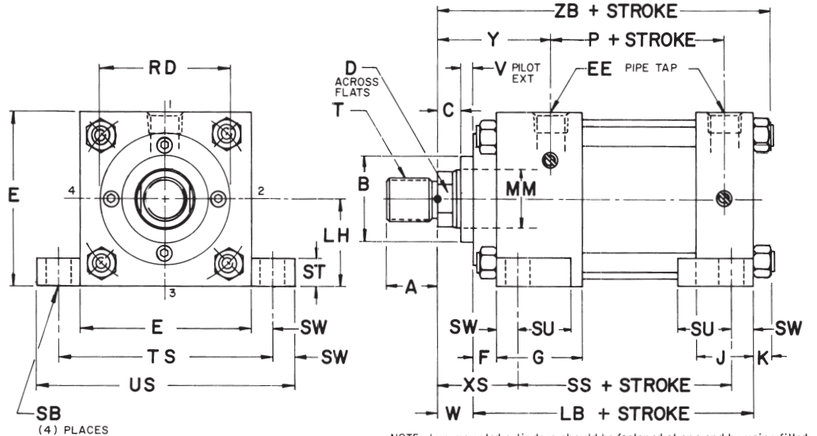
SERIES "3A"

PNEUMATIC CYLINDERS

1.50" - 14.00" BORE

MS2

SIDE LUG MOUNT



These Dimensions are Constant Regardless of Rod Diameter

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 toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to

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.

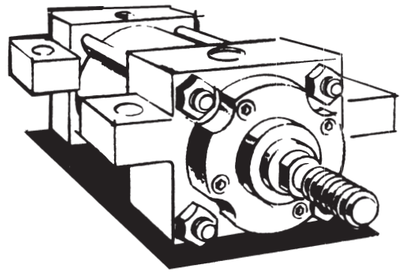
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	RD*	PSI RATING†
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
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
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
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
	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
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
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
	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	3.69	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	3.38	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	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 and 3AN Pneumatic Cylinders



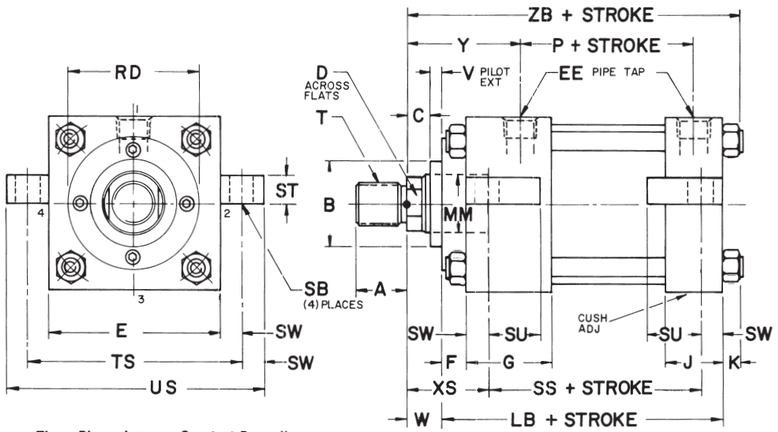
SERIES "3A"

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	± TS .010	US
1.50	2.00	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	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	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	1/2	.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	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	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	3/4	.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	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	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	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	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 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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XS	Y	ZB	RD*	PSI RATING†
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
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
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
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
	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
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
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
	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	3.69	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	3.38	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	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 and 3AN Pneumatic Cylinders

Series 3A and 3AN Pneumatic Cylinders

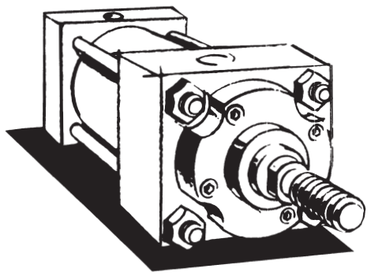
SERIES "3A"

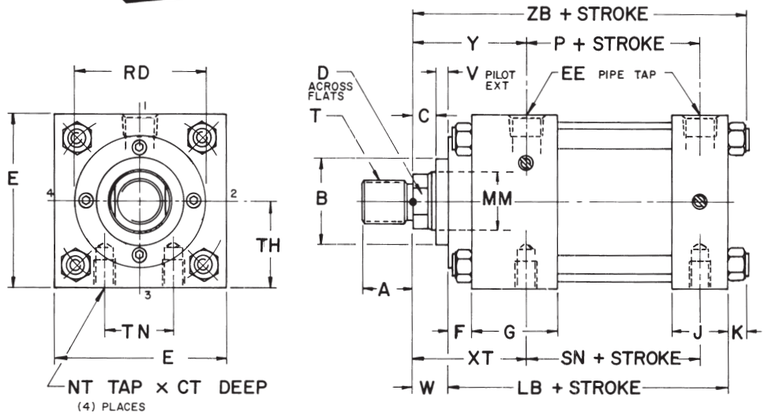
PNEUMATIC CYLINDERS

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	TN ± .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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XT	Y	ZB	RD**	PSI RATING†
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	*	2.25	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	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	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
	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	6.88	--	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
	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	3.50	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
6.00	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	7.31	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	3.19	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	3.44	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	3.44	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	3.44	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	3.44	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	7.31	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	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	7.94	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	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	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	9.31	--	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
	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
12.00	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
	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
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	3.81	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
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.81	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	3.81	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	3.81	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 and 3AN Pneumatic Cylinders

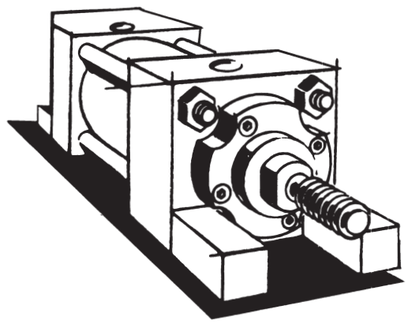
SERIES "3A"

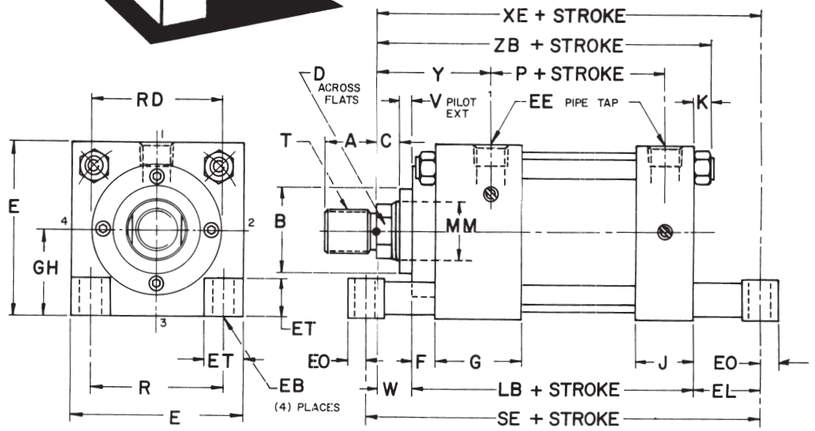
PNEUMATIC CYLINDERS

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	1.43	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	.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.

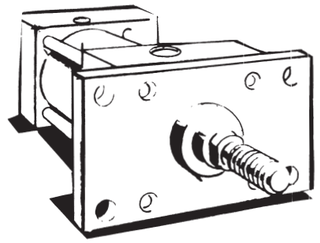
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XE	Y	ZB	RD*	PSI RATING†
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
	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
6.00	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
	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
8.00	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
	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
10.00	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
	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	9.94	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	9.94	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	9.94	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	10.19	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	10.44	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	10.44	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	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
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 -.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.

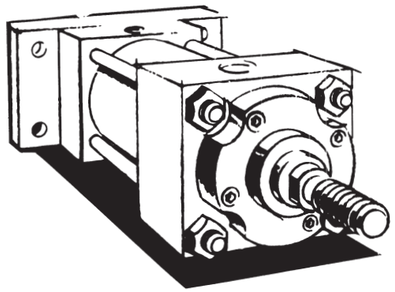
Series 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	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	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 and 3AN Pneumatic Cylinders



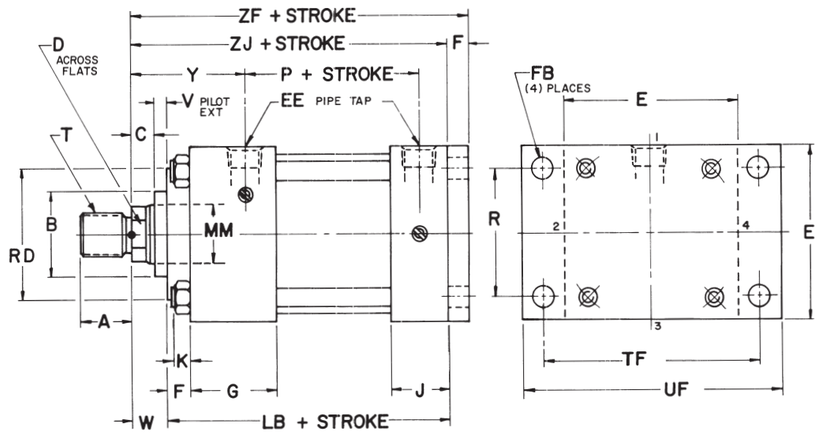
SERIES "3A"

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 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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	ZJ	Y	ZF	RD*	PSI RATING†
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
	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
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
	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 and 3AN Pneumatic Cylinders

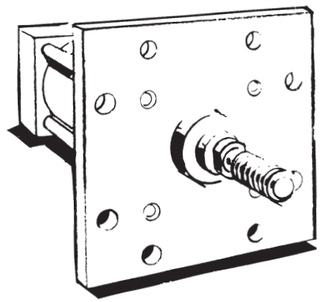
SERIES "3A"

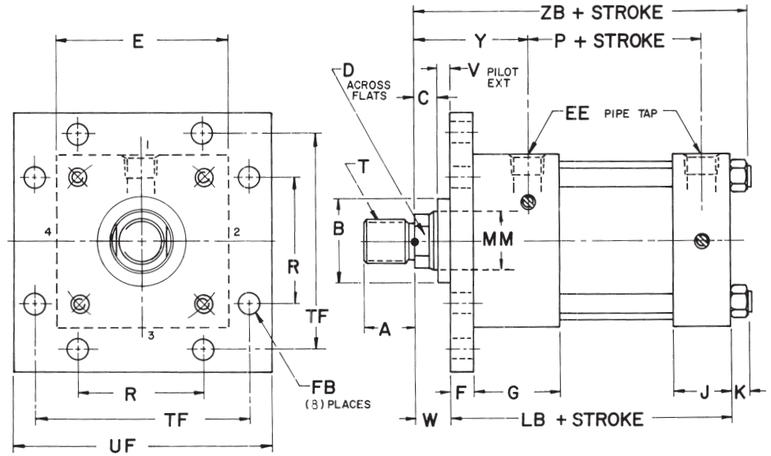
PNEUMATIC CYLINDERS

1.50" - 6.00"
BORE

MF5

HEAD SQUARE FLANGE
MOUNT





These Dimensions are Constant Regardless of Rod Diameter

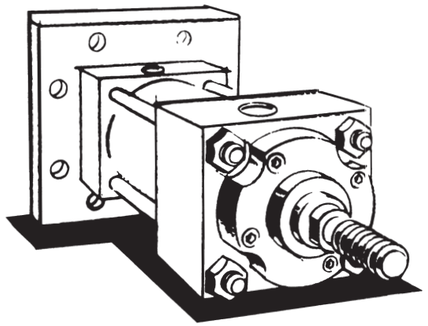
BORE	E	EE (NPTF)	F	FB +.005 -.000	G	J	K	LB	P	R ±.010	TF ±.010	UF
1.50	2.00	3/8	.38	.312	1.50	1.00	.25	4.00	2.31	1.43	2.75	3.38
2.00	2.50	3/8	.38	.375	1.50	1.00	.31	4.00	2.31	1.84	3.38	4.12
2.50	3.00	3/8	.38	.375	1.50	1.00	.31	4.12	2.44	2.19	3.88	4.62
3.25	3.75	1/2	.62	.438	1.75	1.25	.38	4.88	2.69	2.76	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 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	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	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	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.



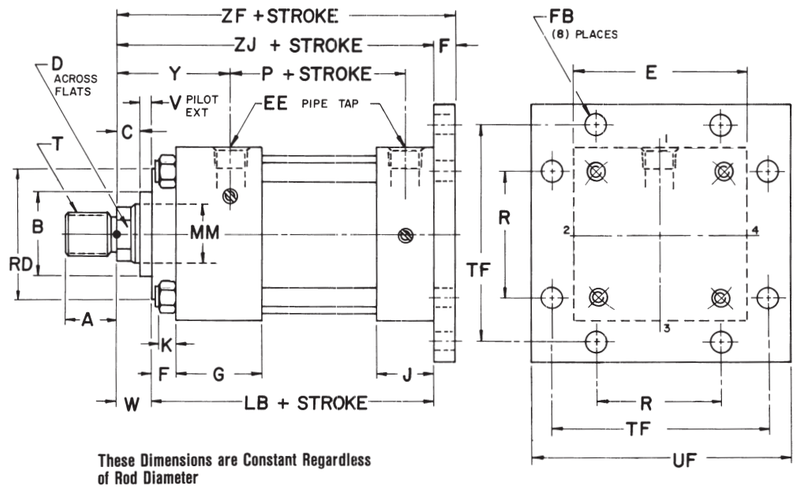
SERIES "3A"

PNEUMATIC CYLINDERS

1.50" - 6.00" BORE

MF6

CAP SQUARE FLANGE MOUNT



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.

Series 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	ZJ	Y	ZF	RD*	PSI RATING†
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
	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
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
	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 and 3AN Pneumatic Cylinders

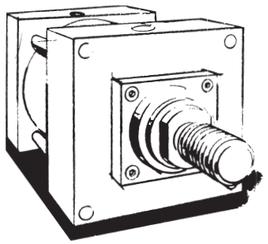
SERIES "3A"

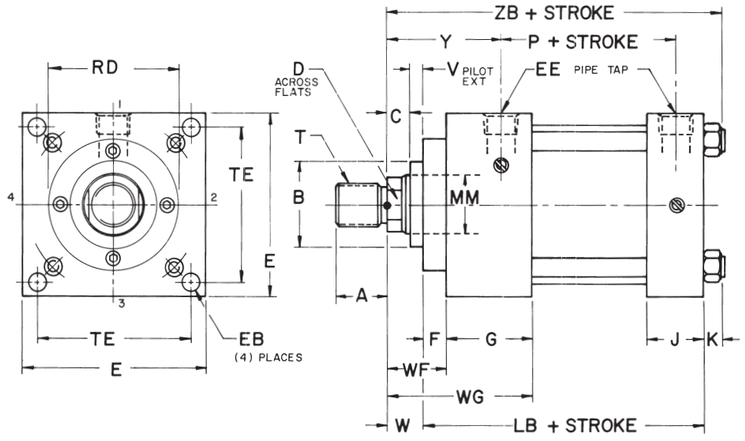
PNEUMATIC CYLINDERS

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.

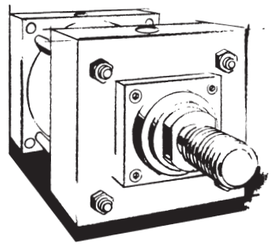
Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	WF	WG	W	Y	ZB	RD*	PSI RATING†
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
	R	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
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.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
	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	9.81	--	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
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.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 and 3AN Pneumatic Cylinders



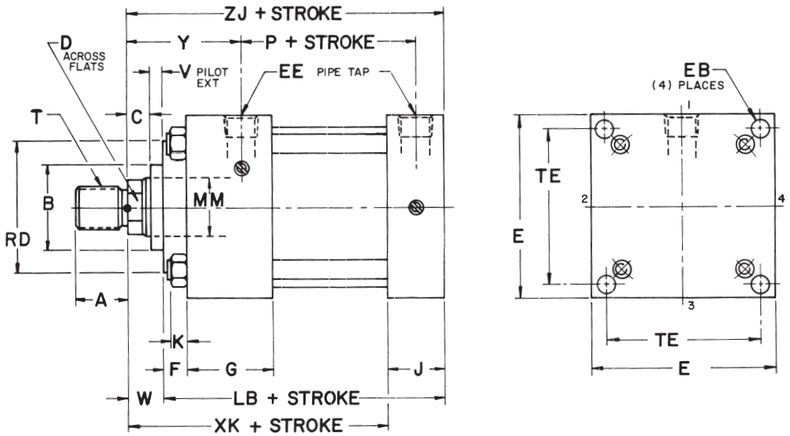
SERIES "3A"

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

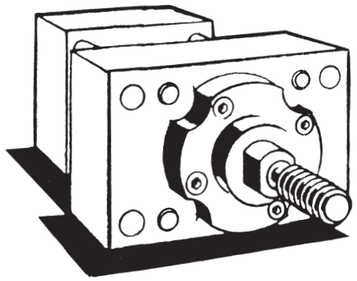
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

CYLINDER							T (THREAD)									
BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF	V	W	XK	Y	ZJ	RD*	PSI RATING†
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.



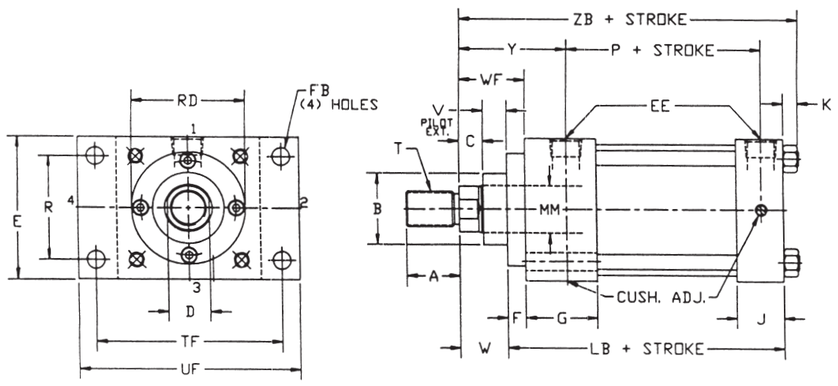
SERIES "3A"

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

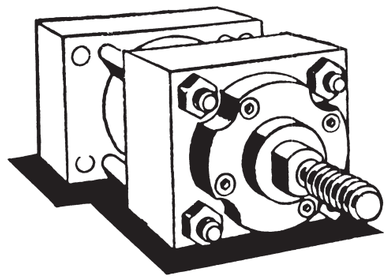
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD* ±.005	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	WF	Y	ZB	PSI RATING†
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
	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	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
	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	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	3 00	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	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
	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	3.00	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	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
	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
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	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	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
	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
	M	3 50	3.50	4.250	1.00	3.00	5 38	2.50-12	3.25-12	2.50-12	.62	1.62	2 25	3.25	7.19	250
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	1.62	2.75	7.06	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
	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.



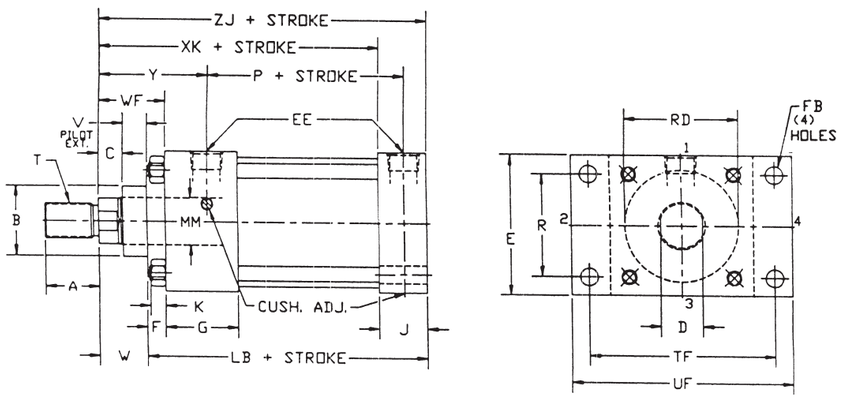
SERIES "3A"

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.

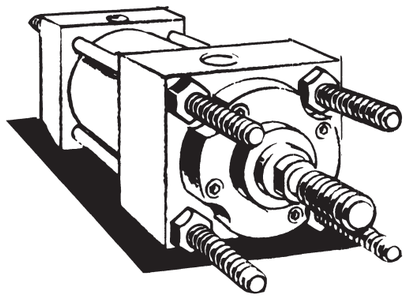
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	RD*	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	XK	ZJ	PSI RATING†
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
	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	.62	1.62	3.25	5.50	6.75	250
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	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
	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	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	5.75	7.25	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	5.75	7.25	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

*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 and 3AN Pneumatic Cylinders



SERIES "3A"

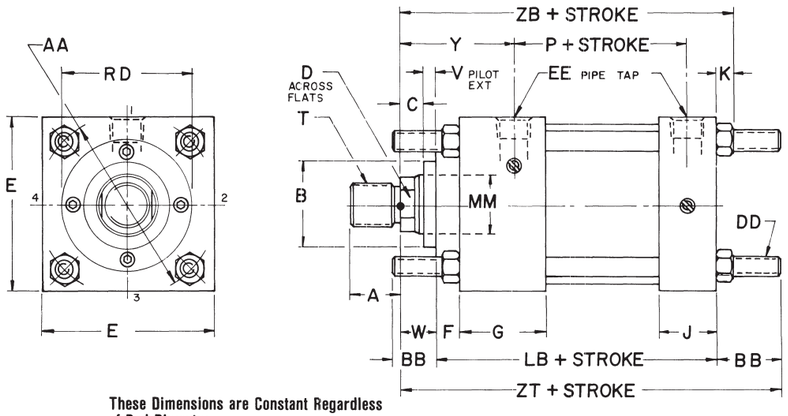
PNEUMATIC CYLINDERS

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
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



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.

Series 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZB	ZT	RD*	PSI RATING†
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	5.25	6.00	--	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
	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	6.88	7.88	--	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
	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	3.50	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
6.00	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
	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	--	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	7.69	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	7.31	9.06	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	3.00	7.56	9.31	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	3.12	7.69	9.44	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	3.38	7.94	9.69	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	3.38	7.94	9.69	--	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	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
	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
12.00	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
	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	3.44	9.81	11.81	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.44	9.81	11.81	--	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	3.69	11.19	13.56	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	3.69	11.19	13.56	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.69	11.19	13.56	--	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.

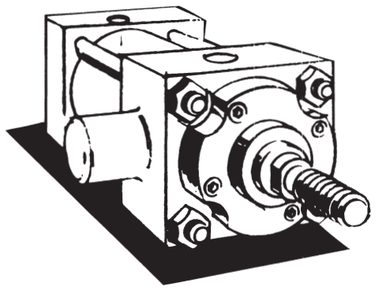
SERIES "3A"

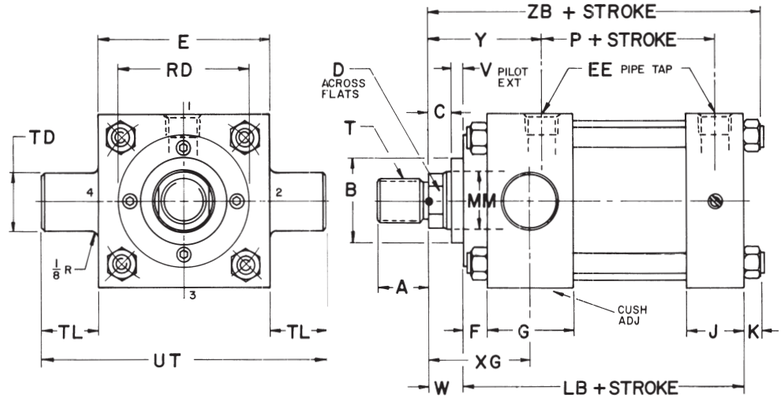
PNEUMATIC CYLINDERS

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.

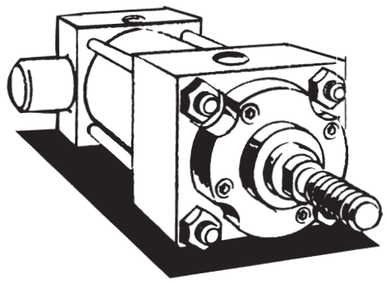
NOTE: Align and mount pillow blocks to avoid bending moments in Trunions.

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XG	Y	ZB	RD*	PSI RATING†
1.50	B	.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
	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
5.00	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
	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
6.00	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
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.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
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	7.31	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	2.88	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	3.00	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	3.25	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	3.25	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	3.25	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	3.25	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
	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
12.00	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
	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
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	3.62	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
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.62	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	3.62	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	3.62	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.



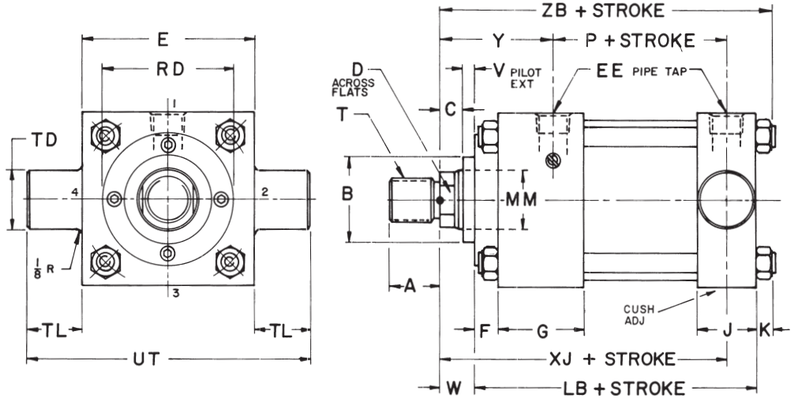
SERIES "3A"

PNEUMATIC CYLINDERS

1.50" - 14.00" BORE

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 Trunions.

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTERMEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XJ	Y	ZB	RD*	PSI RATING†
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	5.88	3.25	6.88	--	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	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	--	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	3.50	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.

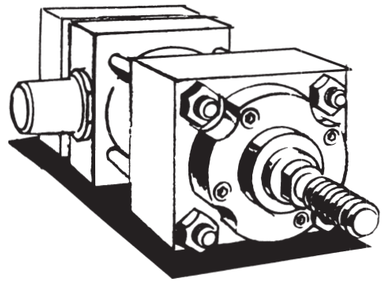
SERIES "3A"

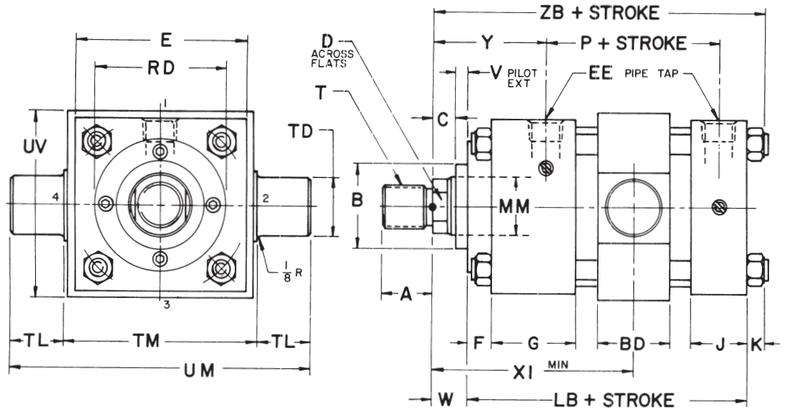
PNEUMATIC CYLINDERS

1.50" - 14.00" BORE

MT4

INTERMEDIATE FIXED TRUNNION MOUNT





BZ = MIN. STROKE

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
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 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 Trunions.

Series 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XI (MIN.)	Y	ZB	RD*	PSI RATING†
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	3.12	1.88	4.88	--	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	--	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
	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
	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	--	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
	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
6.00	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
	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
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.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	7.69	--	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	7.31	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	5.12	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	5.25	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	5.50	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	1.50	5.50	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	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
10.00	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
	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
12.00	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	9.56	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	6.00	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	6.00	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	6.00	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	6.00	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	6.00	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	6.75	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	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 and 3AN Pneumatic Cylinders

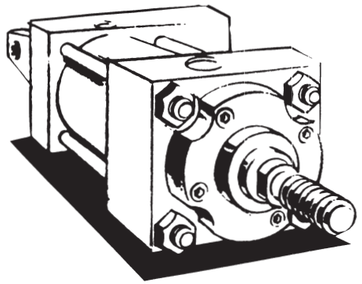
SERIES "3A"

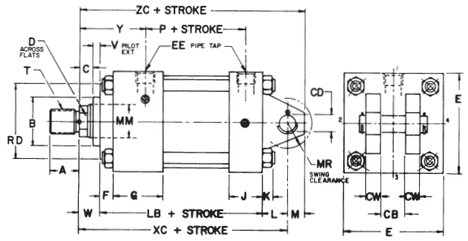
PNEUMATIC CYLINDERS

1.50" - 14.00" BORE

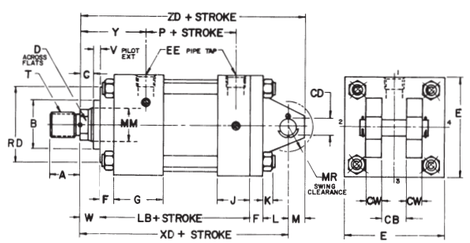
MP1 — CAP FIXED CLEVIS MOUNT

MP2 — DETACHABLE CAP 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

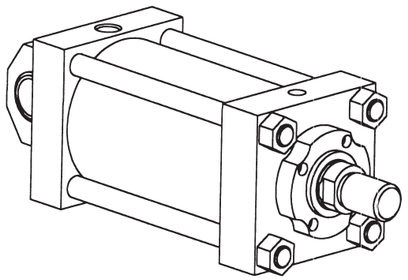
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTERMEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	XC	XD	Y	ZC	ZD	RD*	PSI RATING†
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
	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
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	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	--	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	3.50	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	4.00	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
	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
10.00	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
	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
12.00	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
	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
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	12.88	--	3.69	14.88	--	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	12.88	--	3.69	14.88	--	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	12.88	--	3.69	14.88	--	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	12.88	--	3.69	14.88	--	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	12.88	--	3.69	14.88	--	--	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.



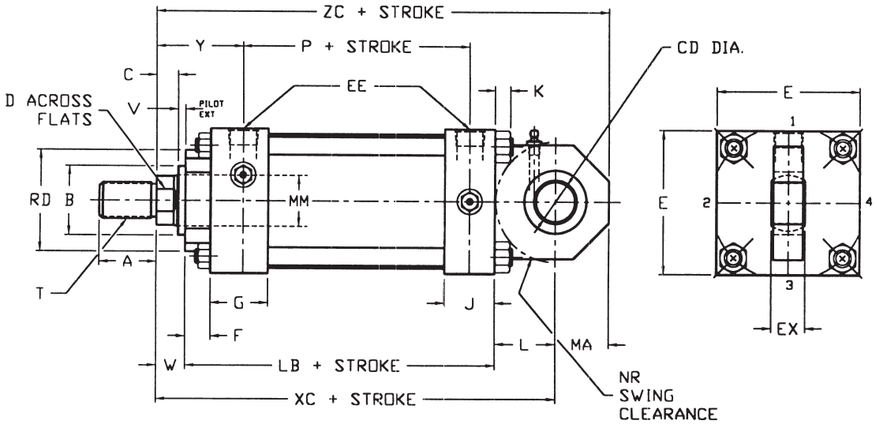
SERIES "3A"

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 toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

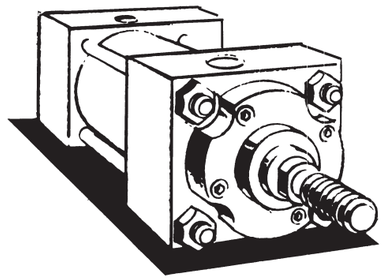
Series 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	B -0.001 -0.003	C	D	RD*	T(THREAD) SMALL MALE SM	T(THREAD) INTER-MEDIATE MALE IM	T(THREAD) SHORT FEMALE SF	V	W	XC	Y	ZC	PSI RATING†
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	5.50	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
	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
4.00	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
	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
	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
8.00	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
	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
10.00	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	10.38	3.06	12.25	150
	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	10.50	3.19	12.38	150
	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	10.75	3.44	12.62	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	10.75	3.44	12.62	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	10.75	3.44	12.62	150
	R	5.00	5.00	5.750	1.00	4.25	–	3.50-12	4.75-12	3.50-12	0.50	1.50	10.75	3.44	12.62	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	10.75	3.44	12.62	150
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	150
	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
	R	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
	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
14.00	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
	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.



SERIES "3A"

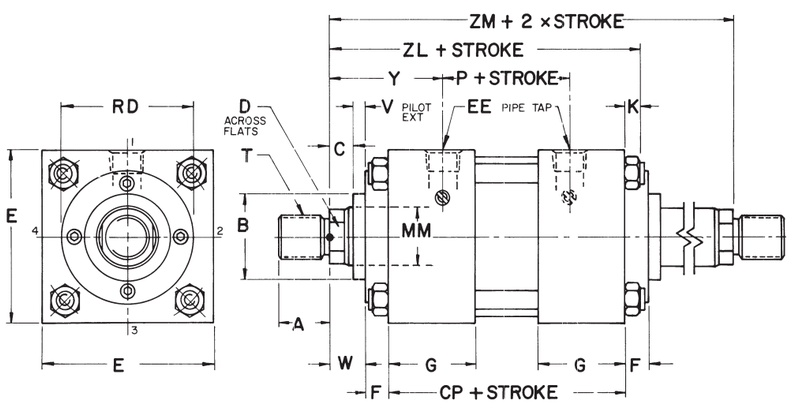
PNEUMATIC CYLINDERS

1.50" - 14.00" BORE

MX0-D

*** DOUBLE ROD END**

* Available in MS2, MS3, MS4, MS7, MF1, MF5, ME3, MT1 and MT4. See single rod pages for mounting dimensions.



These Dimensions are Constant Regardless of Rod Diameter

BORE	CP	E	EE (NPTF)	F	G	K	P	BORE
1.50	4.12	2.00	3/8	.38	1.50	.25	2.31	1.50
2.00	4.12	2.50	3/8	.38	1.50	.31	2.31	2.00
2.50	4.25	3.00	3/8	.38	1.50	.31	2.44	2.50
3.25	4.75	3.75	1/2	.62	1.75	.38	2.69	3.25
4.00	4.75	4.50	1/2	.62	1.75	.38	2.69	4.00
5.00	5.00	5.50	1/2	.62	1.75	.44	2.94	5.00
6.00	5.50	6.50	3/4	.75	2.00	.44	3.19	6.00
8.00	5.62	8.50	3/4	.75	2.00	.56	3.31	8.00
10.00	6.62	10.62	1	.75	2.25	.66	4.19	10.00
12.00	7.12	12.75	1	.75	2.25	.66	4.69	12.00
14.00	8.62	14.75	1 1/4	.75	2.75	.75	5.62	14.00

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 3A and 3AN Pneumatic Cylinders

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	B -.001 -.003	C	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	V	W	Y	ZL	ZM	RD*	PSI RATING†
1.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	5.75	6.12	--	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	6.12	6.88	--	250
2.00	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	5.44	6.12	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	5.81	6.88	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	6.44	7.38	--	250
2.50	D	.62	.75	1.125	.38	.50	.44-20	.50-20	.44-20	.25	.62	1.88	5.56	6.25	2.38	250
	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.50	1.00	2.25	5.94	7.00	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	6.56	7.50	--	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	6.81	8.00	--	250
3.25	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.50	7.50	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	2.62	6.75	8.00	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	7.62	8.50	--	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	7.75	8.75	--	250
4.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.50	7.50	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	2.62	6.75	8.00	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	7.62	8.50	--	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	7.75	8.75	--	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	8.00	9.25	--	250
5.00	F	1.00	1.12	1.500	.50	.88	.75-16	.88-14	.75-16	.25	.75	2.38	6.81	7.75	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	7.06	8.25	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	7.94	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	3.00	8.06	9.00	--	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	8.31	9.50	--	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	8.31	9.50	--	250
	M	3.50	3.50	4.250	1.00	3.00	2.50-12	3.25-12	2.50-12	.62	1.62	3.25	8.31	9.50	--	250
6.00	G	1.38	1.62	2.000	.62	1.12	1.00-14	1.25-12	1.00-14	.25	.88	2.75	7.56	8.75	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	3.00	7.81	9.25	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	7.94	9.50	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	8.94	10.00	--	250
	L	3.00	3.50	3.750	1.00	2.62	2.25-12	2.75-12	2.25-12	.50	1.50	3.38	8.94	10.00	--	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	8.94	10.00	---	250
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.38	8.94	10.00	--	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	7.81	8.88	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	3.00	8.06	9.38	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	8.19	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	3.38	8.44	10.12	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	3.38	8.44	10.12	--	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	8.44	10.12	--	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	8.44	10.12	--	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	8.44	10.12	--	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	9.16	10.38	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	9.28	10.62	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	9.53	11.12	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	3.44	9.53	11.12	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	9.53	11.12	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.44	9.53	11.12	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.44	9.53	11.12	--	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	3.19	9.78	11.12	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	10.03	11.62	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	3.44	10.03	11.62	--	150
	N	4.00	4.00	4.750	1.00	3.38	3.00-12	3.75-12	3.00-12	.50	1.50	3.44	10.03	11.62	--	150
	R	5.00	5.00	5.750	1.00	4.25	3.50-12	4.75-12	3.50-12	.50	1.50	3.44	10.03	11.62	--	150
	S	5.50	5.50	6.250	1.00	4.62	4.00-12	5.25-12	4.00-12	.50	1.50	3.44	10.03	11.62	--	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	3.69	11.62	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	3.69	11.62	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	3.69	11.62	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	3.69	11.62	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	3.69	11.62	13.12	--	150

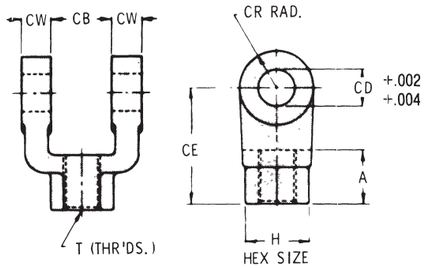
*Where RD is not shown, square retainer is used. See section for Retainer Construction.

†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.

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.

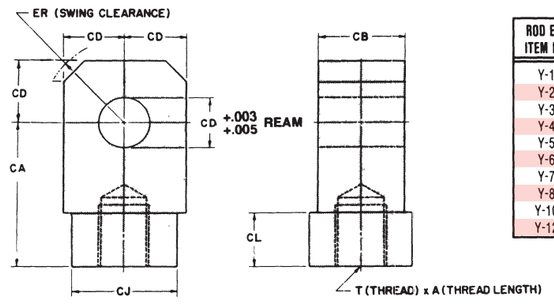
***CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended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

Rod Clevis



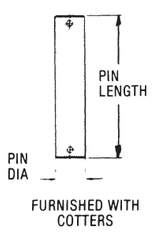
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-1	D	.75	75	50	1.50	.62	50	1 00	.44-20	5,360
V-2	F	1.12	1 25	.75	2 38	88	.62	1.25	75-16	14,000
V-3	G	1 62	1 50	1.00	3 12	1 12	75	1.75	1 00-14	22,500
V-4	H	2 00	2 00	1 37	4 12	1 62	1 00	2.00	1 25-12	41,250
V-5	J	2 25	2 50	1 75	4.50	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



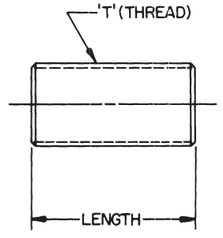
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-1	D	.75	1.50	.75	.50	-	-	.75	44-20	5,060
Y-2	F	1.12	2.06	1.25	.75	-	-	1.12	.75-16	12,500
Y-3	G	1.62	2.81	1.50	1 00	-	-	1.44	1 00-14	20,250
Y-4	H	2.00	3.44	2.00	1.37	-	-	2.00	1.25-12	37,000
Y-5	J	2.25	4.00	2.50	1.75	-	-	2.50	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



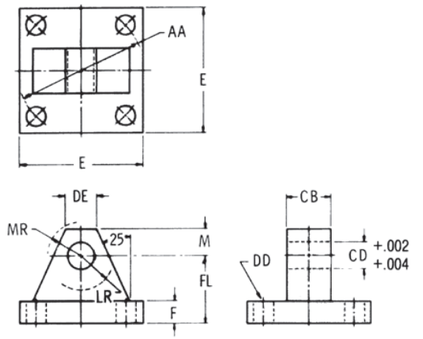
PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P1	2.28	50	6,125
P2	3.09	.75	13,800
P3	3 60	1 00	24,500
P4	4.66	1 37	46,500
P5	5.66	1 75	75,150
P6	5 72	2 00	98,150
P7	6.94	2 50	153,400
P8	7 19	3 00	220,900
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

Piston Rod Stud



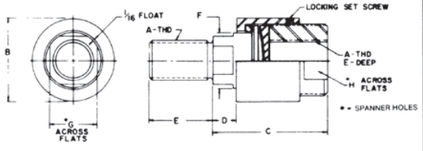
ITEM NO.	T	LENGTH
Stud 1	44-20	1.50
Stud 2	75-16	2.25
Stud 3	1 00-14	3.25
Stud 4	1 25-12	4 00
Stud 5	1 50-12	4.50

Brackets



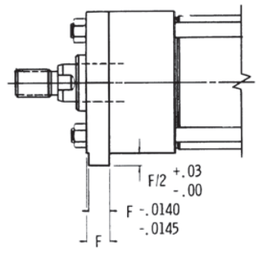
BORE DIA.	BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
1.50, 2 00 2 50	B-1	2.30	.75	500	.44	.56	2.50	.38	1.12	.62	50	.62	2,500
3.25, 4 00 5 00	B-2	3 60	1 25	750	.56	.88	3 50	62	1.88	.88	75	.88	6,300
6 00 8.00	B-3	4 60	1.50	1.000	.69	1 38	4.50	.75	2.25	1 25	1 00	1.25	10,000
10.00	B-4	5.40	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

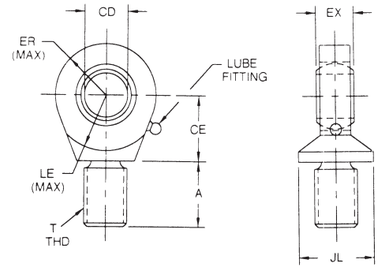
Thrust Key



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

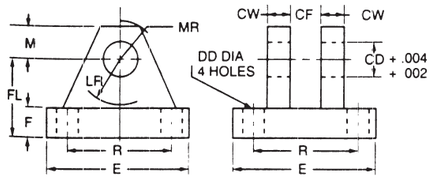
Order to fit Piston Rod thread size.



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

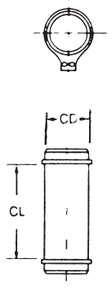
Order to fit Mounting Plate or Rod Eye.



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	1.55	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.

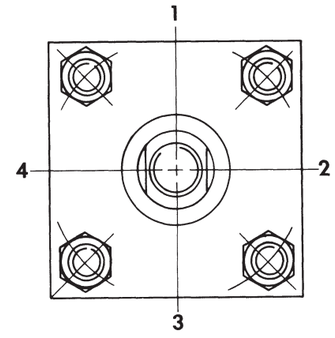
DESCRIPTION **PAGE**

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.

PIPE PORT NUMBERING AND POSITIONING

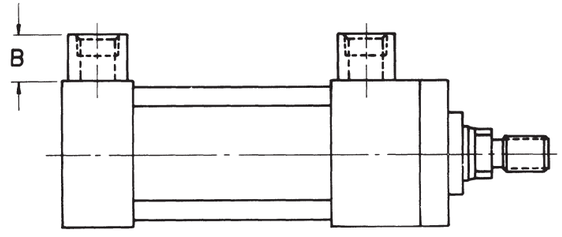


Postion location for both the Front Head and Blind Head is determined by viewing the cylinder at the Rod End.

SERIES "3A" OPTIONAL PORTING

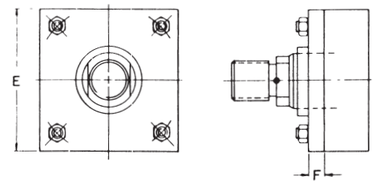
BORE	STANDARD NPT PORT	OVERSIZE BOSSED NPT*	DIM B	STANDARD SAE PORT	OVERSIZE* BOSSED SAE
1.50	3/8	1/2	15/16	9/16-18	7/8-14
2.00	3/8	1/2	15/16	9/16-18	7/8-14
2.50	3/8	1/2	15/16	9/16-18	7/8-14
3.25	1/2	3/4	15/16	7/8-14	1 1/16-12
4.00	1/2	3/4	15/16	7/8-14	1 1/16-12
5.00	1/2	3/4	15/16	7/8-14	1 1/16-12
6.00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

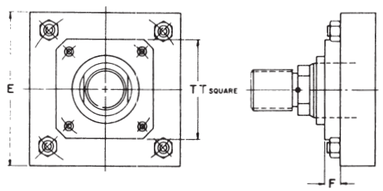


RETAINER PLATE CONSTRUCTION

SQUARE RETAINER CONSTRUCTION

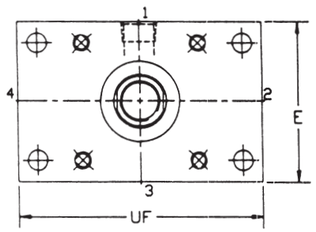


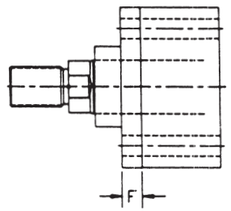
BORE	RODS
1.50	D,F
2.00	G
2.50	G,H
3.25	H,J
4.00	H,J,K
5.00	H,J,K,L,M
6.00	K,L,M,N



BORE	ROD	TT
8.00 THRU 14.00	L,N	5.50
	R,S	7.00

ME5 RETAINER CONSTRUCTION



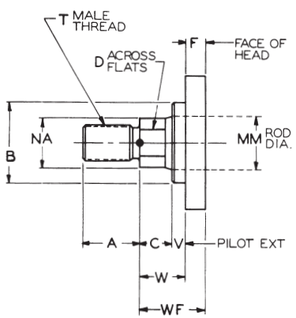


BORE	ROD DIA.
1.50	D (.62) & F (1.00)
2.00	G (1.38)
2.50	H (1.75)
3.25	J (2.00)

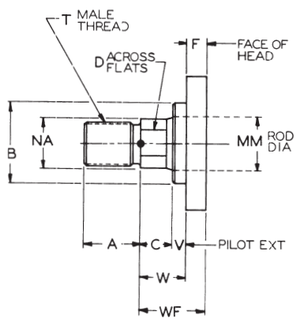
ROD END STYLES SERIES "3A"

STANDARD ROD END STYLES

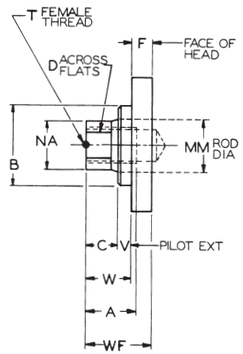
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD



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.

Series 3A and 3AN Pneumatic Cylinders

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 50	70	90	100	150	FLUID REQUIRED PER INCH OF STROKE CU FT
			PUSH	1.77	89	124	160	177	266	.00102
1.50	PDQ D	.62		1.46	73	102	131	146	219	.00084
	F	1.00		.98	49	69	88	98	147	.00057
			PUSH	3.14	157	220	283	314	471	.00182
2.00	PDQ D	.62	P	2.83	142	198	255	283	424	.00164
	F	1.00	U	2.36	118	165	212	236	354	.00136
	G	1.38	L	1.66	83	116	149	166	249	.00096
			PUSH	4.91	245	344	442	491	736	.00284
	PDQ D	.62	P	4.60	230	322	414	460	690	.00266
2.50	F	1.00	U	4.13	206	289	372	413	620	.00239
	G	1.38	L	3.43	172	240	309	343	515	.00198
	H	1.75	L	2.50	125	175	225	250	375	.00145
			PUSH	8.29	414	580	746	829	1244	.00480
	PDQ F	1.00	P	7.51	375	525	676	751	1126	.00435
3.25	PDQ G	1.38	U	6.81	340	477	613	681	1022	.00394
	H	1.75	L	5.88	294	412	529	588	882	.00341
	J	2.00	L	5.15	258	360	464	515	772	.00298
			PUSH	12.57	628	880	1131	1257	1886	.00727
	PDQ F	1.00	P	11.78	589	825	1060	1178	1767	.00682
	PDQ G	1.38	U	11.08	554	776	997	1108	1662	.00641
4.00	H	1.75	L	10.15	508	710	914	1015	1522	.00588
	J	2.00	L	9.43	472	660	849	943	1416	.00545
	K	2.50		7.66	383	536	689	766	1149	.00443
			PUSH	19.64	982	1375	1768	1964	2946	.01136
	PDQ F	1.00	P	18.85	942	1319	1696	1885	2827	.01091
	G	1.38		18.15	908	1270	1633	1815	2722	.01050
	H	1.75	U	17.22	861	1205	1550	1722	2583	.00997
5.00	J	2.00	L	16.50	825	1155	1485	1650	2475	.00954
	K	2.50		14.73	737	1031	1326	1473	2210	.00852
	L	3.00	L	12.57	628	880	1131	1257	1885	.00727
	M	3.50		10.02	501	701	902	1002	1503	.00580
			PUSH	28.27	1413	1979	2544	2827	4240	.01636
	PDQ G	1.38	P	26.79	1339	1875	2411	2679	4018	.01550
	H	1.75		25.86	1293	1810	2327	2586	3879	.01497
6.00	J	2.00	U	25.13	1256	1759	2262	2513	3770	.01454
	K	2.50	L	23.36	1168	1635	2102	2336	3504	.01352
	L	3.00		21.20	1060	1484	1908	2120	3180	.01227
	M	3.50	L	18.65	933	1306	1678	1865	2798	.01079
	N	4.00		15.70	785	1099	1413	1570	2355	.00909
			PUSH	50.26	2513	3518	4523	5026	7539	.02909
	G	1.38		48.78	2439	3415	4390	4878	7317	.02823
	H	1.75	P	47.85	2392	3350	4306	4785	7178	.02770
	J	2.00		47.12	2356	3298	4241	4712	7068	.02727
8.00	K	2.50	U	43.35	2268	3174	4082	4535	6804	.02625
	L	3.00	L	43.19	2160	3023	3887	4319	6478	.02500
	N	4.00		37.69	1884	2638	3392	3769	5655	.02182
	R	5.00	L	30.62	1531	2143	2756	3062	4593	.01773
	S	5.50		26.50	1325	1855	2385	2650	3975	.01534
			PUSH	78.54	3927	5498	7069	7854	11781	.04545
	H	1.75		76.13	3806	5329	6852	7613	11420	.04406
	J	2.00	P	75.40	3770	5279	6787	7540	11310	.04363
	K	2.50	U	73.63	3681	5154	6627	7363	11044	.04261
10.00	L	3.00		71.47	3573	5003	6432	7147	10720	.04136
	N	4.00	L	65.97	3298	4618	5937	6597	9896	.03818
	R	5.00		58.90	2945	4123	5301	5890	8835	.03409
	S	5.50	L	54.78	2739	3835	4930	5478	8217	.03170
			PUSH	113.10	5655	7917	10179	11310	16965	.06545
	J	2.00	P	109.96	5498	7697	9896	10996	16494	.06363
	K	2.50		108.19	5409	7573	9737	10819	16228	.06261
12.00	L	3.00	U	106.03	5302	7422	9543	10603	15904	.06136
	N	4.00	L	100.53	5026	7037	9048	10053	15080	.05818
	R	5.00		93.47	4673	6543	8412	9347	14020	.05409
	S	5.50	L	89.34	4467	6254	8041	8934	13401	.05170
			PUSH	153.94	7697	10776	13855	15394	23091	.0891
	K	2.50	P	149.03	7452	10432	13413	14903	22355	.0862
	L	3.00		146.87	7344	10281	13218	14687	22031	.0850
14.00	N	4.00	U	141.37	7068	9896	12723	14137	21205	.0818
	R	5.00	L	143.30	6715	9401	12087	13430	20145	.0777
	S	5.50	L	130.18	6509	9113	11716	13018	19527	.0753

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.

NOTE: See application figures on next page.

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 = 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	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".

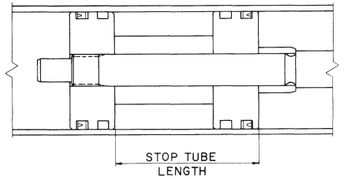
Series 3A and 3AN Pneumatic Cylinders

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" CONSTRUCTION



"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":

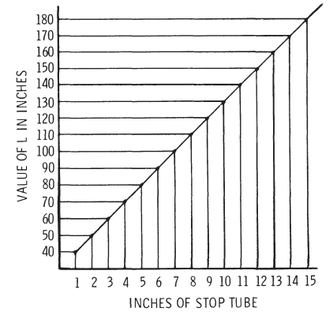
ADD:	MP1	"XC" Dimension	7-3/4"
	V-6	"CE" Dimension	5-1/2"
	Two times stroke (2 x 27)		54"
	Total Value of "L"		67-1/4"

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

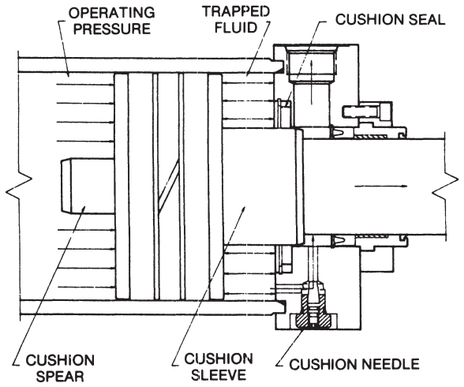
The amount of stop tube will increase the stroke-plus dimensions of the cylinder by the same value. Add length of the stop tube to the value of "L" and recheck column strength on stroke limitation chart.

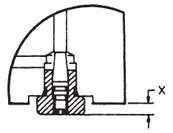
ROD END CONNECTION	
FIXED & WELL GUIDED	FIG 1 D "L" = 0.5 X D
PIVOTED AND WELL GUIDED	FIG. 2 D "L" = 0.7 X D
SUPPORTED NOT WELL GUIDED	FIG 3 D "L" = 2 X D
PIVOTED AND WELL GUIDED	FIG 4 D "L" = 0.7XD FOR LONG STROKE SUPPORT HEAD; HEAD NOT SUPPORTED D "L" = D
	FIG 5 D "L" = 0.7 X D
	FIG 6 D "L" = D
	FIG 7 D "L" = D
	D D FIG 8 "L" = D

STOP TUBE CHART



CYLINDER CUSHION





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

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

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 wher 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.

DETERMINING ENERGY OF THE APPLICATION

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 CUSHION LENGTH	HEAD END CAPACITY (IN.-LBS.)	CAP END CUSHION LENGTH	CAP END 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		
	4.00	.81	2,170		
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		
	5.00	1.00	4,545		
	5.50	1.00	4,545		
10.00	1.75	1.00	7,850	1.31	10,720
	2.00	1.00	7,850		
	2.50	1.00	7,675		
	3.00	1.00	7,200		
	4.00	1.00	6,885		
	5.00	1.00	5,695		
	5.50	1.00	5,695		
12.00	2.00	1.00	11,480	1.03	12,056
	2.50	1.00	11,305		
	3.00	1.00	10,825		
	4.00	1.00	10,510		
	5.00	1.00	9,325		
	5.50	1.00	9,325		
14.00	2.50	1.00	15,595	1.28	20,471
	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:
$0.1865 \times 50 \text{ lbs.} \times (3)^2$
$9.32 \times 9 = 84$ in. lbs.
Propelling Energy:
$8.29 \times 80 \times .81 = 537$
Total Application Energy:
$84 + 537 = 621$ 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.

INSTALLATION, OPERATION AND MAINTENANCE DATA

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.

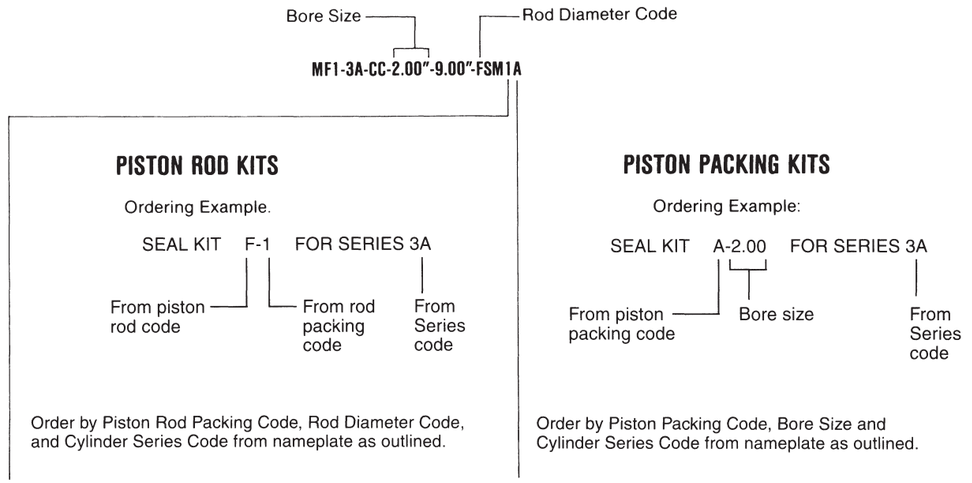
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned 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



1 (STANDARD)
Temperature Range -20° F to +200° F
Buna-N O-Rings, Polyurethane Rod Packing and Polyurethane 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.

*Teflon Rod Wiper recommended for Series 3AN.

A (3A STANDARD)
Temperature Range -20° F to +200° F
Buna-N U-Cups, Teflon Back-Up Washers, Buna-N Tube Seals.

B (3A OPTIONAL)
Temperature Range -20° F to +400° F
Viton U-Cups, Teflon Back-Up Washers, Viton Tube Seals.

G (3AN STANDARD, 3A OPTIONAL)
Temperature Range -20° F to +200° F
Piston Wear Strip(s), Filled Teflon Seal w/Buna-N Expander, Buna-N Tube Seals.

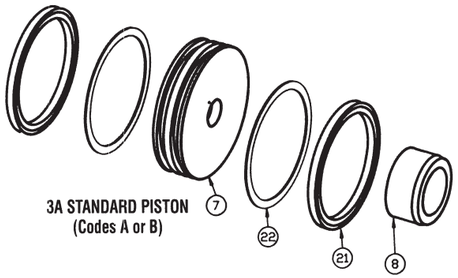
H (3A, 3AN OPTIONAL)
Temperature Range -20° F to +400° F
Piston Wear Strip(s), Filled Teflon Seal w/Viton Expander, Viton Tube Seals.

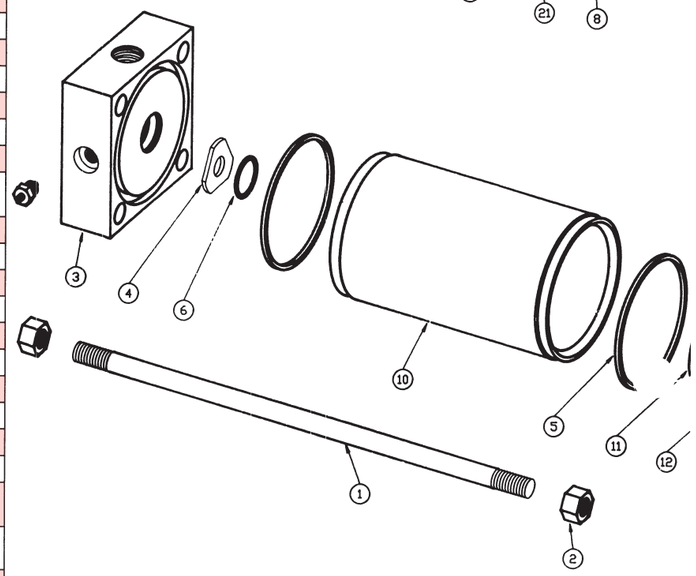
PARTS LIST

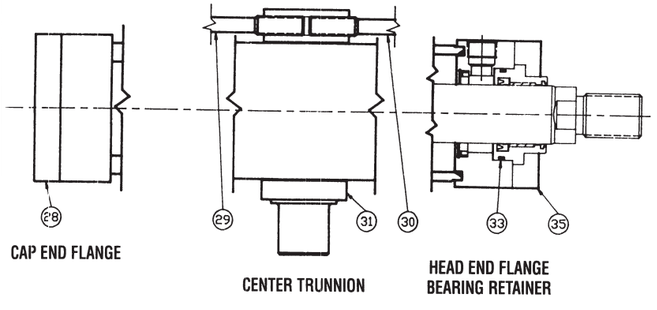
When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

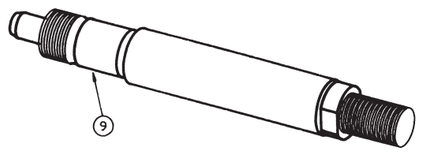
PART NO.	NO. REQ'D.	DESCRIPTION
1	**	Tie Rod
2	**	Tie Rod Nut
3	1	Cap
4	1	Cap Cushion Float
5	2	O-Ring (Tube)
6	1	Cap Retaining Ring
7	1	3A Standard Piston
8	1	Cushion Sleeve
9	1	Piston Rod
10	1	Tube
11	1	Head Cushion Retaining Ring
12	1	Head Cushion Float
13	1	Packing Retaining Ring
14	1	Rod Washer
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

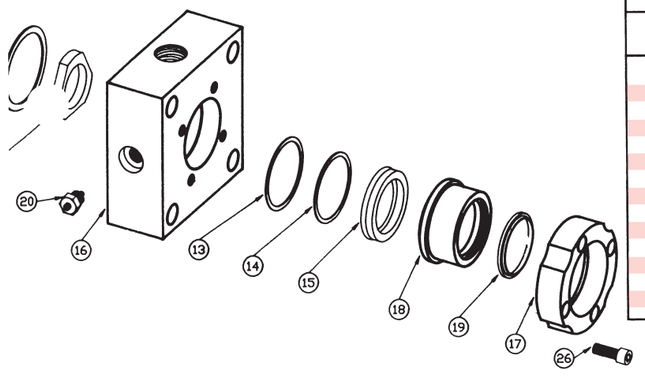
** As required

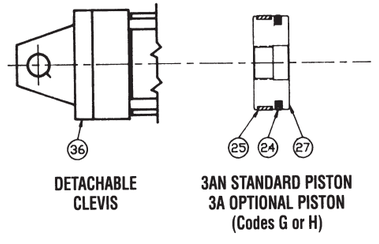












FASTENER TORQUES

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

OPTIONS

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
Metallic Rod Scrapers
Super Cushions
Spring Return Cushions
Stainless Steel Piston Rods
Epoxy Painting Full Face
Rod Boots
Heavy Chrome Plated Piston Rods
Intermediate Center Supports
Tightened Stroke Tolerance
Retainer Plates
MP3 Mount
MS1 Mount
Self Aligning Rode End Couplings
Tandem Mounted Cylinders

Contact factory for other special options.

HOW TO ORDER

MF1 * 3A-CC-2.00"-9.00"-FSM1A

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 Detatchable 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.**

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

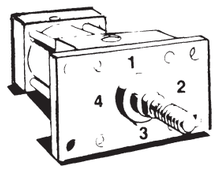
STANDARD —Buna Packings with Teflon Back-Ups, Buna Tube Seals . . . **A**
OPTIONAL —Viton Packings with Teflon Back-Ups, Viton Tube Seals . . . **B**
OPTIONAL —Wear Strips, Filled Teflon Seal with Buna Expander, Buna Tube Seals . . . . . **G**
OPTIONAL —Wear Strips, Filled Teflon Seal with Viton Expander, Viton Tube Seals . . . . . **H**

NOTE: Cushion needles furnished with viton seals.

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

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.

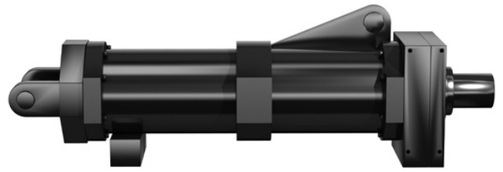


Port location: if other than position 1, must be specified. Mounting accessories must be specified if required.

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



CONTENTS

Series MT

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.

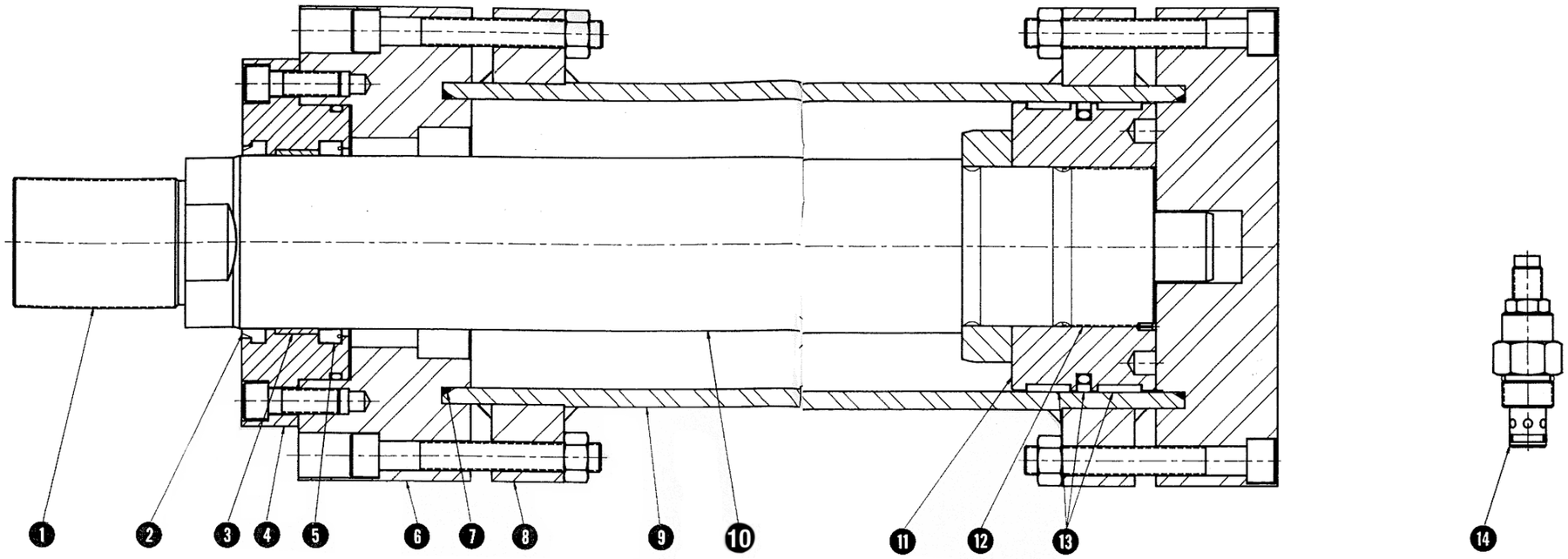
In addition, Hanna offers a wide range of options and accessories to enhance the performance of MT cylinders. Included are proximity switches and, for the ultimate in precision control, our Closed Loop Electronic Feedback device.

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



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 anerobic 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 generation occurs, thereby prolonging both bearing and seal life.

Duralon Rod Bearing in steel cartridge.

Optional Bronze Bearing.

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.

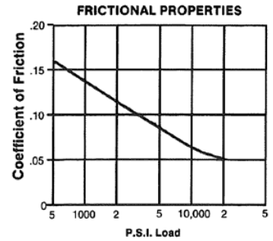
DURALON VS. COMPETITIVE BEARING MATERIALS

COMPARISON OF NON-LUBRICATED BEARINGS AND THEIR OPERATING LIMITS		LOAD CAPACITY (PSI)
Porous Bronze	*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.

FRICTIONAL PROPERTIES



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)

Series MT

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.

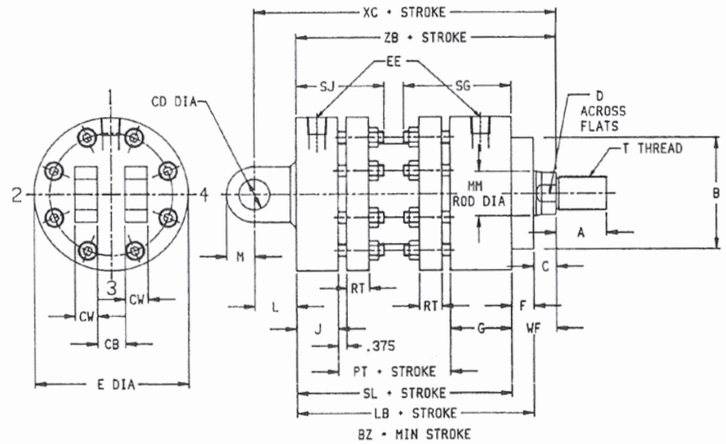
If you are using a zero-leak check valve circuit, however, it may require the use of optional zero-drift U-cup seals to maintain absolute position. The miniscule by-pass with our standard seal may result in some very minor drift. Both Poly-Pak and Viton U-cups seals are available.

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 SAE STRAIGHT THREAD	EE NPTF*	F	G	J	L	LB	M	PT
2.00	3.25	1.38	0.81	1.00	0.750	0.75	4.12	#8 (.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

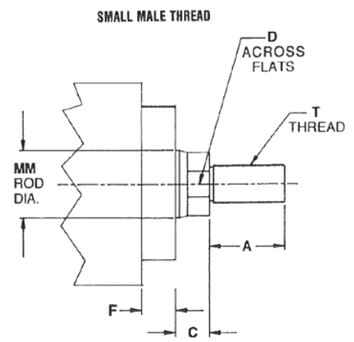
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

NOTE: Pivot Pin included.

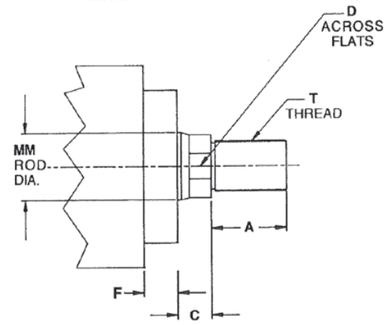
Series MT

STANDARD ROD END STYLES

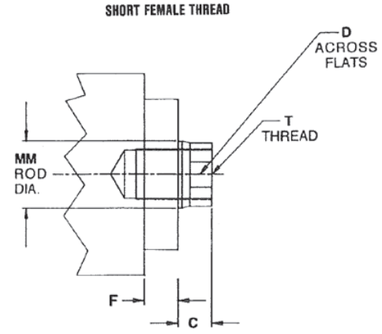
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

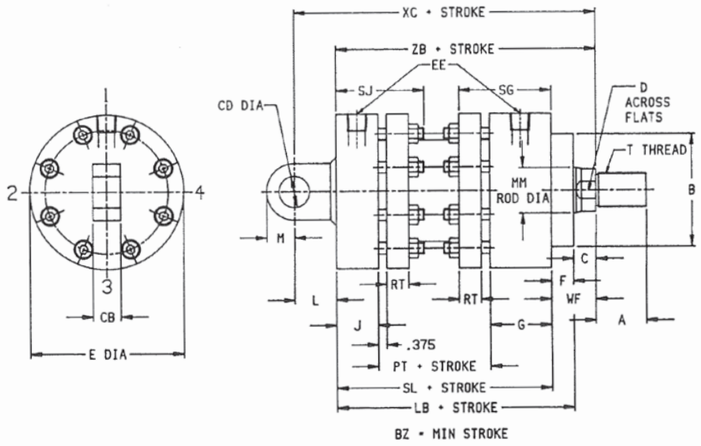


Dimensions are Affected by the Rod Diameter MP1

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTER-MEDIATE MALE	T (THREAD) 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	5.50	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
	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	5.50	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

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 SAE STRAIGHT THREAD	EE NPTF*	F	G	J	L	LB	M	PT	RT
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

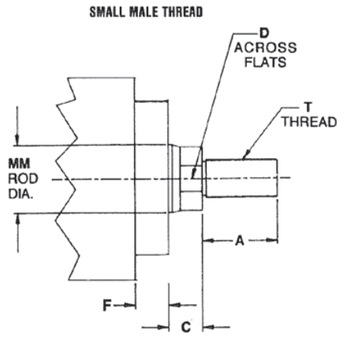
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

NOTE: Pivot Pin not included.

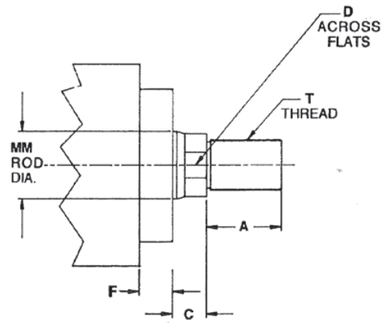
Series MT

STANDARD ROD END STYLES

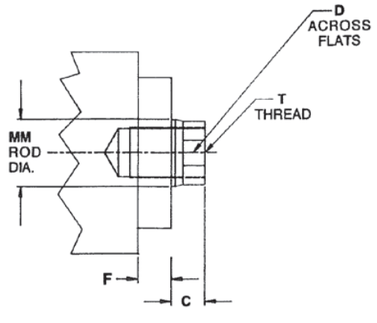
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



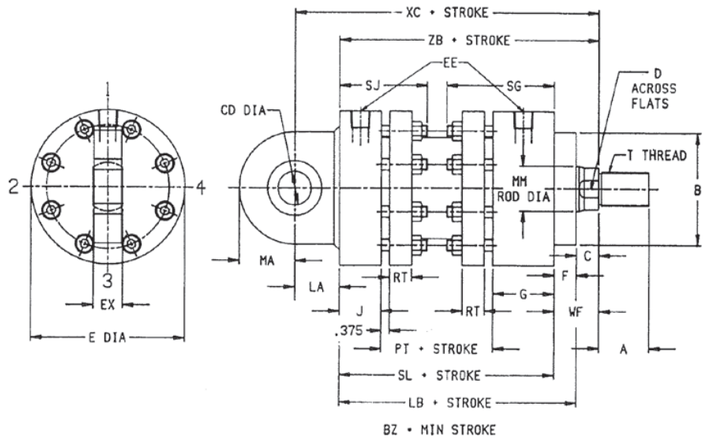
SHORT FEMALE THREAD



Dimensions are Affected by the Rod Diameter MP3

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTER-MEDIATE MALE	T (THREAD) 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	5.50	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
	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	5.50	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"-9.00" Bores
MPU3 Spherical Bearing Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	CD +.000 -.001	E	EE SAE STRAIGHT THREAD	EE NPTF*	EX	F	G	J	LA	LB	MA	PT	RT
2.00	3.25	1.38	0.81	0.750	4.12	#8 (.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.

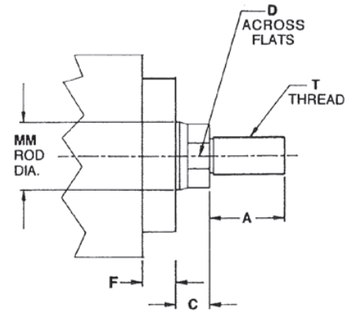
BORE	SG	SJ	SL	WF	XC	ZB
2.00	3.47	2.59	5.00	1.81	8.06	6.81
3.00	4.22	3.34	6.12	2.00	9.88	8.12
4.00	4.78	3.91	6.62	2.00	10.62	8.62
5.00	5.41	4.53	7.62	2.00	12.12	9.62
6.00	6.19	5.19	8.38	2.25	13.38	10.62
7.00	6.69	5.69	8.50	2.25	13.75	10.75
8.00	6.81	5.69	9.62	2.56	15.43	12.19
9.00	6.81	5.69	9.88	2.56	15.69	12.43

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

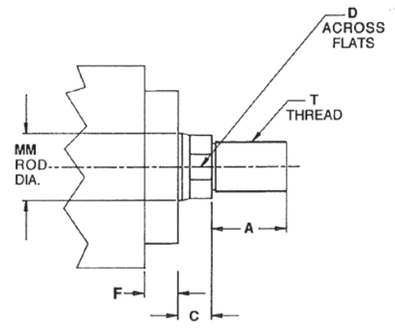
NOTE: Spherical Bearing is rated for 2000 P.S.I. Dynamic Load.

STANDARD ROD END STYLES

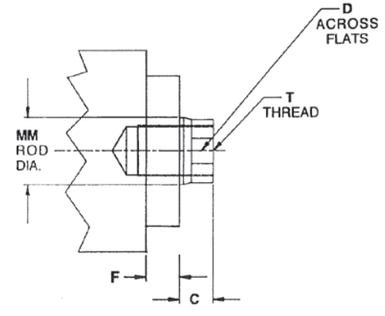
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD



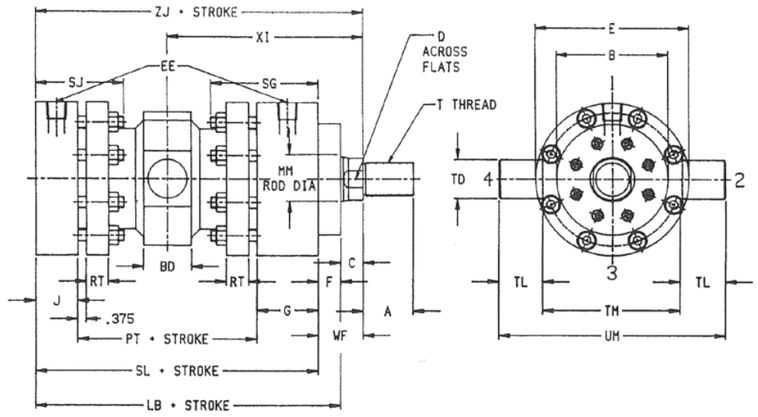
Dimensions are Affected by the Rod Diameter MPU3

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTER-MEDIATE MALE	T (THREAD) 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	5.50	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

Series MT

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 SAE STRAIGHT THREAD	EE NPTF*	F	G	J	LB	PT	RT	SG	SJ	SL
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

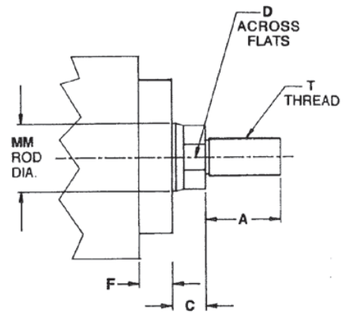
NOTE: Trunnion location (XI) must be specified when ordering.

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

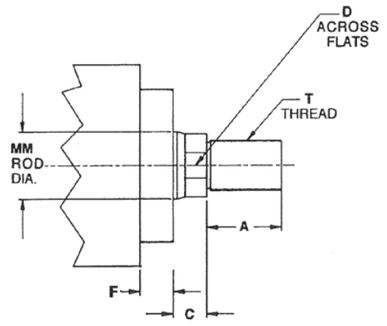
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

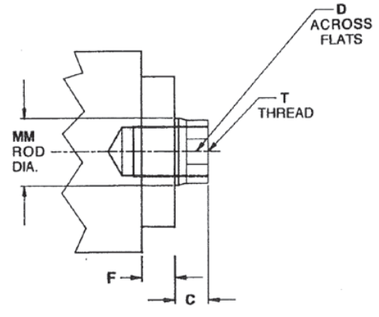
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



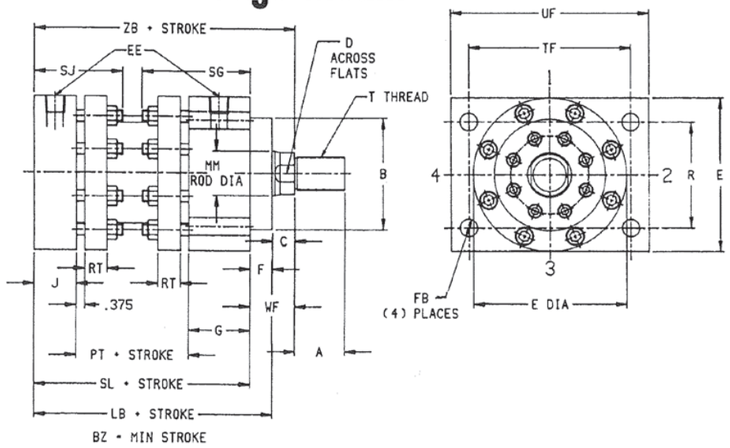
SHORT FEMALE THREAD



Dimensions are Affected by the Rod Diameter **MT4**

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTER-MEDIATE MALE	T (THREAD) 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	5.50	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
	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	5.50	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
ME5 Head Flange Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	E	EE SAE STRAIGHT THREAD	EE NPTF*	F	FB	G	J	LB	PT	R	RT	SG
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

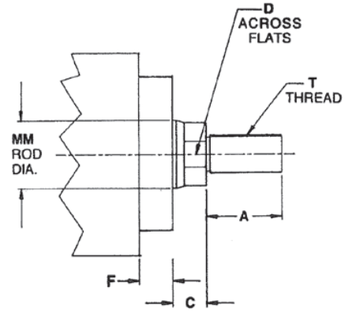
*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

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

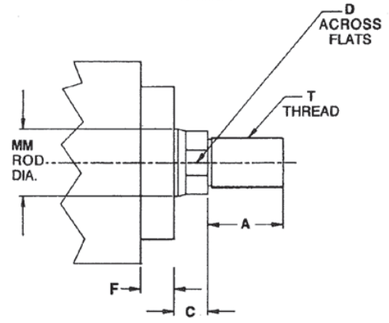
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

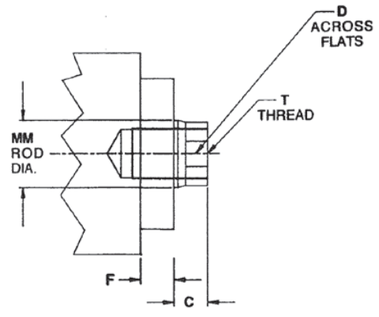
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



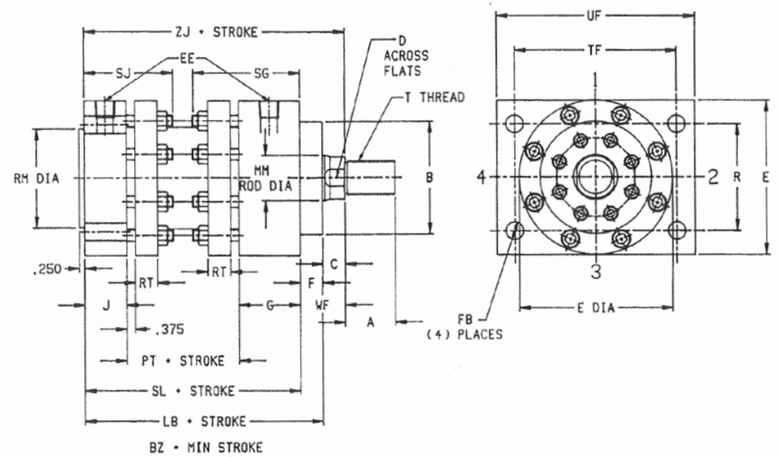
SHORT FEMALE THREAD



Dimensions are Affected by the Rod Diameter **ME5**

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTERMEDIATE MALE	T (THREAD) 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	5.50	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
	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	5.50	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 SAE STRAIGHT THREAD	EE NPTF*	F	FB	G	J	LB	PT	R	RM +.000 -.002	RT	SG
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	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	10.03

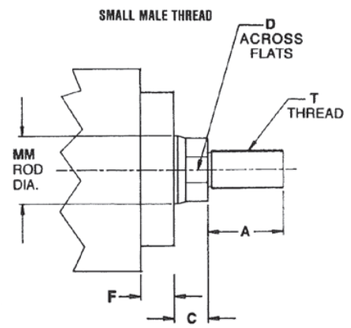
*NPTF ports will be furnished unless SAE straight thread ports are specified.
Optional SAE 4-Bolt Flange Ports may be specified—Flange furnished by customer.

BORE	SJ	SL	TF	UF	WF	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

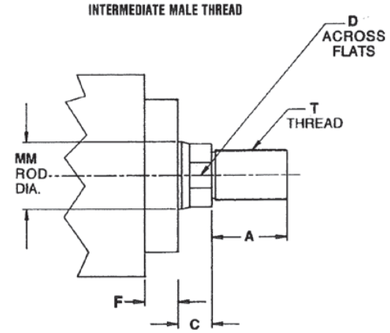
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

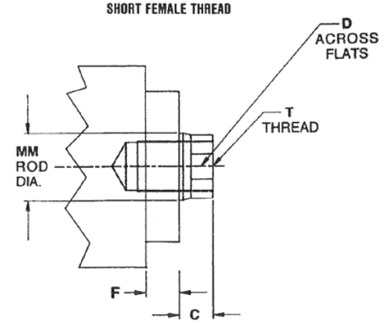
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



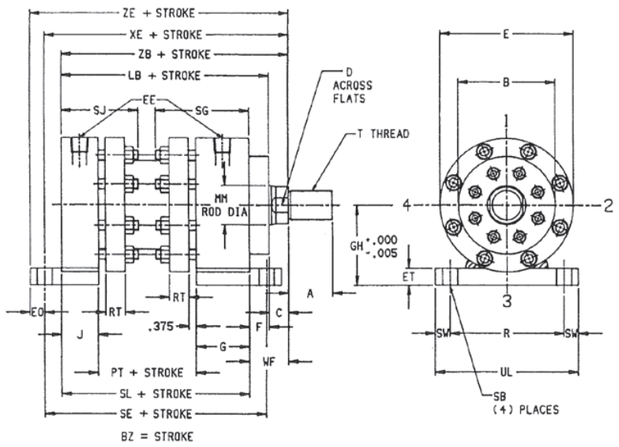
SHORT FEMALE THREAD



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	3.30	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	5.50	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
	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	5.50	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
MS7 End Lug Mount



These Dimensions are Constant Regardless of Rod Diameter

BORE	B	BZ	C	E	EE SAE STRAIGHT THREAD	EE NPTF*	EO	ET	F	G	GH	J	LB	PT	R	RT	SB
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

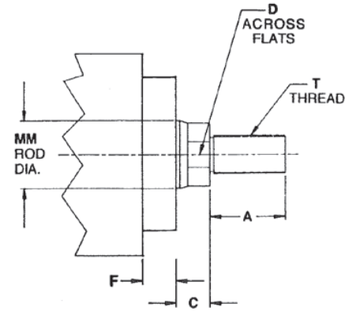
CAUTION: Check for interference between rod attachment and mounting lug. Specify longer than standard "C" dimension if necessary.

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.

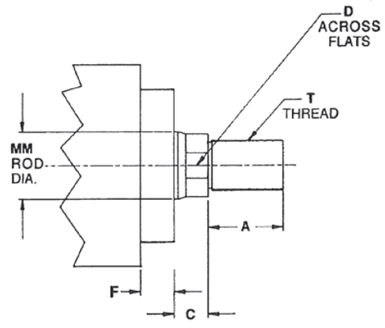
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

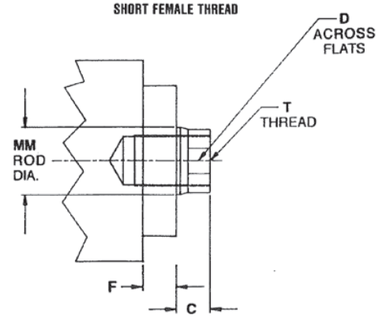
SMALL MALE THREAD



INTERMEDIATE MALE THREAD



SHORT FEMALE THREAD

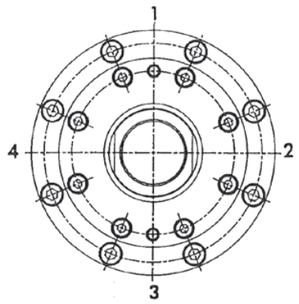


Dimensions are Affected by the Rod Diameter MS7

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SM SMALL MALE	T (THREAD) IM INTER-MEDIATE MALE	T (THREAD) 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	5.50	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
	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	5.50	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	—	—

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.



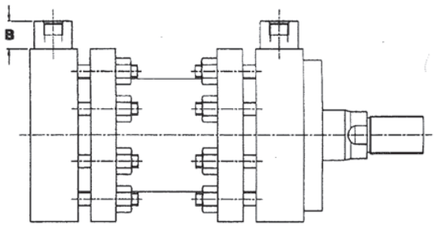
Standard ports will be supplied at Position 1. Orders should specify pipe port locations if other than standard. Optional ports and bossed ports are available. Refer to the charts below to select the appropriate port.

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

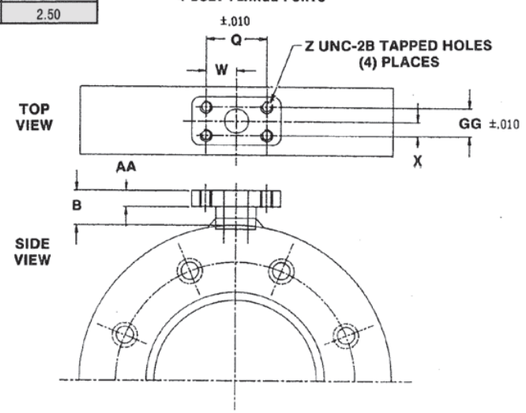
BORE	STANDARD SAE PORT	OVERSIZED BOSSED SAE	DIM. B	STANDARD NPTF PORT	OVERSIZED BOSSED PORT
2.00	#8 (.750-16)	#12 (1.062-12)	0.75	.50	.75
3.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
4.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
5.00	#12 (1.062-12)	#16 (1.312-12)	1.00	.75	1.00
6.00	#16 (1.312-12)	#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



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

4-BOLT FLANGE PORTS



HYDRAULIC FORCE DATA

The formula for determining the force producd by a cylinder is

F = A X 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 x 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 x 1250 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 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	Gallons of Oil Consumed Per Inch of Travel
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	95430	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. 250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	Gallons of Oil Consumed Per Inch of Travel
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

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 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.

NOTE: SEE APPLICATION FIGURES ON NEXT PAGE.

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."

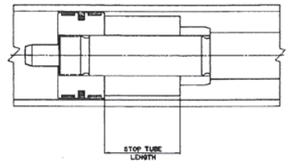
FORCE VALUE in pounds	VALUE OF "L" IN INCHES — PISTON ROD DIAMETER												
	1.00	1.38	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	7.00	8.00
400	85													
600	70	132												
800	60	114	184											
1000	54	102	165	215										
1300	47	90	145	188										
1700	41	78	127	165	258									
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":

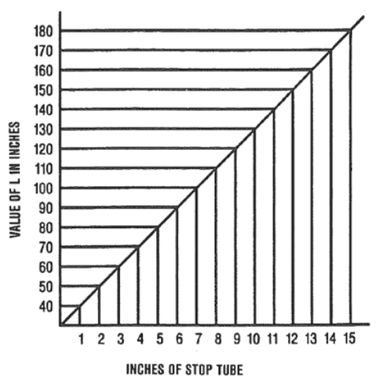
2 x Stroke (2 x 45) = 90

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



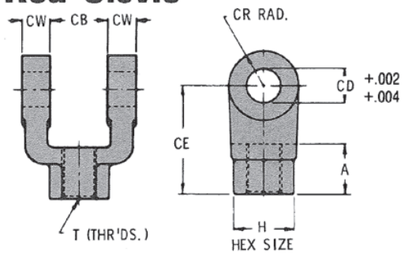
ROD END CONNECTION	
FIXED & WELL GUIDED	FIG. 1 — "L" = 0.5 X D
PIVOTED AND WELL GUIDED	FIG. 2 — "L" = 0.7 X D
SUPPORTED NOT WELL GUIDED	FIG. 3 — "L" = 2 X D
PIVOTED AND WELL GUIDED	FIG. 4 — "L" = 0.7XD FOR LONG STROKE SUPPORT HEAD; HEAD NOT SUPPORTED — "L" = D
	FIG. 5 — "L" = 0.7 X D
	FIG. 6 — "L" = 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.

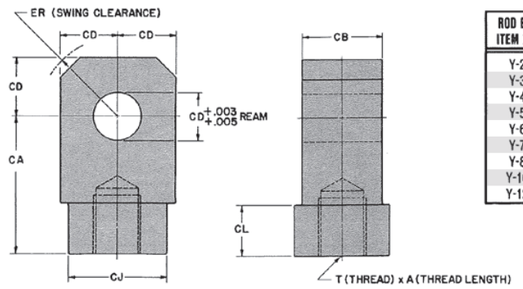
Rod Clevis

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

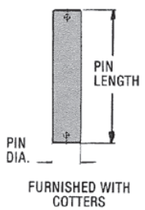
Rod Eye



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

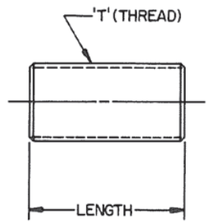
Pin

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

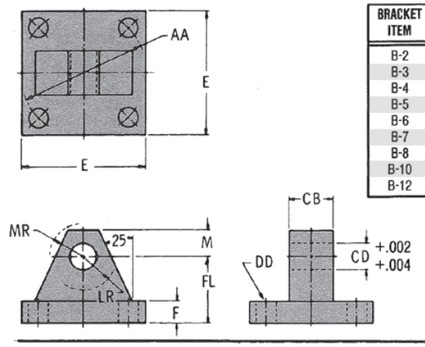
Piston Rod Stud



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

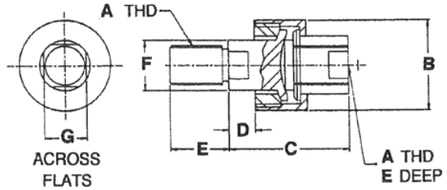
Brackets

Use with Item V Rod Clevis and Item P Pin.



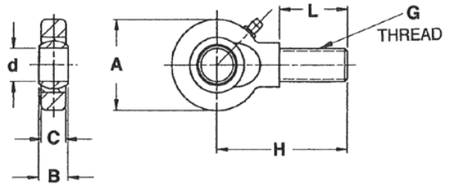
BRACKET ITEM	AA	CB	CD	DD	DE	E	F	FL	LR	M	MR	*LBS. CAPACITY
B-2	3.60	1.25	.750	.56	.88	3.50	.62	1.88	.88	.75	.88	6,300
B-3	4.60	1.50	1.000	.69	1.38	4.50	.75	2.25	1.25	1.00	1.25	10,000
B-4	5.40	2.00	1.375	.69	1.75	5.00	.88	3.00	1.75	1.38	1.75	19,250
B-5	7.00	2.50	1.750	.94	2.25	6.50	.88	3.12	2.12	1.75	2.12	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



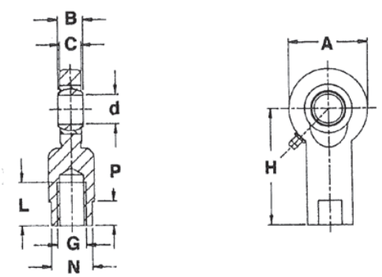
PART NO.	A	B	C	D	E	F	G	H	MAX. PULL LOAD
S-2	.750-16	1.75	2.31	0.50	1.12	0.94	0.81	1.12	8.750
S-3	1.000-14	2.50	2.94	0.53	1.62	1.34	1.16	1.62	16.125
S-4	1.250-12	2.50	2.94	0.53	1.62	1.34	1.16	1.62	19.600
S-5	1.500-12	3.25	4.38	0.88	2.25	1.94	1.75	2.38	34.000
S-6	1.875-12	3.75	5.62	1.00	3.00	2.94	—	—	41.250
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

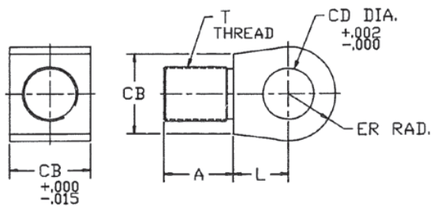
PART NO.	d	B	H	G	L	A	C	LBS. CAPACITY
UMY-12	0.75	0.66	3.00	.750-16	1.56	2.06	0.56	7500
UMY-20	1.25	1.09	4.56	1.250-12	2.56	3.31	0.94	20700
UMY-24	1.50	1.31	5.41	1.500-12	3.06	4.00	1.12	29800
UMY-28	1.75	1.53	6.31	1.750-12	3.56	4.62	1.31	40800
UMY-32	2.00	1.75	7.19	2.000-12	4.06	5.25	1.50	52800
UMY-36	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

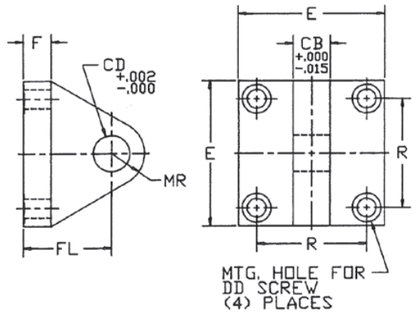
Male Rod Eye



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.

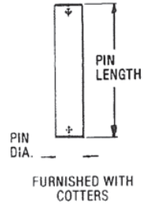


BRACKET ITEM NO.	CB	CD	DD	E	F	FL	MR	R	*LBS. CAPACITY
MB-2	1.00	.752	.38	3.00	.56	1.75	.62	2.25	7,350
MB-3	1.25	1.252	.62	5.00	.94	3.00	1.12	3.75	18,562
MB-4	1.25	1.377	.75	6.00	1.19	3.88	1.25	4.50	21,000
MB-5	1.25	1.502	1.00	7.00	1.44	4.62	1.38	5.00	23,625
MB-6	1.50	1.752	1.25	8.25	1.69	5.62	1.62	6.00	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



FURNISHED WITH COTTERS

***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.

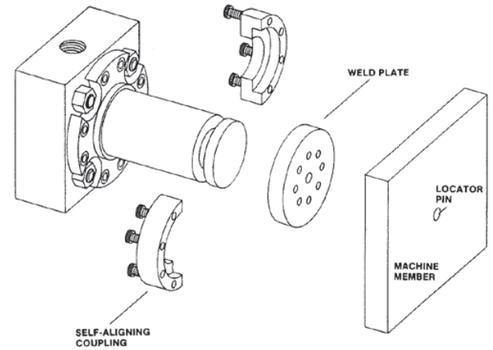
Self-Aligning Rod End Coupling

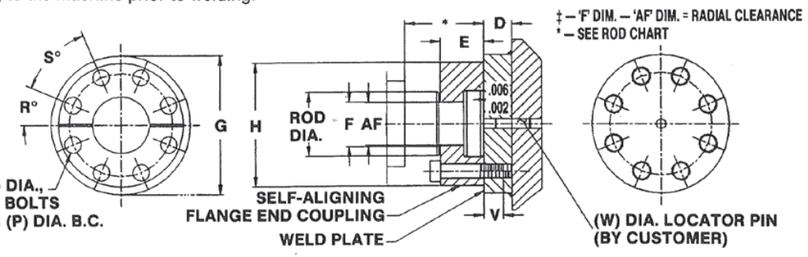
Hanna's Self-Aligning Rod End Coupling permits fast, easy assembly, disassembly, installation and servicing. Precision-machined, two-piece steel construction provides close radial alignment between piston rod end and machine member.

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 conjuction 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.



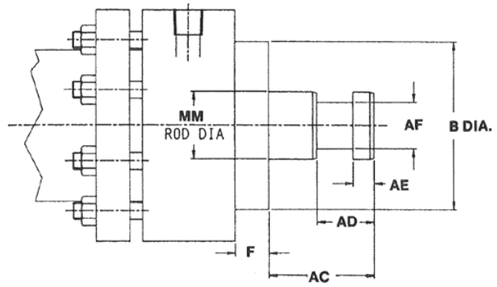


COUPLING NO.	ROD DIA. MM	AF ‡	E	F ‡	H	M	N	P	R	S	V	WELD PLATE NO.	D	G	W PIN DIA.	BOLT TORQ. FT. LB.
CP—100	1.00	.688	.62	.750	2.00	.250-20	6	1.50	30	60	.375	WP—100	.500	2.50	.25	13
CP—138	1.38	.875	.69	.938	2.50	.312-18	6	2.00	30	60	.562	WP—138	.625	3.00	.25	25
CP—175	1.75	1.12	.88	1.19	3.00	.375-16	8	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

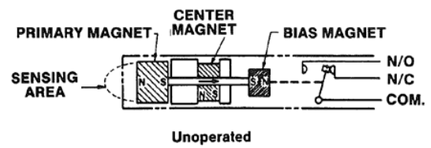
Proximity Switches

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 bias 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.

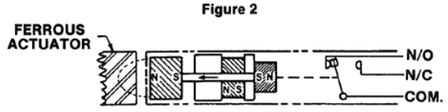
When a ferrous actuator enters the sensing area of the switch (Figure 2), the magnetic attraction of the primary magnet to the center magnet is weakened. The primary magnet moves toward the actuator, pulling the connecting rod forward and moving the common terminal to the Normally Open (N/O) contact position.

Figure 1



Unoperated

Figure 2

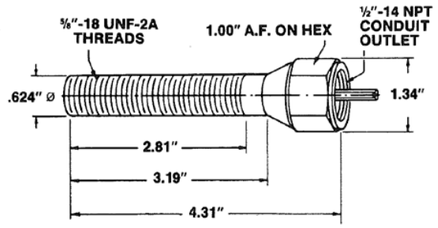


Operated

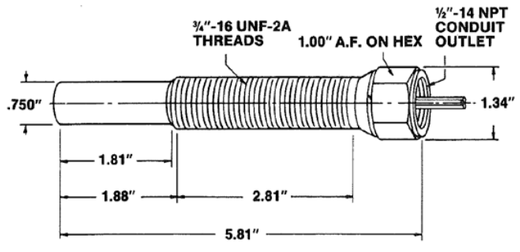
SPECIFICATIONS

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.

Model 75



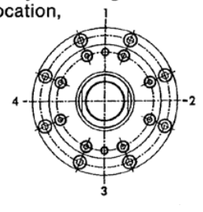
Model 77



ORDERING INFORMATION

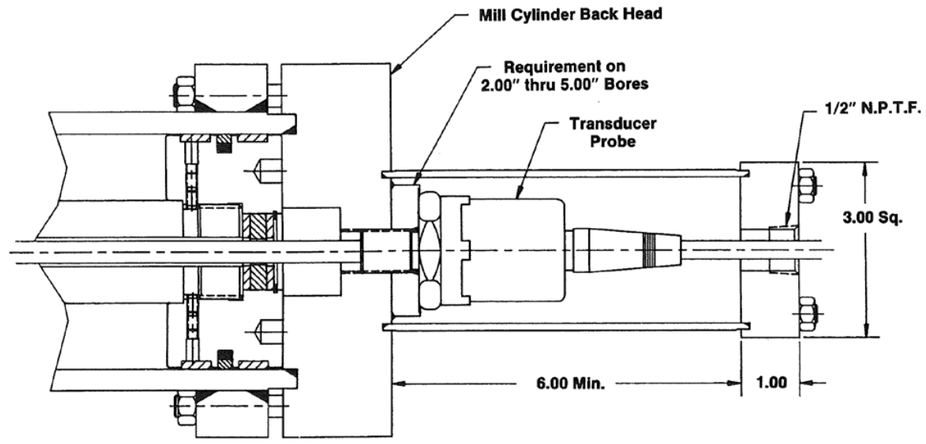
GO Models 75 and 77 Proximity Switches are available on Hanna's Series MT Mill-Type Hydraulic Cylinders 2.00" through 8.00" bores. Consult factory for availability and mounting on bore sizes over 8.00".

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.

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 conect 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

Bore Size — Rod Diameter Code

MP1-MT-CC-2.00"-9.00"-FSM 1 G

PISTON ROD KITS

Ordering Example:

SEAL KIT F-1 For Series MT

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 Polyurethane Wiper.

3 (OPTIONAL)
Temperature Range -20° F to +400° F
Viton O-Rings, Viton Rod Packing, Viton Wiper.

PISTON PACKING KITS

Ordering Example:

SEAL KIT G-2.00 For Series MT

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
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.

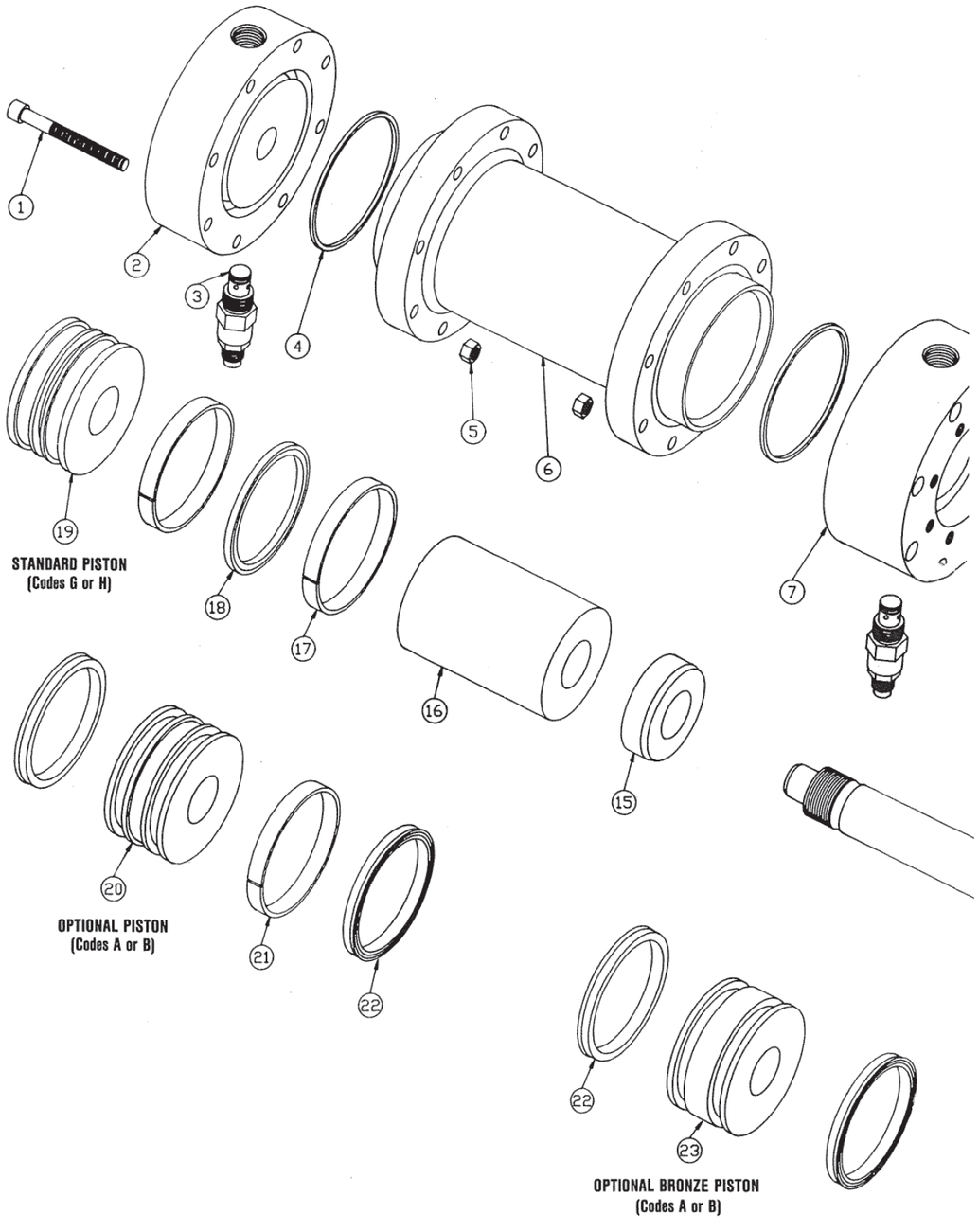
G Temperature Range -20° F to +200° F
Piston Wear Strip(s), Filled Teflon seal w/Buna-N Expander, Buna-N Tube Seals.

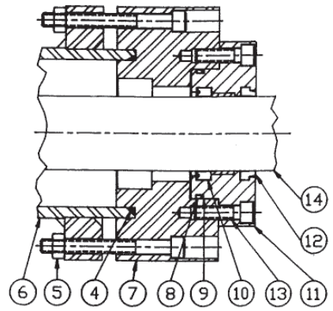
H Temperature Range -20° F to +400° F
Piston Wear Strip(s), Filled Teflon Seal w/Viton Expander, Viton Tube Seals.

CYLINDER WEIGHTS

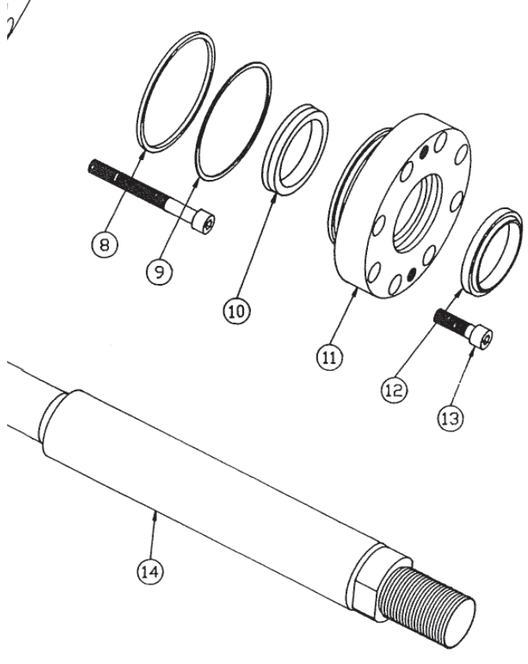
BORE	BASE WEIGHT AT ZERO STROKE	BODY WEIGHT PER INCH OF STROKE	ROD SIZE	ROD WEIGHT PER INCH OF STROKE
2.00	18 lbs.	.50 lbs.	1.00	.22 lbs.
3.00	41	.72	1.38	.42
4.00	70	1.20	1.75	.68
5.00	124	1.88	2.00	.89
6.00	178	2.12	2.50	1.39
7.00	226	3.33	3.00	2.00
8.00	333	3.77	3.50	2.72
9.00	397	4.22	4.00	3.56
10.00	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





FRONT HEAD/GLAND DETAIL

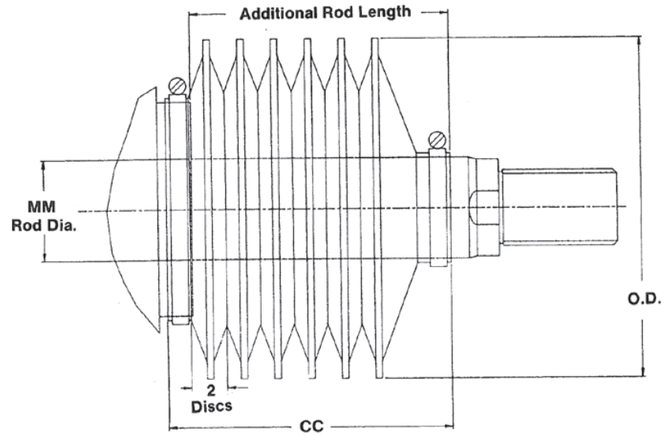


When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

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		3.50	10.00	2.56		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		5.00	11.00	2.38		7.00	13.25	2.50
	2.00	6.00	1.31	8.00	3.00	11.00	3.31	12.00	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		4.00	11.00	2.75		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	14.00	5.50	14.25	3.62
6.00	2.50	9.00	2.56	9.00	3.50	11.00	3.06		7.00	14.25	3.00
	3.00	9.00	2.31		4.00	11.00	2.75		8.00	14.25	2.50
	3.50	9.00	2.06		4.50	11.00	2.50	16.00	5.50	14.25	3.62
	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	2.50
					6.00	11.75	2.25				

ROD BOOT CALCULATIONS

Number of Discs = (2 x Total Stroke)
÷ BF (Raise result to next even whole number.)

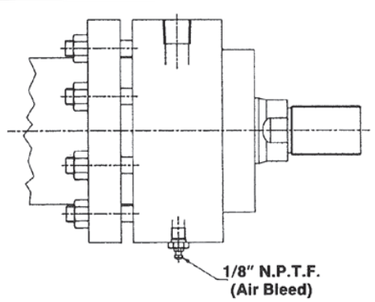
CC (Length of Boot) = Number of Discs
x .050 + 1.50.
(Raise result to nearest 1/8 inch.)

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.



MP1 ★ - MT-CC-2.00"-9.00"-FSM1G

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
Mill-Type Hydraulic (Heavy Duty) ..... MT

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

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,
Polyurenthane 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 .....G
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

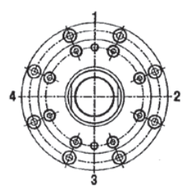
ROD DIAMETER
(Specify Piston
Rod Code from
dimensional chart)

OPTIONS (Specify only if required)
Bronze Piston
Bronze Rod Bearing
Bronze Rod Scraper
Metric Sizing

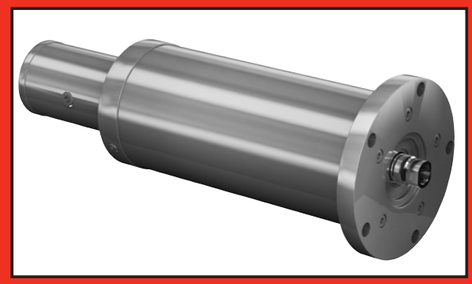
When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

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

NOTE: Cushion needles furnished with viton seals.



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



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.

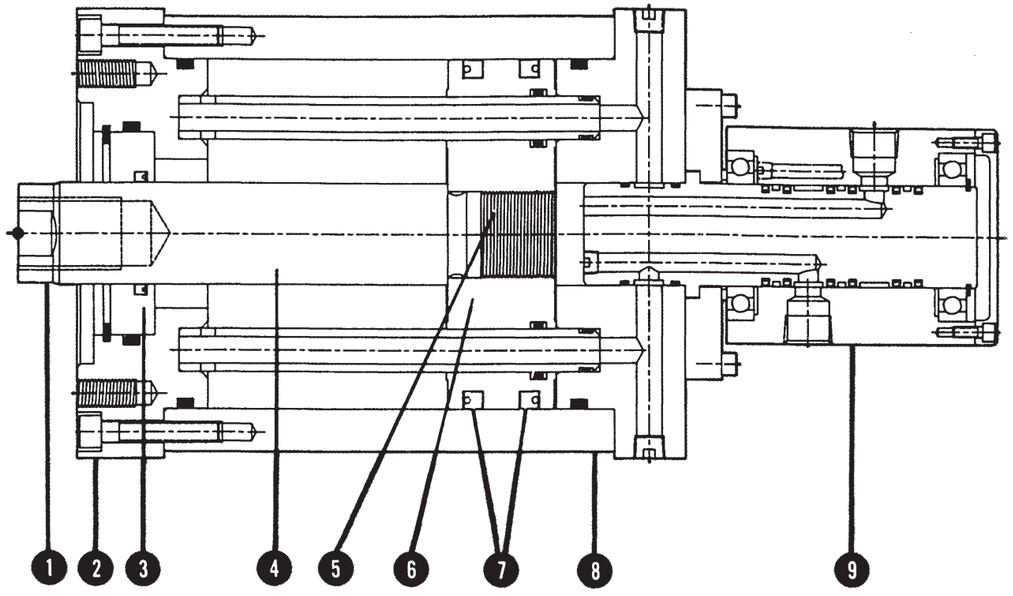
In addition to the axial support and stability of the coupling, the large diameter permits the use of either a probe indicator to actuate travel limit devices; or Hanna's optional Electronic Feedback device for the ultimate in safety and product yield. The design latitude thus offered expands the inherent 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

CONTENTS



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 anerobic adhesive, torqued and pinned.

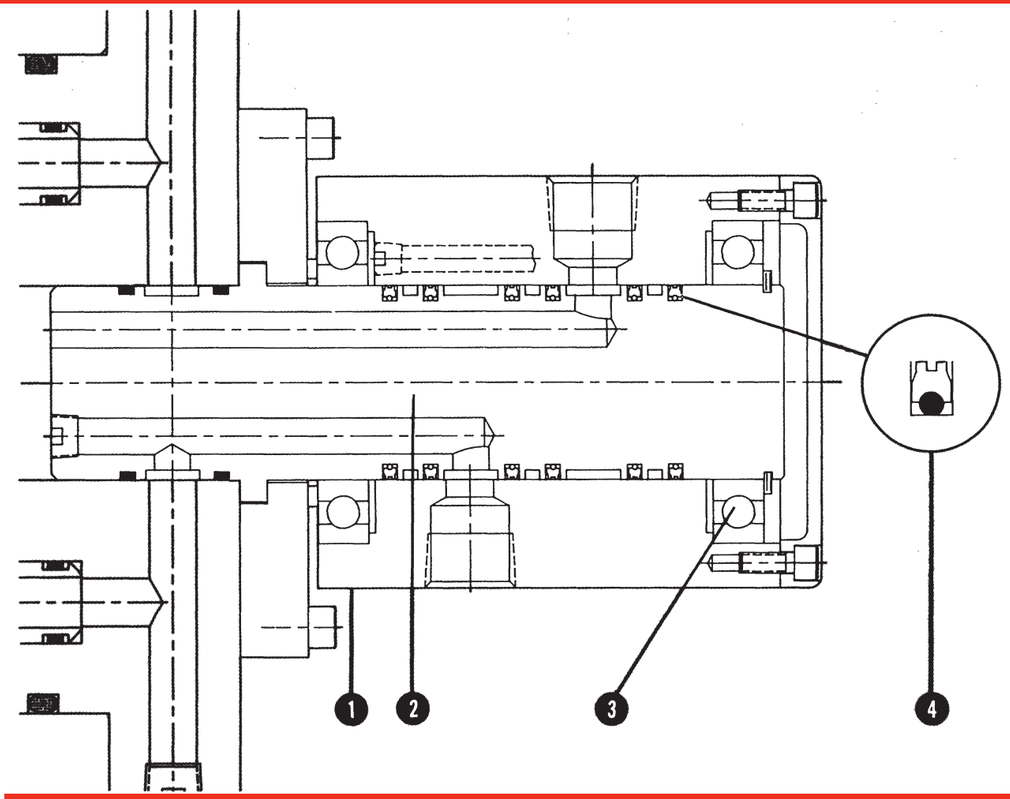
6. Piston
One-piece piston is made of high impact ductile iron, threaded to the piston rod.

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 Hydraulic Rotating Cylinders



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 thousands 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.

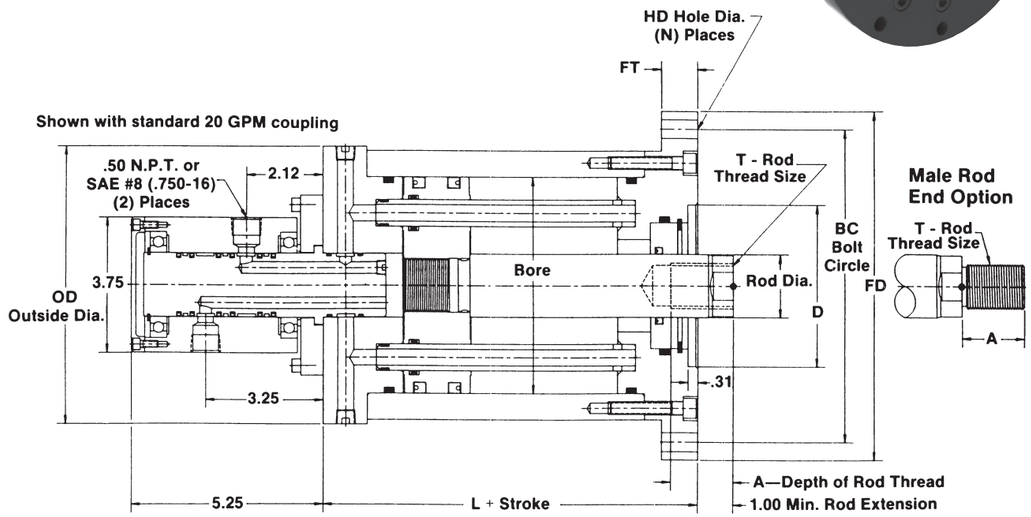
Prior to the Nitrotec treatment, the interior surface layer is precision honed for exacting size control. The combination of the Nitrotec process and the precision honing provides the optimum surface for extended seal life, and corrosion resistance when high water based fluids are used.

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



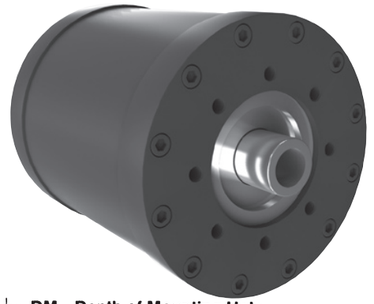
NOTE: .25 NPT (or #4 [.438-20] SAE) coupling drain port not shown. Must be piped back unrestricted.

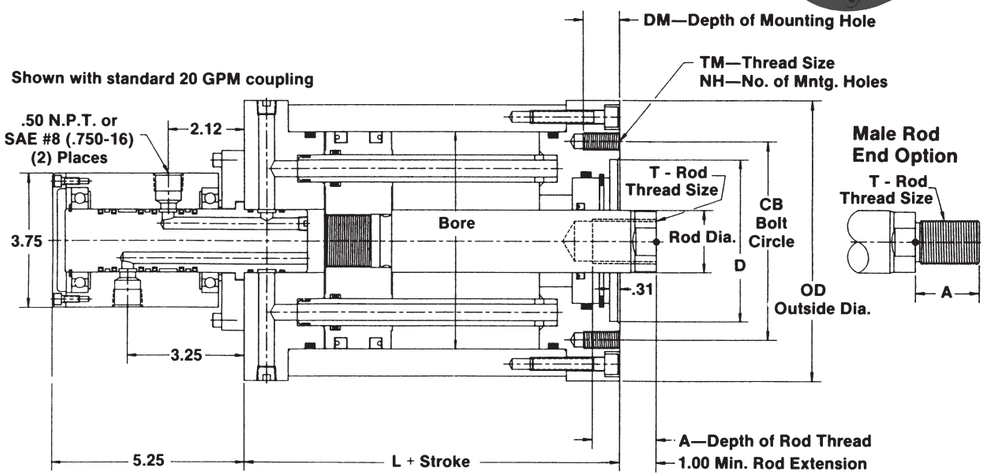
DIMENSIONS

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 H	1 25 1 75	1 25 1 75	3 000 4 002	5 69 5 69	88-14 1 25-12	88-14 1 25-12	6 12 6 12	7 00 7 00	5 5	53 53	8 00 8 00	1 00 1 00
6 00	H K	1 75 2 50	1 75 2 50	4 500 5 502	6 31 6 31	1 25-12 1 88-12	1 25-12 1 88-12	7 75 7 75	8 75 8 75	8 8	53 53	9 75 9 75	1 00 1 00
8 00	J L	2 00 3 00	2 00 3 00	5 000 6 002	6 56 6 56	1 50-12 2 25-12	1 50-12 2 25-12	9 88 9 88	11 50 11 50	6 6	78 78	13 12 13 12	1 25 1 25
10 00	K M	2 50 3 50	2 50 3 50	6 000 8 002	6 68 6 68	1 75-12 2 50-12	1 75-12 2 50-12	11 88 11 88	13 50 13.50	10 10	78 78	15 62 15 62	1 38 1 38
12 00	M P	3 50 4 50	3 50 4 50	7 500 10 002	6 94 6 94	2 00-12 3 00-12	2 00-12 3 00-12	14 19 14 19	16 25 16 25	10 10	91 91	18 00 18 00	1 50 1 50
14 00	N R	4 00 5 00	4 00 5 00	9 000 10 002	7 69 7 69	2 50-12 3 50-12	2 50-12 3 50-12	16 25 16 25	18 25 18 25	12 12	91 91	20 00 20 00	1 50 1 50
16 00	N R	4 00 5 00	4 00 5 00	10 000 10 002	10 00 10 00	2 50-12 3 50-12	2 50-12 3 50-12	18 62 18 62	20 88 20 88	12 12	1 06 1 06	23 00 23 00	1 50 1 50

Series RT Hydraulic Rotating Cylinders

MR2 Flush Mount





NOTE: .25 NPT (or #4 [.438-20] SAE) coupling drain port not shown. Must be piped back unrestricted.

DIMENSIONS

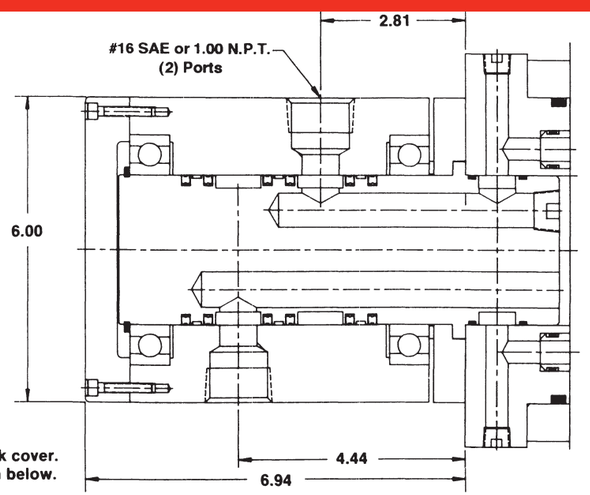
CYLINDER			A	D +.001 -.000	L	T (THREAD)		OD	CB	DM	NH	TM
BORE	ROD DIA. CODE	ROD DIA.				SMALL MALE SM	SHORT FEMALE SF					
4 50	I H	1 25 1 75	1 25 1 75	3 000 4 002	5 69 5 69	88-14 1 25-12	88-14 1 25-12	6 12 6 12	3 75 5 00	1 00 75	4 5	50-13 50-13
6 00	H K	1 75 2 50	1 75 2 50	4 500 5 502	6 31 6 31	1 25-12 1 88-12	1 25-12 1.88-12	7 75 7 75	5 50 6 50	1 00 75	8 8	50-13 50-13
8 00	J L	2 00 3 00	2 00 3 00	5 000 6 002	6 56 6 56	1 50-12 2 25-12	1 50-12 2 25-12	9 88 9 88	6 50 8 00	1 00 1 00	8 6	62-11 75-10
10 00	K M	2 50 3 50	2 50 3 50	6 000 8 002	6.68 6 68	1 75-12 2 50-12	1 75-12 2 50-12	11 88 11 88	8 50 9 50	1 12 1 00	8 10	75-10 .75-10
12 00	M P	3 50 4.50	3 50 4 50	7 500 10 002	6.94 6 94	2 00-12 3 00-12	2 00-12 3 00-12	14 19 14 19	10 50 11 50	1 25 1 12	10 10	75-10 .88-9
14 00	N R	4 00 5.00	4 00 5.00	9 000 10.002	7 69 7 69	2 50-12 3 50-12	2 50-12 3 50-12	16 25 16 25	12 50 12 00	1 25 1 12	15 12	75-10 .88-9
16 00	N R	4 00 5 00	4 00 5 00	10.000 10 002	10 00 10 00	2 50-12 3 50-12	2 50-12 3 50-12	18 62 18.62	14 50 13 00	2 00 1 50	16 12	1 25-7 1 00-8

OPTIONS

45 GPM Coupling

Hanna offers a 45 GPM coupling as an option for Series RT rotating cylinders with 8.00" and larger bore sizes.

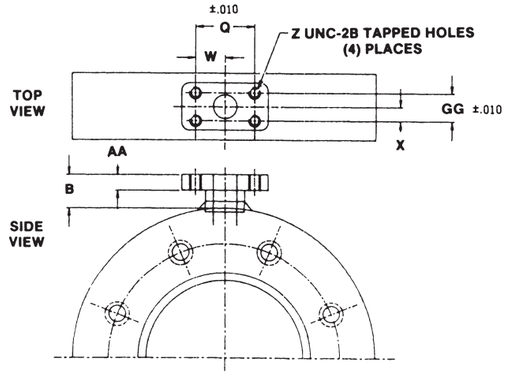
The unit has a 45 GPM flow rate at 15 feet per second velocity, and 350 RPM. Maximum hydraulic pressure rating is 1500 P.S.I. Higher pressures and RPM are available as specials. Please consult the factory. Tell-tale sensor and Electronic Feedback device options are also available. See Page 227.



Shown with standard back cover.
Slotted back cover shown below.

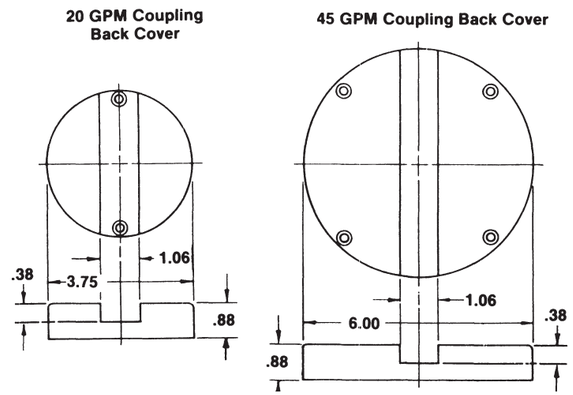
SAE 4-Bolt Flange Ports

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



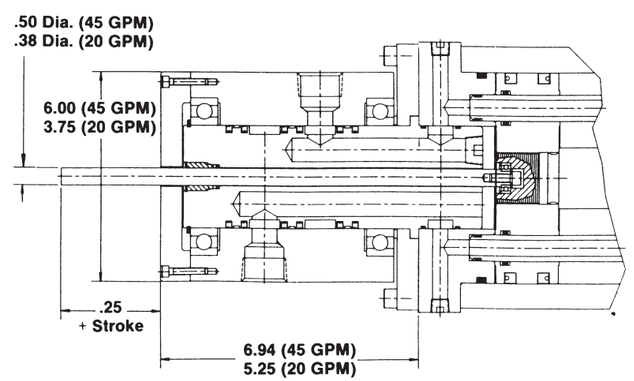
Slotted Coupling Back Covers

Both 20 GPM and 45 GPM couplings are available with a slotted back plate to accommodate a stabilizer bar.

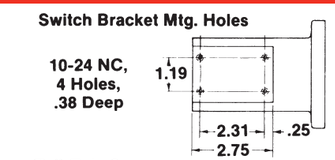


TELL-TALE SENSOR

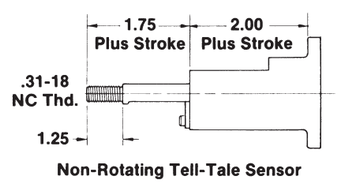
This mechanical position indicator is an option available on both 20 GPM and 45 GPM couplings.



Rotating Cylinder with Tell-Tale Sensor



Tell-Tale Sensor

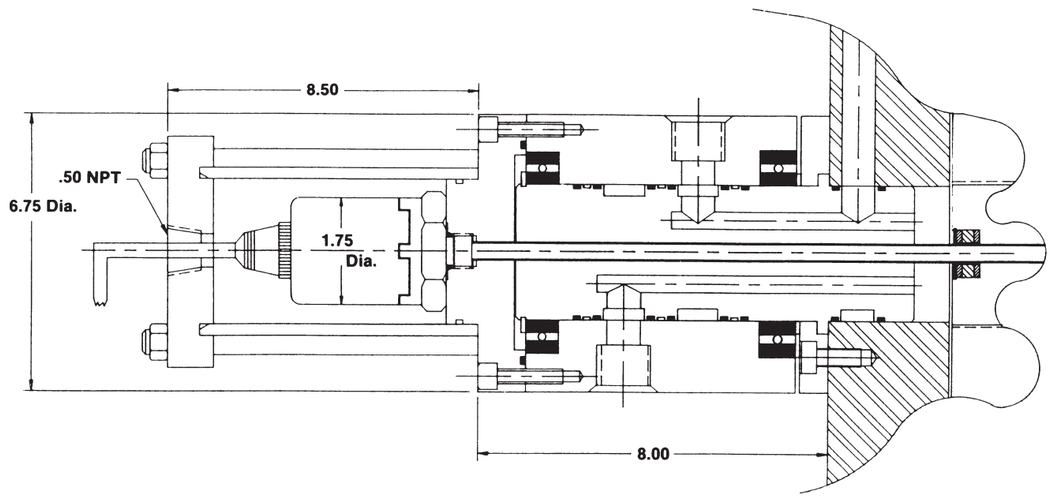


Non-Rotating Tell-Tale Sensor

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 ±.001 in digital systems; analog responses on positions less than .010 are common.



PRESSURE, FORCE AND VOLUME DATA

CYLINDER THRUST FORCE

Cylinder Thrust Force in Pounds for Various Line Pressures								Consumption Per Inch of Stroke in One Direction		
		Pressures of Operating Medium—Air or Hydraulic								
Cylinder Bore Inches	Piston Area Sq In	50 PSI	80 PSI	100 PSI	250 PSI	500 PSI	1,000 PSI	Oil* Gallons Displaced	Pressure Air Cubic Ft Displaced	Free Air Cubic Ft at 80 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		
		Pressures of Operating Medium—Air or Hydraulic								
Piston Rod Bore Inches	Piston Area Sq. In.	50 PSI	80 PSI	100 PSI	250 PSI	500 PSI	1,000 PSI	Oil* Gallons Displaced	Pressure Air Cubic Ft Displaced	Free Air Cubic Ft at 80 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	0732
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		
				Velocity = 10 Ft Per Sec		Velocity = 20 Ft Per Sec		Velocity = 30 Ft Per Sec				
Pipe Size	Bursting Pressure PSI	Internal Diameter Inches	Internal Area Sq. In.	Gals Per Minute	Pressure Drop in PSI	Gals Per Minute	Pressure Drop in PSI	Gals Per Minute	Pressure Drop in PSI	Pipe Size	Elbow	Tee
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 — $P\lambda = \frac{.323 f SLV^2}{d}$

(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 $\frac{dvs}{Z}$

INSTALLATION AND MAINTENANCE DATA

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.

PARTS LIST

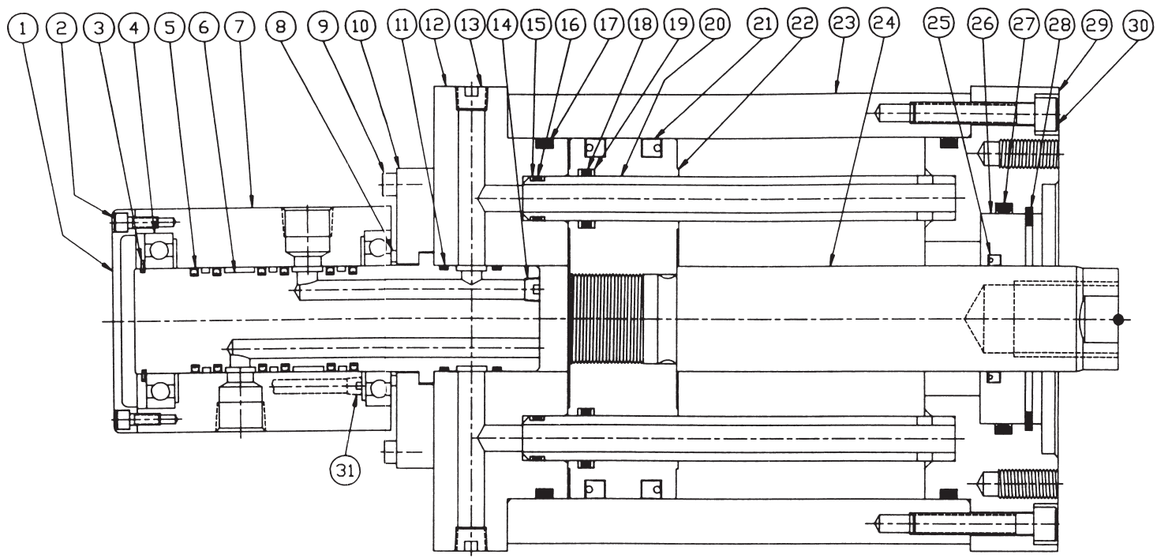
When ordering replacement parts, identify Model Number, Serial Number and Part Number as shown below.

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	COUPLER 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 piston rod code — From rod packing 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 piston packing code — Bore Size

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

MF3 - RT - SC - 4.50 - 6.00 - HSM - 2A

MOUNTING STYLE
Flange MF3
Flush MR2

SERIES
Hydraulic, Rotating ..... RT

COUPLING OPTION
20 GPM Coupling (Standard) ..... SC
45 GPM Coupling* ..... HC
20 GPM with Slotted Cover ..... SS
45 GPM* with Slotted Cover ..... SH

*Available Option for 8.00" and large bore sizes.

BORE SIZE (Specify)

STROKE (Specify)

ROD END STYLE
Small Male ..... SM
Short Female ..... SF
Alternate Male (Specify) ..... AL
Alternate Female (Specify) ..... AF

PISTON ROD PACKING
STANDARD— Polyurethane Packing with Buna-N O-Ring Expander, Buna-N O-Ring 2
OPTIONAL— Viton Packing, Viton O-Ring 3

PISTON PACKING AND TUBE SEALS
STANDARD— Polyurethane Packing with Buna-N O-Ring Expander, Buna-N Tube Seals ..... A
OPTIONAL— Viton Packings with Teflon Back-Ups, Viton Tube Seals ..... B

NOTE: NPTF ports will be furnished as standard unless SAE straight thread or 4-bolt flange ports are specified.

Consult Factory for special requirements such as larger bore sizes, higher RPM and/or P.S.I.

ROD DIAMETER
(Specify Piston Rod Code from Dimensional Chart)

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.

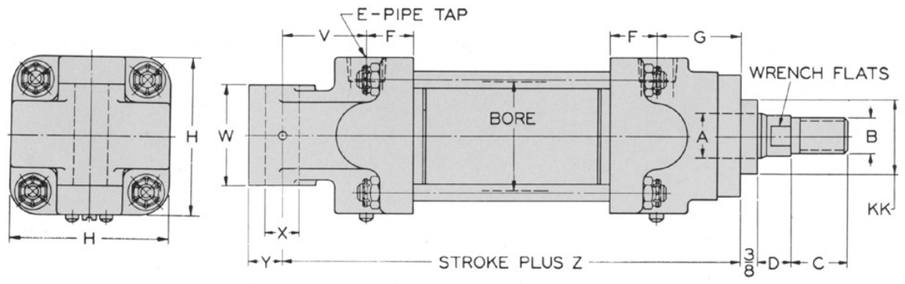
Featuring rugged construction and extra-long rod and piston bearings, Series T750 cylinders are engineered to provide extended life. Unique cushion design assures positive cushioning over the entire cushion stroke, with immediate full speed on return stroke.

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.

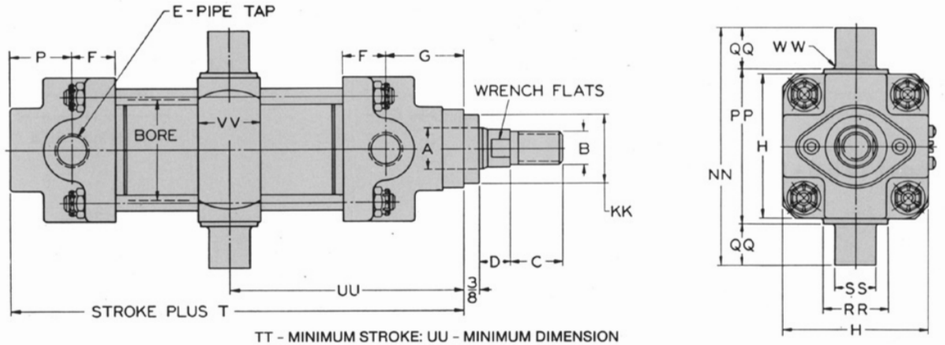
Model T751 - Hinge Mount



BORE	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T
1½	⅝	⅞-20	⅝	⅝	⅜	15/16	1 15/16	2½	1¼	1 1/32	1¾	4⅜	1 3/32	1¼	⅝	⅞	1¾	5 15/16
2	¾	½-20	⅞	¾	½	1	1 13/16	3	1½	1 3/32	2	4¾	1 3/32	1 1/16	⅝	½	2 1/16	6⅜
2½	1	¾-16	1¼	¾	⅜	1 1/16	1⅞	3½	1¾	1 3/32	2½	4⅞	1 1/32	1½	1 1/16	½	2½	6⅞
3	1	¾-16	1¼	¾	⅜	1 3/16	1⅞	4¼	2⅛	1 1/32	3	5⅛	1 1/32	1½	1 1/16	½	2 15/16	6⅞
4	1½	1-14	1¾	⅞	⅜	1¼	2⅝	5¼	2⅝	2 1/32	3¾	7¼	2 1/32	2⅛	⅞	⅝	3⅜	9½

HANNA cylinders

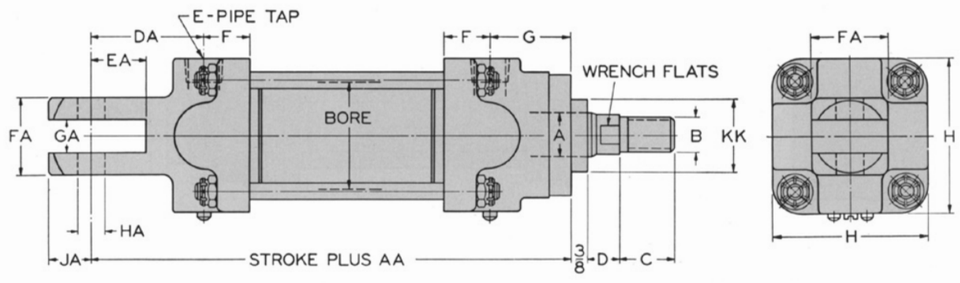
Model T755 — Trunion Mount



TT - MINIMUM STROKE: UU - MINIMUM DIMENSION

BORE	A	B	C	D	E	F	G	H	P	T	KK	NN	PP	QQ	RR	SS	TT	UU	VV	WW
1½	⅝	⅞-20	⅝	⅝	⅜	1⅝	1⅝	2½	1¼	5⅛	1¼	4	2¾	⅝	⅞	⅝	0	3	1	⅛
2	¾	1-20	⅞	¾	⅜	1	1⅜	3	1⅝	6⅜	1⅜	5	3¼	⅞	1⅛	⅞	⅛	3⅛	1¼	⅛
2½	1	¾-16	1¼	¾	⅜	1⅛	1⅞	3½	1½	6⅜	1⅝	5¾	3¾	1	1⅜	1	⅜	3⅛	1½	⅛
3	1	¾-16	1¼	¾	⅜	1⅜	1⅞	4¼	1½	6⅞	1⅝	7	4½	1¼	1⅝	1¼	⅝	3⅛	1¾	⅛
4	1½	1-14	1¾	⅞	⅜	1¼	2⅛	5¼	2⅛	8½	2½	8¾	5¾	1½	2	1½	1	5	2¼	⅛

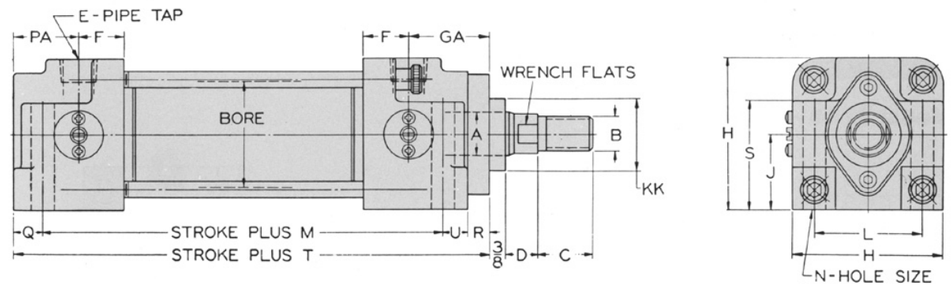
Model T761 — Clevis Mount



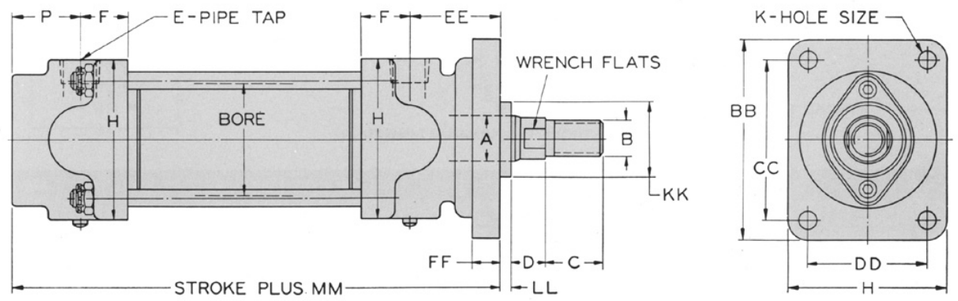
BORE	A	B	C	D	E	F	G	H	AA	KK	DA	EA	FA	GA	HA	JA
1½	⅝	⅞-20	⅝	⅝	⅜	1⅝	1⅝	2½	6¾	1¼	2⅛	1⅝	1¼	⅞	⅜	⅝
2	¾	1-20	⅞	¾	⅜	1	1⅜	3	7⅞	1⅜	2½	1⅛	1½	½	½	¾
2½	1	¾-16	1¼	¾	⅜	1⅛	1⅞	3½	7¹⅛	1⅝	2⅞	1¼	1¾	¾	⅝	1
3	1	¾-16	1¼	¾	⅜	1⅜	1⅞	4¼	7¹⅜	1⅝	2⅞	1¼	1¾	¾	⅝	1
4	1½	1-14	1¾	⅞	⅜	1¼	2⅝	5¼	10⅛	2½	3¾	1⅝	2¾	1	⅞	1⅝

Series T750 Pneumatic and Hydraulic Cylinders

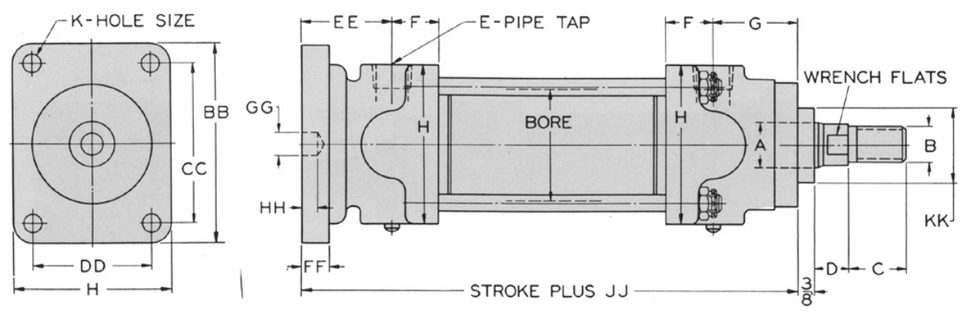
Model T752 - Foot Mount



Model T753 - Rod Flange Mount



Model T754 - Blind Flange Mount

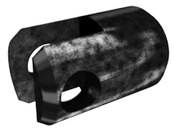


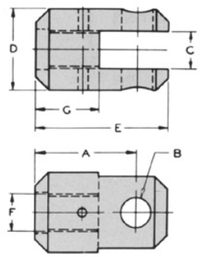
U	V	W	X	Y	Z	BB	CC	DD	EE	FF	GG	HH	JJ	KK	LL	MM	PA	GA
½	1⅜	1½	½	½	6⅛	3½	2¾	1¾	1¹⅜	⅞	⅝	⅜	6⅜	1¼	¼	6⅛	1¼	1⅜
½	1⅝	1¾	⅝	⅝	6⅜	4	3⅛	2⅛	1¹⅜	½	⅜	⅜	6⅞	1⅜	¼	6½	1⅞	1¹⅜
⅝	1⅞	2¼	¾	¾	7	4⅜	3½	2⅝	2	⅝	½	⅜	7⅛	1⅝	¼	6¾	1½	1⅞
⅝	1⅞	2½	⅞	⅞	7¼	5	4	3¼	2	⅝	½	⅜	7⅜	1⅝	¼	7	1½	1⅞
¾	2⅛	3	1	1	9	8	6½	3¾	2¾	1	½	½	9⅛	2½	¼	8⅝	2⅝	3⅛

OPTIONS

Rod Clevis

The rod clevis attaches to the piston rod of Series T750 cylinders. Clevis pins are also available.

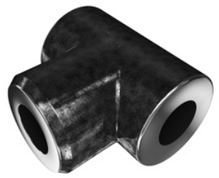


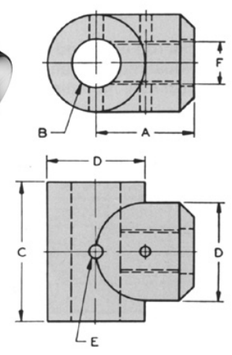


BORE	ITEM NO.	A	B	C	D	E	F	G
1½	V15	1⅛	⅜	7/16	1	1½	7/16-20	⅝
2	V20	1½	½	½	1¼	2	½-20	⅞
2½	V25	2	⅝	¾	1⅝	2⅝	¾-16	1¼
3	V30	2	⅝	¾	1⅝	2⅝	¾-16	1¼
4	V40	3	⅞	1	2½	4	1-14	1¾

Rod Eye

The rod eye attaches to the piston rod of Series T750 cylinders. May be used with or without mounting bracket.

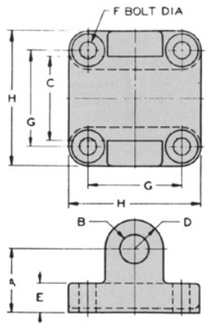




BORE	ITEM NO.	A	B	C	D	E	F
1½	Y15	1	½	1½	1	⅛	7/16-20
2	Y20	1¼	⅝	1¾	1¼	⅛	½-20
2½	Y25	1¾	¾	2¼	1½	3/16	¾-16
3	Y30	1¾	⅞	2½	1¾	¼	¾-16
4	Y40	2⅜	1	3	2	3/16	1-14

Mounting Bracket

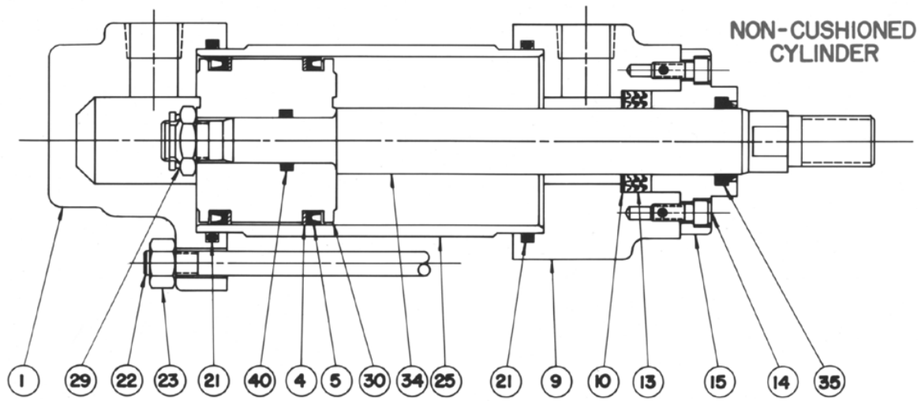
The mounting bracket fits the back head of the hinge mount cylinder. It may also be used on the rod end of any cylinder equipped with a rod eye. Comes complete with pin.

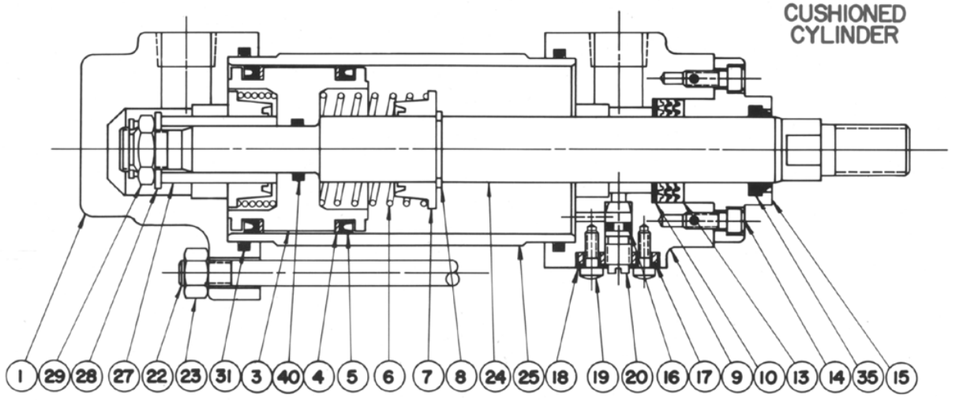


BORE	ITEM NO.	A	B	C	D	E	F	G	H
1½	B15	1⅛	½	1½	½	½	13/16	1¾	2½
2	B20	1⅜	⅝	1¾	⅝	⅝	⅜	2⅛	3
2½	B25	1⅜	¾	2¼	¾	¾	7/16	2½	3½
3	B30	1⅞	⅞	2½	⅞	⅞	½	2⅞	4
4	B40	2¼	1	3	1	1	⅝	3½	5

PARTS LIST

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.

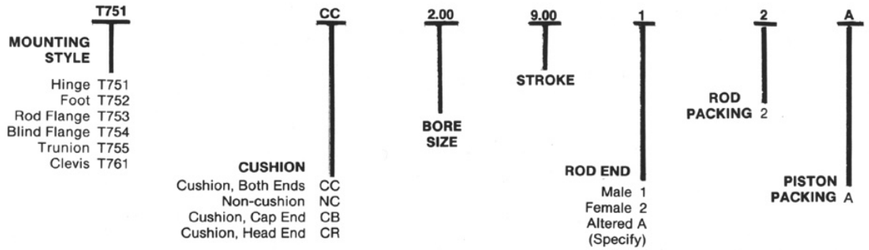




Item No.	Description
1	Back Head
3	Piston (Cushioned)
4	Back-up Washer
5	Piston Packing
6	Cushion Spring
7	Cushion Valve
8	Cushion Retaining Ring
9	Front Head
10	Packing Washer
13	Rod Packing Set
14	Screw
15	Gland
16	Cushion Needle O-Ring
17	Cushion Needle Retainer
18	Cushion Plate
19	Retaining Screw

Item No.	Description
20	Cushion Needle
21	Head O-Ring
22	Tie Rod
23	Tie Rod Nut
24	Piston Rod (Cushioned)
25	Tube
27	Cushion Valve Sleeve
28	Cushion Retainer Washer
29	Piston Rod Nut
30	Piston (Non-Cushioned)
34	Piston Rod (Non-Cushioned)
35	Rod Wiper
40	Piston O-Ring
45	Piston Kit C (Not Shown)
46	Gland Kit (Not Shown)

HOW TO ORDER

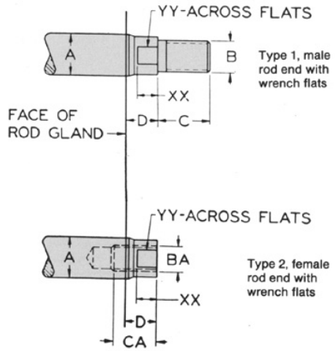


Rod End Dimensions

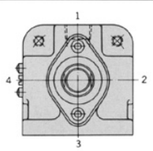
The two piston rod ends illustrated and dimensioned are standard. Rod End type 1 will be furnished on all cylinders unless otherwise specified. Type 2 is optional at no extra charge.

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.

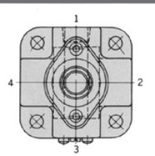
BORE	A	B	C	D	BA	CA	XX	YY
1½	⅝	⅞-20	⅝	⅝	⅜-24	½	⅜	½
2	¾	½-20	⅞	¾	⅞-20	¾	½	⅝
2½	1	¾-16	1¼	¾	⅝-18	1	½	⅞
3	1	¾-16	1¼	¾	⅝-18	1	½	⅞
4	1½	1-14	1¾	⅞	1-14	1½	⅝	1¼



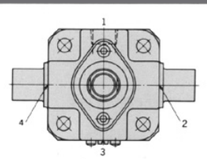
Pipe Port and Cushion Needle Adjustment Locations



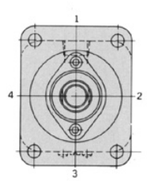
STANDARD LOCATION
PIPE PORT AT 1
CUSHION NEEDLE AT 4
MODEL 752 & 752CC



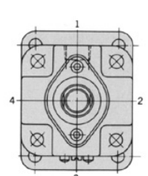
STANDARD LOCATION
PIPE PORT AT 1
CUSHION NEEDLE AT 3
MODEL 751 & 751CC



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

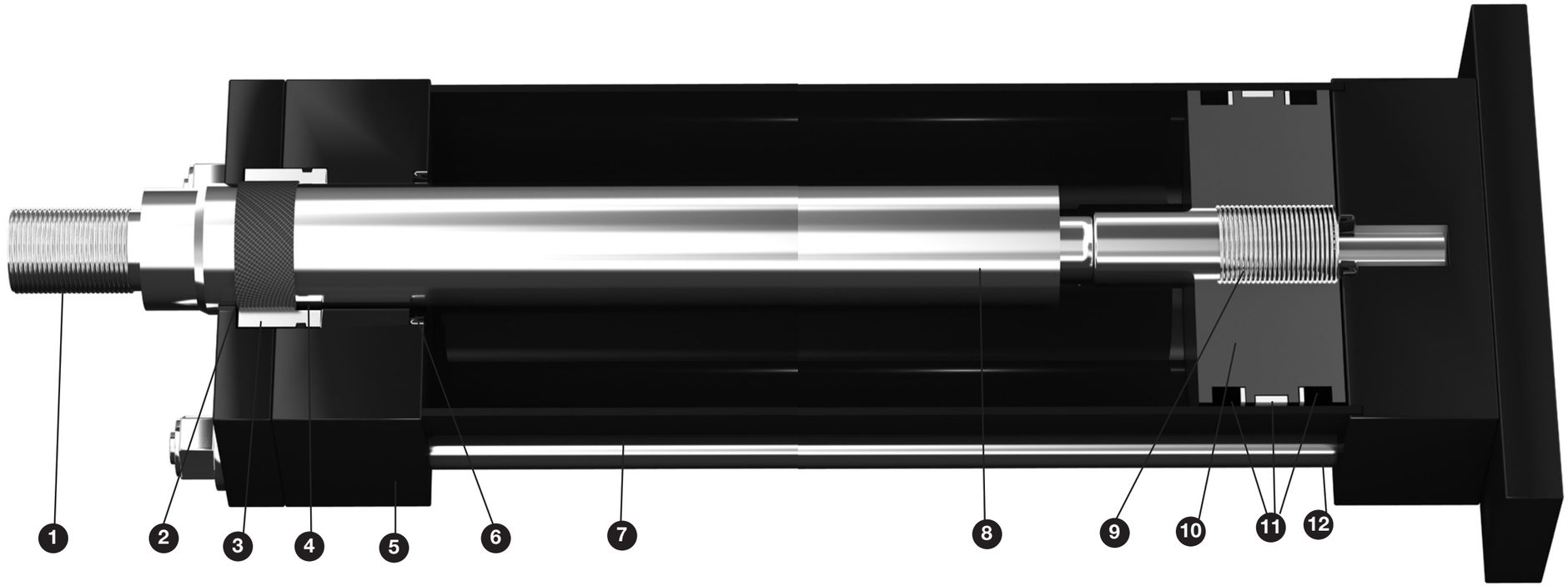
Series CA Composite Pneumatic Cylinders

- 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

Series CA Composite Pneumatic Cylinders



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.

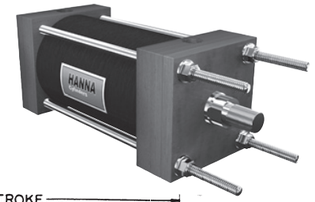
9. Piston-to-Rod Connection
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anerobic adhesive, torqued and pinned.

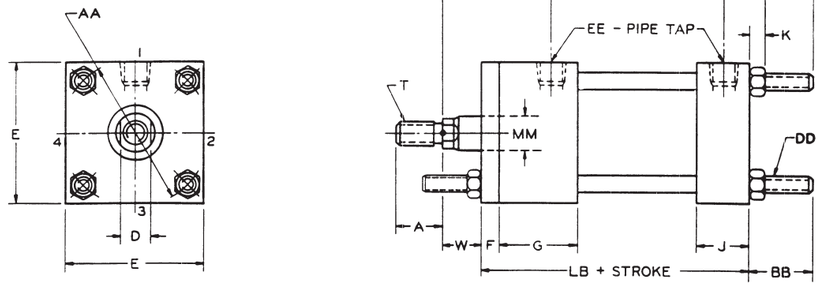
10. Piston
One-piece piston is made of high-strength, non-corrosive, impact-resistant aluminum. Threaded to the piston rod, the piston is furnished with break-away spirals on each side. For AWWA-approved water service, optional cadmium-plated piston is available.

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.

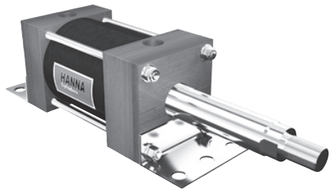
12. Tie Rods
Made from high-strength, corrosion-resistant Series 303 stainless steel. Tie rod nuts, washers and all other fasteners are also made of stainless steel for corrosion resistance and low maintenance.

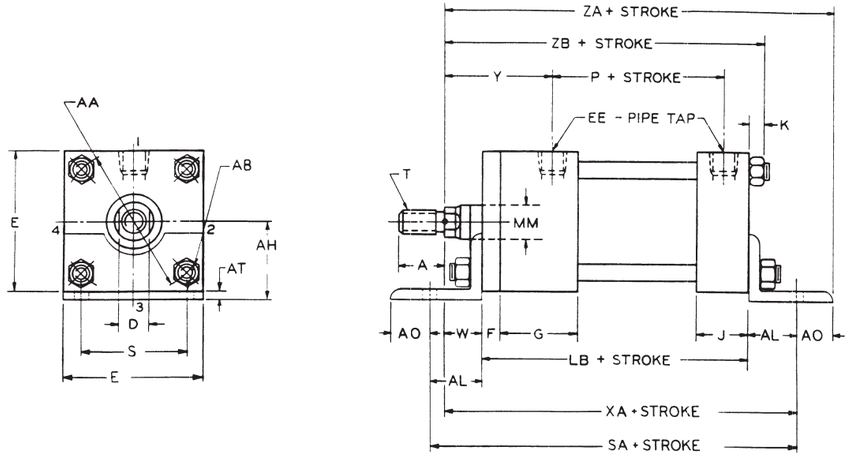
MX0, MX1, MX2, MX3, MX4 Tie Rod Mounts





MS1 End Angle Mount





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

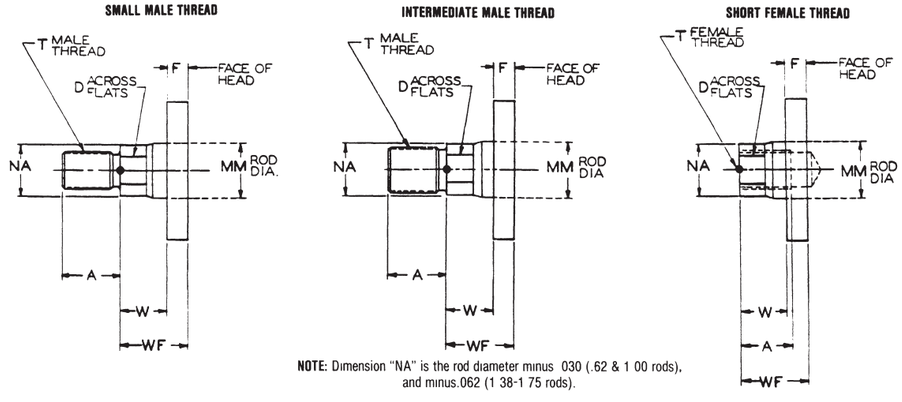
Dimensions are Affected by the Rod Diameter

CYLINDER					T (THREAD)							
BORE	ROD DIA. CODE	MM ROD DIA.	A	D	SMALL MALE SM	INTER-MEDIATE MALE IM	SHORT FEMALE SF	W	XA	Y	ZA	ZB	ZT
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.

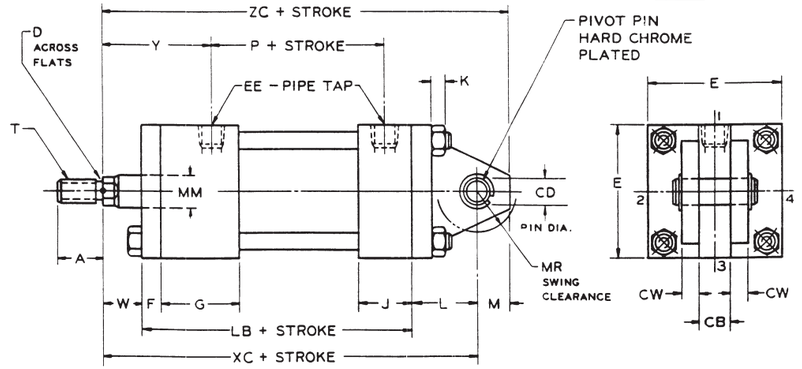
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

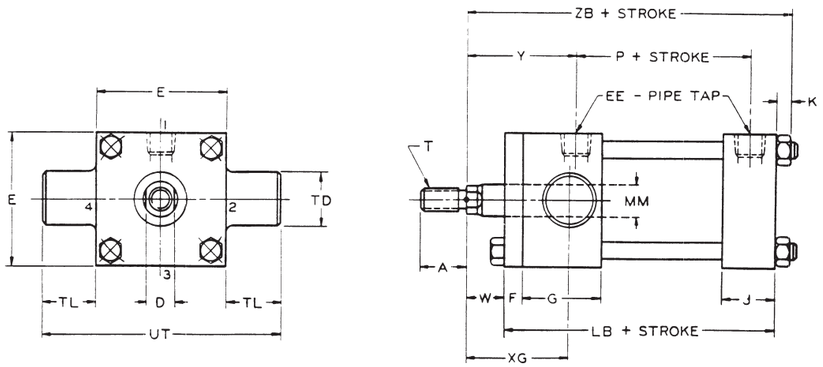


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1 00 rods), and minus.062 (1 38-1 75 rods).

MP1 Fixed Clevis Mount



MT1 Head Trunnion Mount



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

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 +.000 −.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

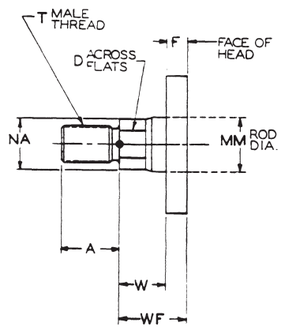
CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	W	XC	XG	Y	ZB	ZC
1.50	D	.62	75	50	44-20	50-20	44-20	.62	5 38	1 75	1.88	5.00	5 88
2.00	D	62	75	.50	.44-20	50-20	44-20	.62	5 38	1 75	1.88	5.03	5.88
	F	1.00	1 12	88	75-16	.88-14	.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

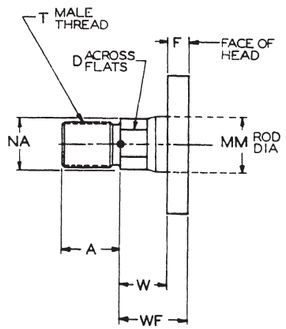
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES

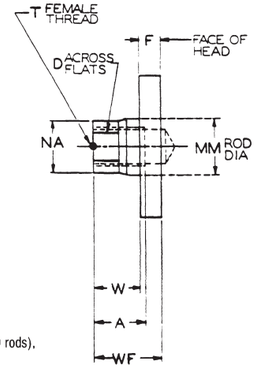
SMALL MALE THREAD



INTERMEDIATE MALE THREAD

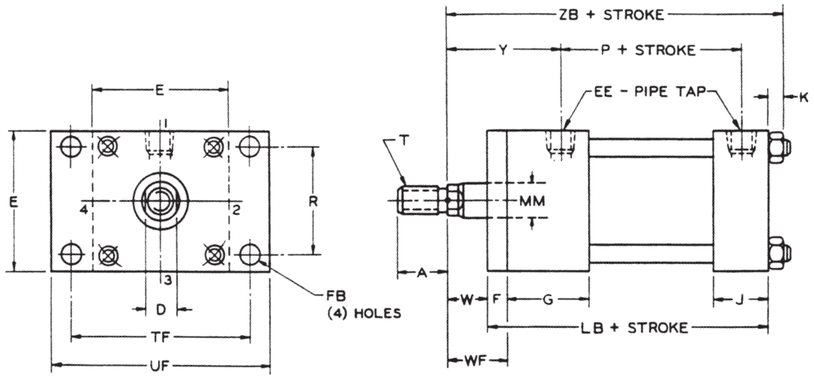


SHORT FEMALE THREAD

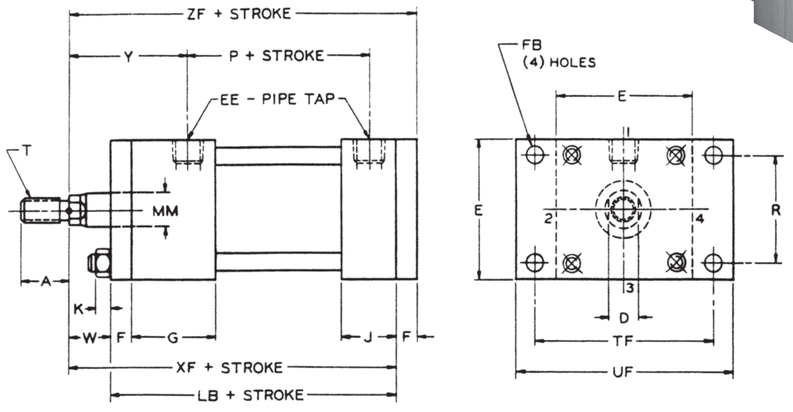


NOTE: Dimension "NA" is the rod diameter minus .030 (.62 & 1.00 rods), and minus .062 (1 38-1 75 rods)

MF1 Head Rectangular Flange Mount



MF2 Cap 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

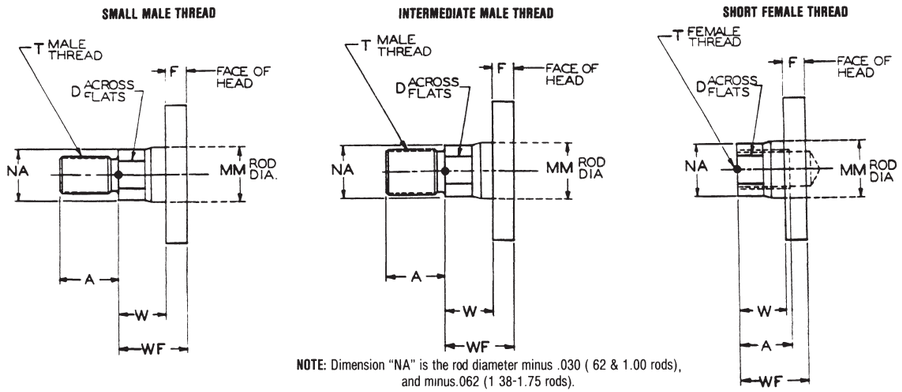
Dimensions are Affected by the Rod Diameter

BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	W	WF	Y	ZB	ZF	ZJ
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.

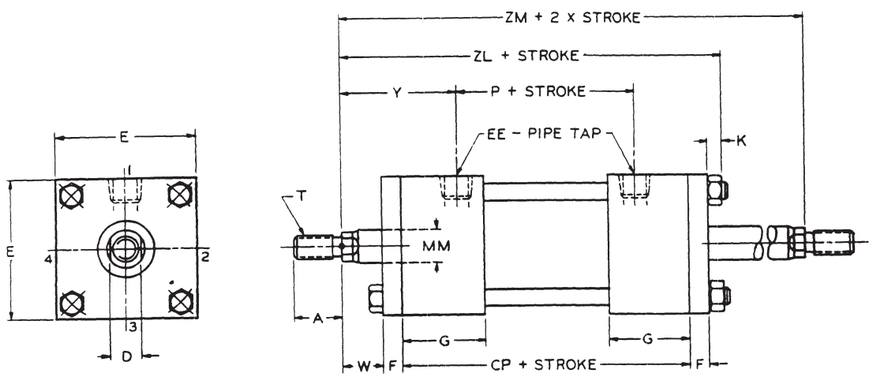
NOTE: Dimensions are nominal except where specifically toleranced Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

STANDARD ROD END STYLES



NOTE: Dimension "NA" is the rod diameter minus .030 (62 & 1.00 rods), and minus.062 (1 38-1.75 rods).

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	1/4	.38	1.50	38	2 31
2.00	4 12	2.50	1/4	.38	1.50	41	2 31
2 50	4 25	3 00	1/4	38	1 50	41	2.44
3.25	4 75	3.75	3/8	62	1 75	53	2 69
4 00	4.75	4.50	3/8	.62	1 75	53	2.69
5 00	5 00	5 50	3/8	62	1 75	69	2 94
6.00	5 50	6 50	1/2	.75	2 00	.69	3.19

Dimensions are Affected by the Rod Diameter

CYLINDER BORE	ROD DIA. CODE	MM ROD DIA.	A	D	T (THREAD) SMALL MALE SM	T (THREAD) INTER-MEDIATE MALE IM	T (THREAD) SHORT FEMALE SF	W	Y	ZL	ZM
1.50	D	62	75	50	44-20	50-20	44-20	62	1 88	5 88	6.12
2.00	D	.62	.75	50	44-20	50-20	44-20	62	1 88	5.88	6.12
	F	1 00	1 12	88	75-16	.88-14	75-16	1 00	2.25	6.31	6.88
2.50	D	62	.75	.50	44-20	50-20	44-20	62	1 88	6 06	6 25
	F	1 00	1 12	88	75-16	.88-14	75-16	1 00	2.25	6.42	7.00
3.25	F	1 00	1.12	.88	.75-16	.88-14	.75-16	75	2.38	7.28	7.50
	G	1 38	1 62	1 12	1.00-14	1.25-12	1 00-14	1 00	2 62	7 53	8.00
4.00	F	1 00	1 12	88	75-16	88-14	.75-16	75	2 38	7 28	7 50
	G	1 38	1 62	1.12	1 00-14	1 25-12	1 00-14	1 00	2 62	7.53	8.00
5.00	F	1 00	1 12	88	75-16	88-14	.75-16	.75	2.38	7 69	7 75
	G	1.38	1.62	1.12	1.00-14	1.25-12	1.00-14	1 00	2 62	7.94	8.25
6.00	G	1 38	1.62	1 12	1.00-14	1 25-12	1 00-14	88	2.75	8.56	8.75
	H	1 75	2 00	1 50	1 25-12	1 50-12	1 25-12	1 12	3.00	8 81	9.25

† Available in MX0, MX1, MX2, MX3, MX4, MT1 and MF1 mounting styles. See single rod pages for mounting instructions

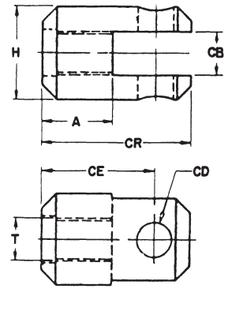
PRESSURE RATING: 150 P S I maximum operating pressure Check Stroke Limitation Data (Page 250) which may reduce maximum operating pressure Check Stop Tube Data (Page 251) to see if stop tube is required

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.

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. SB-1 Bracket fits SV-1 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.

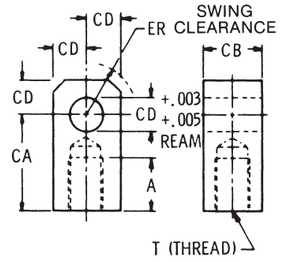
*** CAUTION:**
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended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

Rod Clevis



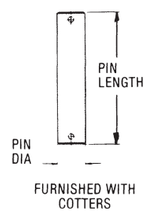
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	H	T	*LBS. CAPACITY
SV-1	D	75	75	50	1 50	2.00	1 50	.44-20	2,700
SV-2	F	1 12	1 25	75	2.38	3 12	2 38	75-16	7,500
SV-3	G	1 62	1 50	1 00	3.12	4 12	3 00	1 00-14	13,000
SV-4	H	2 00	2.00	1 37	4 12	5.50	4 00	1 25-12	21,000

Rod Eye



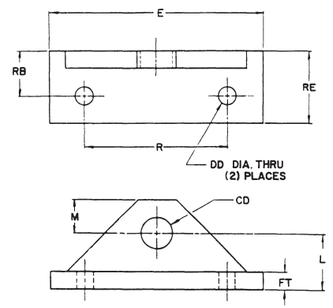
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	ER	T	*LBS. CAPACITY
SY-1	D	.75	1.50	75	50	75	44-20	2,700
SY-2	F	1 12	2 06	1.25	75	1 12	75-16	7,500
SY-3	G	1.62	2.81	1.50	1.00	1 44	1.00-14	13,000
SY-4	H	2.00	3.44	2.00	1.37	2.00	1.25-12	21,000

Pin



PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
SP1	2.28	.50	2,700
SP2	3 09	75	7,500
SP3	3 60	1 00	13,000
SP4	4.66	1 37	21,000

Brackets



†BRACKET ITEM	PISTON ROD CODE	CA SERIES BORE DIA.	CD	DD	E	FT	L	M	R	RB	RE	*LBS. CAPACITY
SB-1	D	1.50 2 00 2.50	500	33	2 50	.19	.75	50	1 84	.53	88	1,425
SB-2	F	3.25 4 00 5.00	750	39	3 75	38	1.25	75	2 76	74	1.25	4,200
SB-3	G	6 00	1 000	52	6 50	38	1 50	.75	4.88	1.68	2.50	7,550
SB-4	H	6.00	1 375	.52	6.50	.38	1 50	1 00	4.88	1 68	2.50	8,000

† 2 required

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	VALUE OF "L" IN INCHES PISTON ROD DIAMETER			
in pounds	.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 50	70	90	100	150	FLUID Required PER INCH OF STROKE CU. FT.
			PUSH	1 77	89	124	160	177	266	00102
1.50	D	62	PULL	1 46	73	102	131	146	219	00084
			PUSH	3 14	157	220	283	314	471	00182
2.00	D	62	PULL	2.83	142	198	255	283	424	00164
	F	1.00		2 36	118	165	212	236	354	00136
			PUSH	4 91	245	344	442	491	736	.00284
2.50	D	62	PULL	4 60	230	322	414	460	690	00266
	F	1.00		4 13	206	289	372	413	620	00239
			PUSH	8.29	414	580	746	829	1244	00480
3.25	F	1.00	PULL	7 51	375	525	676	751	1126	00435
	G	1 38		6.81	340	477	613	681	1022	00394
			PUSH	12 57	628	880	1131	1257	1886	00727
4.00	F	1 00	PULL	11 78	589	825	1060	1178	1767	00682
	G	1.38		11 08	554	776	997	1108	1662	.00641
			PUSH	19 64	982	1375	1768	1964	2946	01136
5.00	F	1.00	PULL	18.85	942	1319	1696	1885	2827	.01091
	G	1 38		18 15	908	1270	1633	1815	2722	01050
			PUSH	28.27	1413	1979	2544	2827	4240	01636
6.00	G	1 38	PULL	26 79	1339	1875	2411	2679	4018	01550
	H	1.75		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

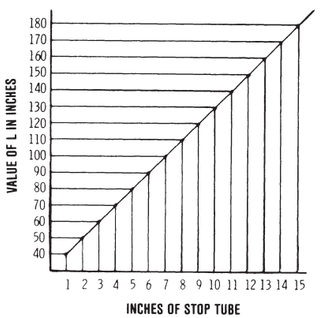
From the description, the cylinder falls into Fig. 8. To determine the value of "L":

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

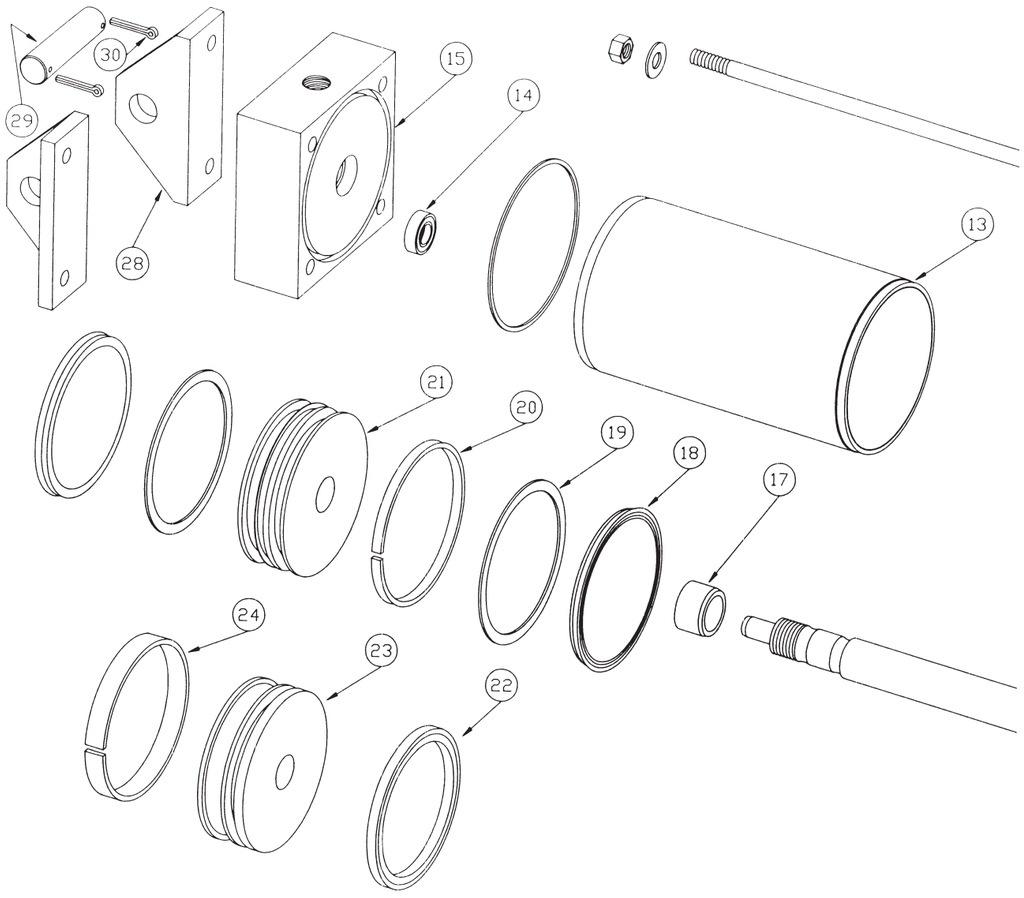


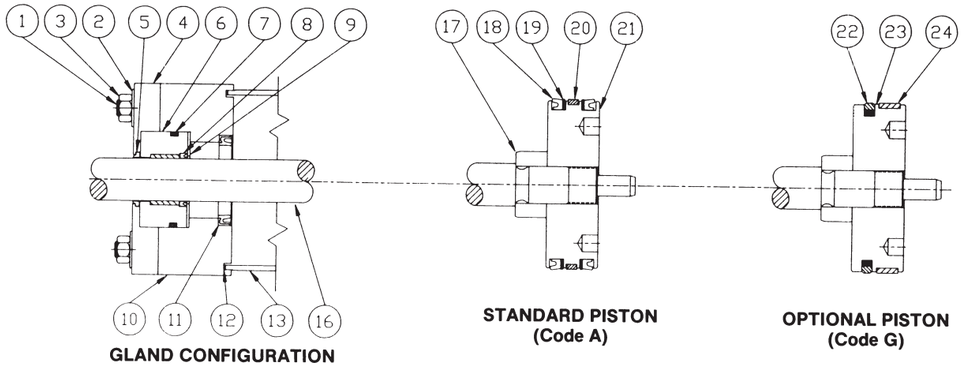
ROD END CONNECTION	
FIXED & WELL GUIDED	FIG 1 D "L" = 0 5 X D
PIVOTED AND WELL GUIDED	FIG 2 D "L" = 0 7 X D
SUPPORTED NOT WELL GUIDED	FIG 3 D "L" = 2 X D
PIVOTED AND WELL GUIDED	FIG 4 D "L" = 0 7 X D FOR LONG STROKE SUPPORT HEAD HEAD NOT SUPPORTED D "L" = D
	FIG 5 D "L" = 0 7 X D
	FIG 6 D "L" = D
	FIG 7 D "L" = D
	D D FIG 8 "L" = D

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

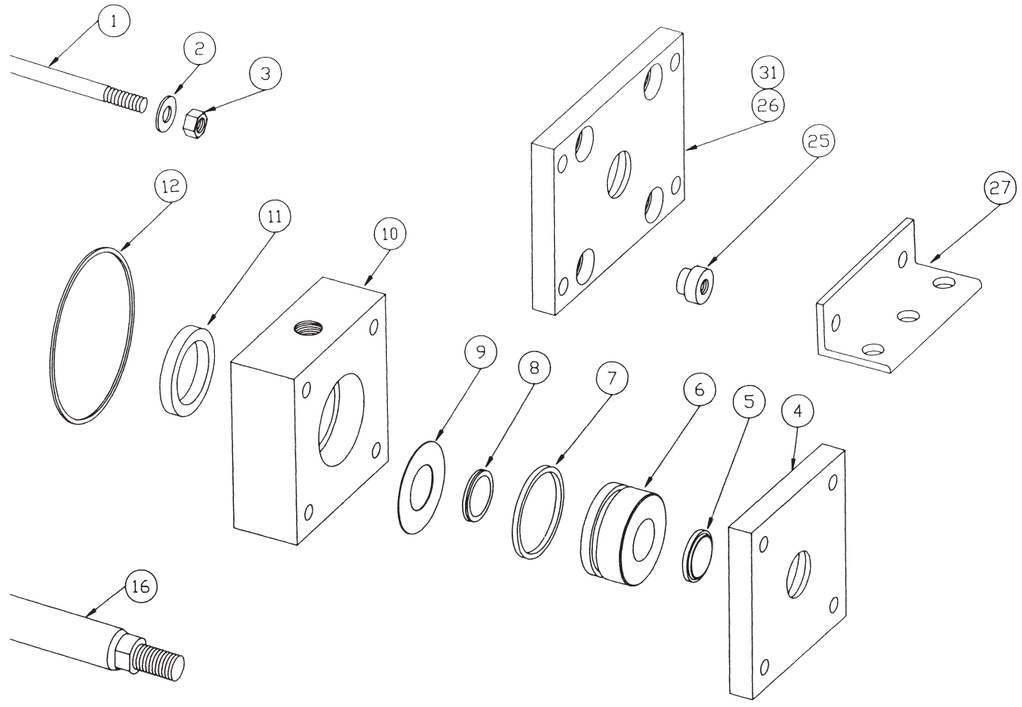




GLAND CONFIGURATION

STANDARD PISTON (Code A)

OPTIONAL PISTON (Code G)



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)			
8	1	Rod Packing	23	1	Optional Piston*
9	1	Rod Washer	24	1	Wear Strip
10	1	Front Head	25	4	Tie Rod Insert (Flange Mounts)
11	1	Front Cushion Seal	26	1	Front Flange
12	2	Gasket	27	2	End Angle Bar
13	1	Tube	28	2	Clevis Bracket
14	1	Rear Cushion Seal	29	1	Pivot Pin
15	1	Back Head	30	2	Cotter Pin
16	1	Piston Rod	31	1	Rear Flange

*Optional Part

STORAGE, INSTALLATION AND MAINTENANCE DATA

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.

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.

EXCELLENT CORROSION RESISTANCE ASSURES LONG SERVICE LIFE IN THE HARSHEST ENVIRONMENTS. COST EFFECTIVELY.

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

HOW TO ORDER

MF1-CA-CC-2.00"-9.00"-FSM1A

MOUNTING STYLE

Tie Rods **MX0, MX1, MX2, MX3, MX4**
End Angle **MS1**
Cap Fixed Clevis **MP1**
Head Trunnion **MT1**
Head Rectangular Flange **MF1**
Cap Rectangular Flange **MF2**
Double Rod (Available in most mounting styles) **MX0-D**

SERIES

Composite Pneumatic ..... **CA**

CUSHION

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

All cushions are non-adjustable.

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**

PISTON ROD PACKING, GLAND O-RING, ROD WIPER

STANDARD—Polyurethane Packing, Buna O-Ring, Polyurethane Wiper ... **1**

PISTON PACKING AND TUBE SEALS

STANDARD—Temperature Range -20°F. to +200°F. Buna Packings with Teflon Back-Ups, Wear Strip, Buna Tube Seals ..... **A**

OPTIONAL—Temperature Range +32°F. to +200°F. Filled Teflon Seal with Buna Expander, Wear Strip, Buna Tube Seals ..... **G**

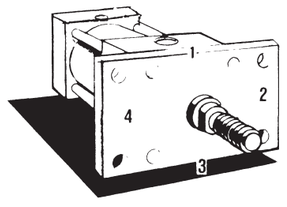
ROD DIAMETER

(Specify Piston Rod Code from dimensional chart)

* Maximum stroke is 9 ft. Consult factory for longer stroke lengths.

NOTE: For optional AWWA construction, specify Cadmium-Plated Piston with Standard Piston Packing and Tube Seals. (Code A).

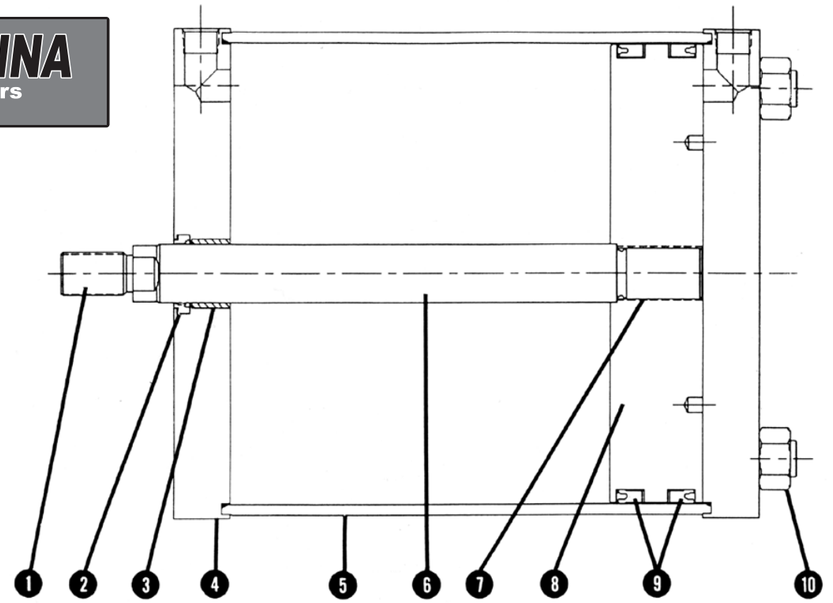
When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.



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



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.

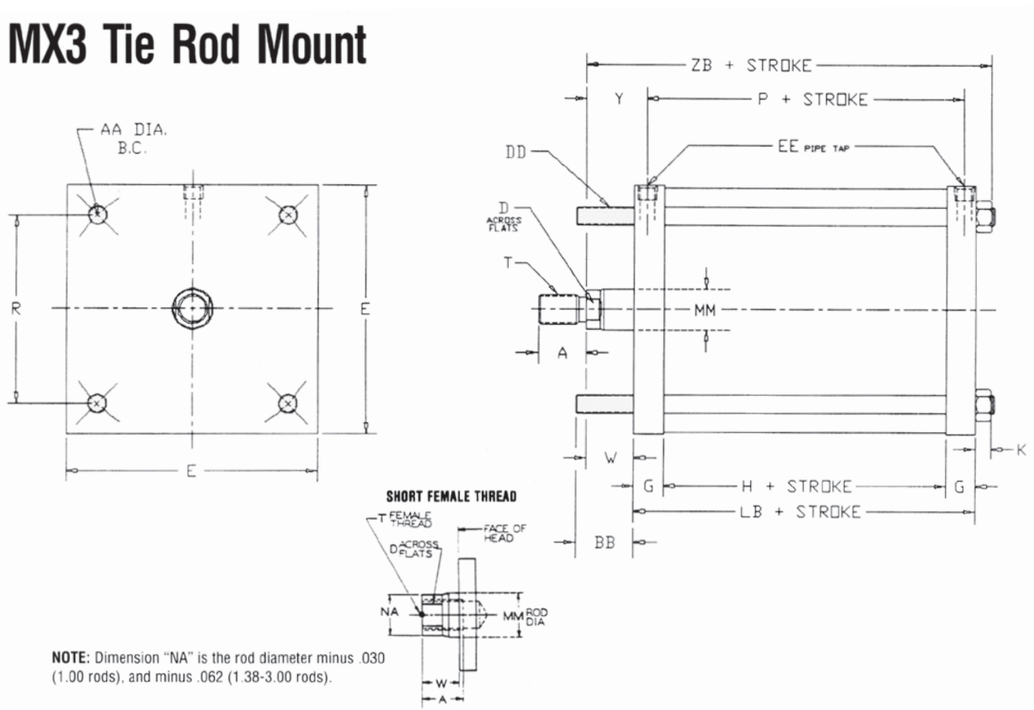
7. Piston-to-Rod Connection
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anerobic adhesive, torqued and pinned.

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

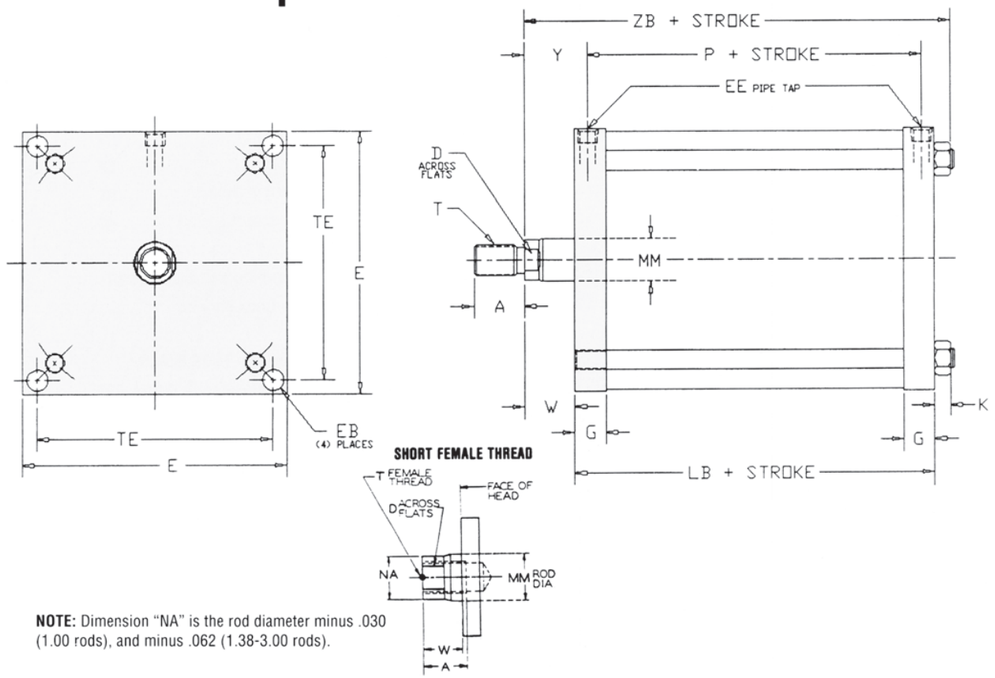


NOTE: Dimension "NA" is the rod diameter minus .030 (1.00 rods), and minus .062 (1.38-3.00 rods).

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	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



NOTE: Dimension "NA" is the rod diameter minus .030 (1.00 rods), and minus .062 (1.38-3.00 rods).

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.

MX3-LA-NC-4.00"-9.00"-FSM2A

MOUNTING STYLE
Tie Rods **MX3**
Head Square **ME3**

SERIES
Air/Water Hydraulic ..... **LA**

CUSHION
Non-Cushion ..... **NC**
NOTE: Cushions are not available on Series LA cylinders.

OPTIONS (Please specify)
Removable Gland—all sizes
Oversize Rods
AWWA Construction
Bronze or Stainless Steel Construction

BORE SIZE
(Specify)

STROKE
(Specify)

ROD DIAMETER
(Specify Piston Rod Code from dimensional chart)

ROD END STYLE
Small Male ..... **SM**
Short Female ..... **SF**
Alternate Male (Specify) ..... **AL**
Alternate Female (Specify) ..... **AF**

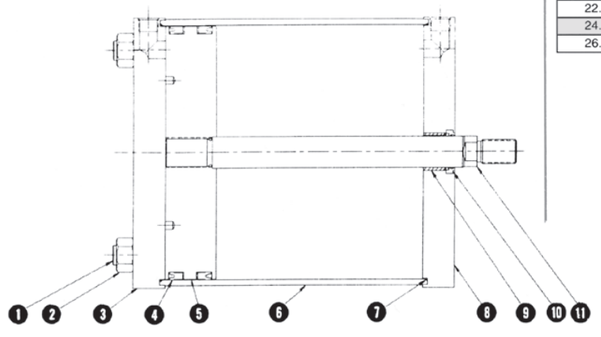
PISTON ROD PACKING/ROD WIPER
STANDARD–Buna Packing **2**

PISTON ROD AND TUBE SEALS
STANDARD– Temperature Range -20°F. to +200°F. Buna Packings, Buna Tube Seals ..... **A**

PARTS LIST

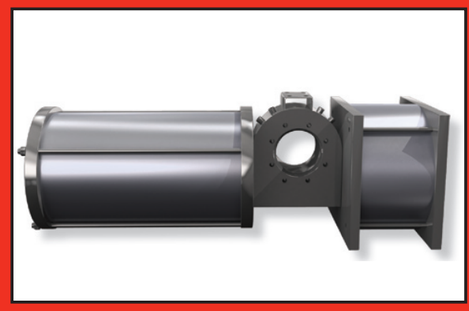
When ordering replacement parts, identify Model Number, Serial Number and Part Number, as shown below.

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

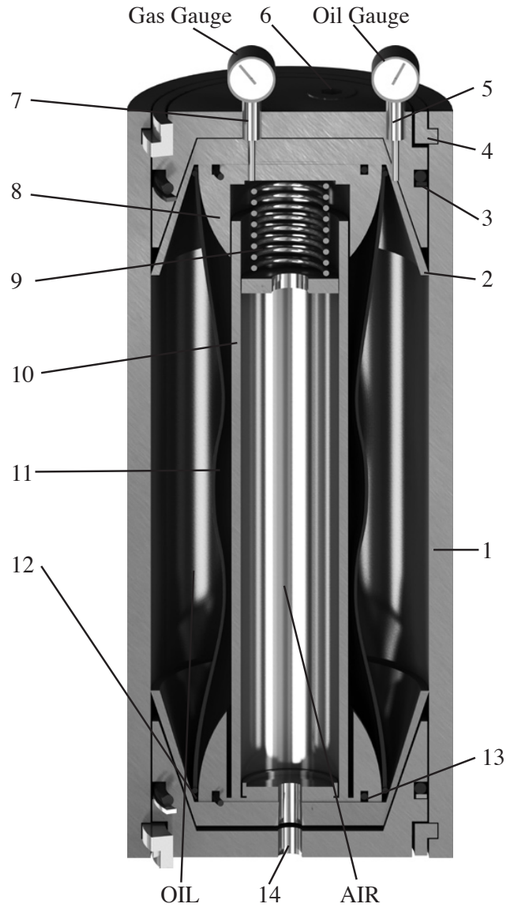
BORE	SIZE	TORQUE IN FT.-LBS. MX3	TORQUE IN FT.-LBS. ME3
3.25	.38-24	30	—
4.00	.38-24	30	—
5.00	.50-20	50	—
6.00	.50-20	50	—
7.00	.62-18	75	—
8.00	.62-18	75	50
10.00	.75-16	95	65
12.00	.75-16	95	65
14.00	.88-14	150	100
16.00	1.00-14	240	160
18.00	1.12-12	330	220
20.00	1.25-12	500	350
22.00	1.25-12	500	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
2. Steel end cap
3. "O" ring and back-up
4. Split shear ring
5. Fluid opening for pressure gauge
6. Safety fuse
7. Gas opening for pressure gauge
8. Sleeve cap
9. Spring
10. Sleeve stop tube
11. Sleeve bladder
12. Sleeve bladder end seal
13. Sleeve cap "O" ring
14. Fluid discharge port
15. Optional fluid ort

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 fliud 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?

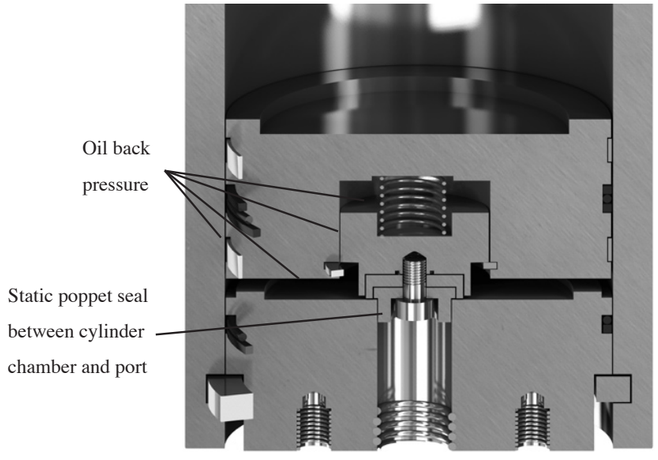
This is why…

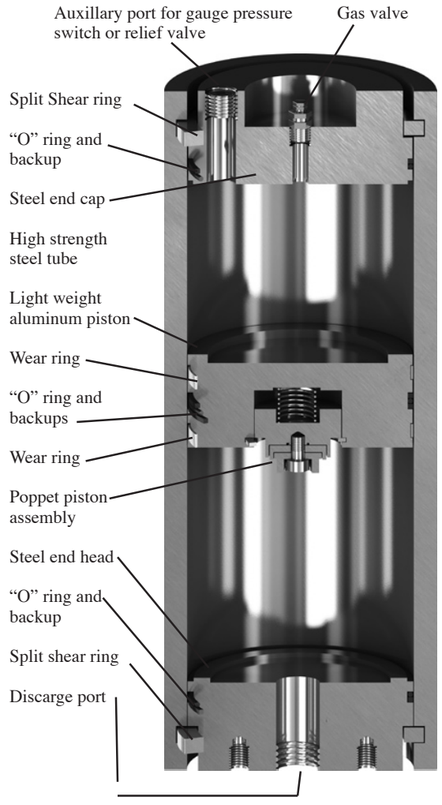
The addition of a patented poppet piston assembly with a built-in cushion secured within the main piston makes all the difference. By retaining a small unusable portion of the accumulator oil from discharging, then pressure is balanced on both sides of the piston. With oil on one side and gas on the 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.

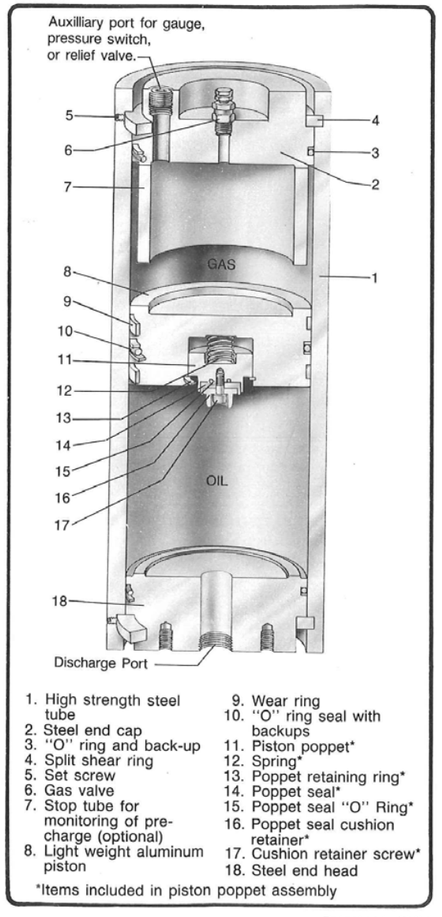




Series Accumulators/Nuclear Actuators

ACCUMULATORS

POPPET PISTON TYPE



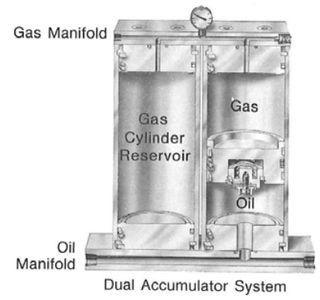
1. High strength steel tube
2. Steel end cap
3. "O" ring and back-up
4. Split shear ring
5. Set screw
6. Gas valve
7. Stop tube for monitoring of pre-charge (optional)
8. Light weight aluminum piston
9. Wear ring
10. "O" ring seal with backups
11. Piston poppet*
12. Spring*
13. Poppet retaining ring*
14. Poppet seal*
15. Poppet seal "O" Ring*
16. Poppet seal cushion retainer*
17. Cushion retainer screw*
18. Steel end head

*Items included in piston poppet assembly

Patented in U.S.A.
Foreign patents applied for.

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 loose 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 presssure 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.



Dual Accumulator System

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.
10 in.³	10C-25	10	⅜" to ¾" NPT	2.86	7.82	7¼
30 in.³	30C-25	30		2.86	11.90	9
60 in.³	60C-25	60		2.86	18.00	11
60 in.³	60C-4	60	½" to 1½" NPT or Straight Thd.	4.53	12.27	27
½ Gal.	05G-4	116		4.53	16.73	31
1 Gal.	1G-4	231		4.53	25.88	40
1½ Gal.	1-5G-4	350		4.53	35.35	49
2½ Gal.	2-5G-4	580		4.53	53.66	66
1 Gal.	1G-6	231	¾", 1½", or 2½"* NPT or Straight Thd. Opt. Flange Ports	6.78	16.54	83
2½ Gal.	2-5G-6	580		6.78	28.88	110
4 Gal.	4G-6	925		6.78	41.09	137
5 Gal.	5G-6	1155		6.78	49.22	155
7½ Gal.	7-5G-6	1740		6.78	69.91	200
10 Gal.	10G-6	2315		6.78	90.24	245
12 Gal.	12G-6	2776		6.78	106.55	281
15 Gal.	15G-6	3470		6.78	131.10	335
20 Gal.	20G-6	4625		6.78	171.95	425

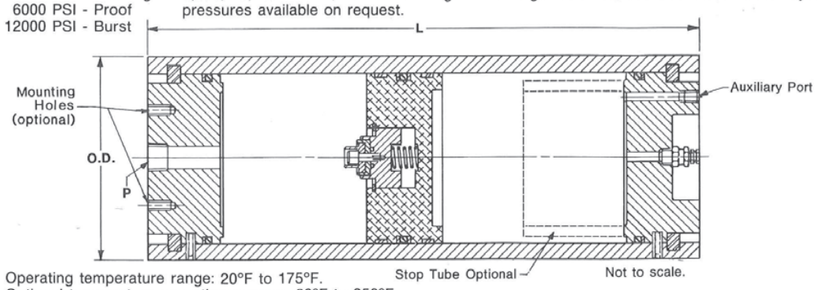
Size	Model No.	Total Volume cu. in.	P Port Size	O.D. in.	L Length in.	Dry Weight lbs.
2½ Gal.	2-5G-8	580	¾" to 1½" NPT or Straight Thd. 2½"* NPT or Opt. Flange Ports	9.03	21.29	184
5 Gal.	5G-8	1155		9.03	32.73	230
7½ Gal.	7-5G-8	1740		9.03	44.37	276
10 Gal.	10G-8	2315		9.03	55.81	322
15 Gal.	15G-8	3470		9.03	78.78	414
20 Gal.	20G-8	4625		9.03	101.76	506
25 Gal.	25G-8	5780		9.03	124.74	597
30 Gal.	30G-8	6970		9.03	148.42	693
35 Gal.	35G-8	8085		9.03	170.60	781
10 Gal.	10G-10	2315	2½" NPT or Straight Thd. Opt. Flange Ports	11.28	40.99	455
15 Gal.	15G-10	3470		11.28	55.71	547
20 Gal.	20G-10	4625		11.28	70.44	638
25 Gal.	25G-10	5780		11.28	85.12	731
30 Gal.	30G-10	6970		11.28	100.27	825
40 Gal.	40G-10	9240		11.28	129.17	1007
50 Gal.	50G-10	11550		11.28	158.58	1188
60 Gal.	60G-10	13860		11.28	188.00	1365

*2½" ports are available on special order due to larger piston poppet assembly required.

3000 PSI - Working
6000 PSI - Proof
12000 PSI - Burst

5,000, 10,000 and 20,000 PSI working pressures available on request.

For larger volumes, see Dual Accumulator Systems.



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.
10 Gal.	D5G-6	1155	2388	L=23.50 W=7.75	52.70	330
15 Gal.	D7-5G-6	1740	3558		73.41	375
20 Gal.	D10G-6	2315	4708		93.74	420
25 Gal.	D12-5G-6	2887	5852		114.00	465
30 Gal.	D15G-6	3470	7018		134.60	510
40 Gal.	D20G-6	4625	9328		175.45	600
10 Gal.	D5G-8	1155	2485	L=27.50 W=10.00	36.47	499
15 Gal.	D7-5G-8	1740	3655		48.11	545
20 Gal.	D10G-8	2315	4805		59.54	591
30 Gal.	D15G-8	3470	7115		82.52	683
40 Gal.	D20G-8	4625	9425		105.45	776
50 Gal.	D25G-8	5780	11735		128.45	867
60 Gal.	D30G-8	6970	14115		152.15	962

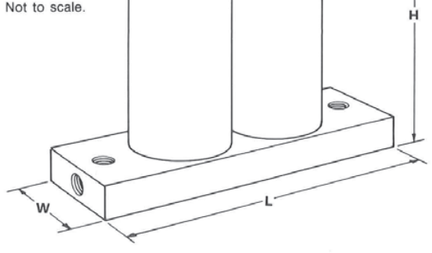
Size	Model No.	Max. Oil Vol. cu. in.	Total Volume cu. in.	L-Length W-Width in.	H Height in.	Dry Weight lbs.
20 Gal.	D10G-10	2315	4942	L=33.00 W=12.00	44.98	857
30 Gal.	D15G-10	3470	7252		59.68	949
40 Gal.	D20G-10	4625	9562		74.39	1041
50 Gal.	D25G-10	5780	11872		89.09	1133
60 Gal.	D30G-10	6970	14252		104.24	1228
80 Gal.	D40G-10	9240	18792		133.15	1408
100 Gal.	D50G-10	11550	23412		162.56	1592
120 Gal.	D60G-10	13860	28032		191.97	1775
60 Gal.	D30G-12	6970	14252	L=38.00 W=14.00	78.88	1495
90 Gal.	D45G-12	10395	21102		109.15	1748
120 Gal.	D60G-12	13860	28032		139.79	2004
150 Gal.	D75G-12	17325	34962		170.43	2259
180 Gal.	D90G-12	20790	41892		201.07	2514

Volumes not shown in chart are available as specials; consult factory.

3000 PSI - Working
6000 PSI - Proof
12000 PSI - Burst

5,000, 10,000 and 20,000 PSI working pressures available on request.

Operating temperature range: 20°F to 175°F.
Optional temperature ranges: -60°F to 350°F.



Dual Accumulator Systems Porting Options

Model (Last Digit)	End Port NPT	Top of Bottom Plate Options NPT	Straight Thd.	Flange
-6	1½	2½	2½	2½
-8	1½	2½	2½	2½
-10	1½	2½	3	3
-12	1½	2½	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: 10 in.³

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		5.76	7.65	8.61	9.17	9.58	9.95																							
200			3.82	5.74	6.91	7.66	8.21	8.53	8.94	9.21	9.41	9.57	9.75	9.86																
300				2.89	4.61	5.76	6.55	7.18	7.66	8.03	8.34	8.61	8.83	9.05	9.21	9.36	9.51	9.61	9.69	9.76	9.85	9.91									
400					2.31	3.82	4.93	5.76	6.48	6.91	7.31	7.68	7.95	8.21	8.43	8.61	8.81	8.94	9.08	9.21	9.31	9.38	9.51	9.56	9.67	9.72	9.81	9.86	9.91	9.94
500						1.90	3.28	4.30	5.11	5.76	6.25	6.71	7.06	7.37	7.66	7.91	8.11	8.31	8.46	8.63	8.74	8.87	9.00	9.10	9.22	9.28	9.36	9.46	9.52	9.67
600							1.65	2.89	3.82	4.61	5.33	5.76	6.18	6.57	6.91	7.18	7.45	7.66	7.87	8.06	8.22	8.36	8.51	8.61	8.75	8.84	8.96	9.06	9.13	9.21
700								1.44	2.56	3.46	4.17	4.78	5.32	5.76	6.11	6.45	6.76	7.03	7.26	7.48	7.69	7.84	8.00	8.13	8.29	8.39	8.52	8.61	8.73	8.82
800									1.27	2.31	3.13	3.84	4.44	4.93	5.35	5.75	6.08	6.40	6.66	6.91	7.13	7.33	7.50	7.66	7.81	7.96	8.09	8.21	8.30	8.42
900										1.16	2.07	2.89	3.45	4.11	4.61	5.02	5.42	5.76	6.04	6.31	6.55	6.81	6.96	7.18	7.35	7.52	7.66	7.81	7.95	8.06
1000											1.06	1.91	2.65	3.28	3.82	4.32	4.72	5.11	5.45	5.76	6.02	6.25	6.51	6.71	6.90	7.06	7.24	7.41	7.56	7.68
1100												.958	1.76	2.45	3.06	3.58	4.05	4.48	4.83	5.18	5.47	5.76	6.10	6.22	6.44	6.66	6.83	6.99	7.14	7.27
1200													.883	1.63	2.31	2.87	3.37	3.81	4.22	4.61	4.91	5.24	5.47	5.76	5.96	6.18	6.41	6.58	6.78	6.91
1300														.824	1.52	2.15	2.71	3.17	3.63	3.90	4.39	4.72	5.01	5.26	5.51	5.76	6.07	6.15	6.34	6.51
1400															.767	1.43	2.01	2.45	3.01	3.46	3.84	4.16	4.51	4.81	5.06	5.32	5.53	5.76	5.95	6.12
1500																.718	1.34	1.91	2.41	2.88	3.32	3.66	4.01	4.32	4.61	4.85	5.11	5.33	5.55	5.76
1600																	.675	1.27	1.80	2.31	2.75	3.12	3.47	3.82	4.13	4.44	4.66	4.92	5.16	5.35
1700																		.638	1.22	1.72	2.19	2.60	3.00	3.35	3.67	3.97	4.25	4.51	4.75	4.97
1800																			.605	1.16	1.63	2.08	2.51	2.89	3.21	3.45	3.84	4.11	4.35	4.61
1900																				.576	1.11	1.56	2.01	2.32	2.75	3.11	3.41	3.71	3.95	4.21
2000																					.546	1.04	1.48	1.91	2.31	2.61	3.08	3.28	3.55	3.84
2100																						.519	1.01	1.43	1.83	2.20	2.54	2.86	3.16	3.46
2200																							.493	.943	1.37	1.78	2.12	2.45	2.76	3.06
2300																								.470	.921	1.31	1.71	2.05	2.36	2.67
2400																									.461	.886	1.26	1.65	1.97	2.31
2500																										.436	.850	1.24	1.58	1.91
2600																											.426	.826	1.18	1.52
2700																												.415	.794	1.16

Size: 30 in.³

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		15.2	20.1	22.7	24.3	25.2	26.2	26.5	27.0	27.3	27.6	27.8	28.0																	
200			10.1	15.2	18.2	20.2	21.7	22.8	23.6	24.3	24.8	25.3	25.9	26.0	26.3	26.6	26.8	27.1	27.1	27.3	27.5	27.6	27.6	28.1	28.1	28.1	28.2			
300				7.31	12.1	15.2	17.4	19.0	20.2	21.3	22.1	22.8	23.4	24.0	24.5	24.7	25.2	25.3	25.6	25.8	26.0	26.2	26.6	26.5	26.7	26.8	27.2	27.1	27.2	27.3
400					6.10	10.1	13.2	15.2	17.1	18.2	19.3	20.3	21.2	21.7	22.3	22.8	23.2	23.6	24.0	24.3	24.6	25.1	25.3	25.3	25.7	25.7	26.1	26.1	26.5	26.4
500						5.08	8.71	11.3	13.4	15.2	16.5	17.7	19.1	19.5	20.2	21.1	21.4	22.0	22.3	22.7	23.1	23.4	23.6	24.2	24.5	24.5	24.9	25.2	25.1	25.3
600							4.34	7.01	10.1	12.1	13.8	15.2	16.3	17.3	18.4	19.1	19.8	20.4	20.9	21.2	21.6	22.1	22.4	22.9	23.1	23.3	23.6	24.0	24.1	24.3
700								3.81	6.75	9.16	10.7	12.6	14.2	15.2	16.1	17.2	17.9	18.5	19.1	19.7	20.2	20.7	21.3	21.7	21.8	22.1	22.6	22.7	23.2	23.5
800									3.37	6.11	8.31	10.1	11.6	13.0	14.3	15.4	16.0	17.1	17.6	18.2	18.7	19.3	19.7	20.3	20.6	21.2	21.3	21.6	22.1	22.2
900										3.06	5.51	7.60	9.34	10.7	12.3	13.4	14.3	15.2	16.0	16.6	17.3	18.2	18.6	19.2	19.6	19.8	20.3	20.8	21.1	21.5
1000											2.76	5.11	7.00	8.66	10.3	11.5	12.8	13.6	14.3	15.2	15.8	16.5	17.1	17.8	18.4	18.8	19.1	19.5	20.1	20.4
1100												2.55	4.68	6.51	8.12	9.52	10.0	11.7	12.7	13.6	14.6	15.3	15.8	16.4	17.2	17.5	18.2	18.4	10.1	19.2
1200													2.33	4.34	6.11	7.62	8.96	10.3	11.1	12.1	13.2	13.9	14.6	15.2	15.8	16.3	17.1	17.3	17.8	18.2
1300														2.19	4.06	5.71	7.17	8.44	9.61	10.6	11.5	12.5	13.2	14.1	14.8	15.2	15.7	16.3	16.7	17.2
1400															2.04	3.80	5.35	6.76	8.00	9.14	10.1	11.0	11.8	12.6	13.3	14.2	14.8	15.4	15.9	16.4
1500																1.90	3.58	5.11	6.43	7.62	8.71	9.70	10.7	11.5	12.1	12.8	13.6	14.1	14.6	15.2
1600																	1.71	3.38	4.80	6.10	7.25	8.33	9.24	10.1	11.1	11.6	12.5	13.0	13.6	14.1
1700																		1.67	3.20	4.56	5.81	6.94	7.94	8.91	9.74	10.6	11.4	12.1	12.7	13.3
1800																			1.60	3.04	4.36	5.56	6.61	7.63	8.54	9.35	10.1	10.8	11.4	12.1
1900																				1.52	2.91	4.16	5.31	6.33	7.31	8.23	9.01	9.81	10.6	11.3
2000																					1.44	2.76	3.95	5.11	6.11	7.01	8.22	8.71	9.44	10.1
2100																						1.39	2.67	3.81	4.88	5.86	6.78	7.66	8.45	9.19
2200																							1.30	2.53	3.66	4.72	5.69	6.54	7.37	8.15
2300																								1.24	2.45	3.51	4.54	5.49	6.31	7.13
2400																									1.21	2.35	3.41	4.36	5.25	6.11
2500																										1.15	2.25	3.26	4.21	5.12
2600																											1.14	2.21	3.19	4.08
2700																												1.11	2.12	3.07

Series Accumulators/Nuclear Actuators

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 60 in.³

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		29.6	39.6	44.5	47.5	49.6	51.1	52.0	52.9	53.5	54.2	54.7	54.8	55.4	55.6	55.6	56.1	56.2	56.2	56.4										
200			19.7	29.6	35.6	39.8	42.6	44.5	46.4	47.5	48.5	49.6	50.3	5.11	51.7	52.0	52.6	52.9	53.1	53.5	53.7	54.1	54.2	54.7	54.8	54.8	55.2	55.2	55.3	55.4
300				14.8	23.7	29.8	34.2	37.1	39.8	41.5	43.2	44.7	45.6	46.9	47.7	48.3	49.1	49.6	50.0	50.5	51.1	51.3	51.7	52.2	52.4	52.4	52.9	53.0	53.3	53.5
400					11.8	19.9	25.6	29.6	33.2	35.6	37.8	39.8	41.3	42.6	43.7	44.5	45.6	46.2	47.1	47.5	48.1	48.5	49.2	49.6	50.1	50.5	50.8	51.1	51.2	51.5
500						9.92	17.1	22.2	26.3	29.6	32.4	34.8	36.7	38.4	39.8	40.8	42.1	43.1	43.7	44.5	45.2	46.0	46.5	47.3	47.5	48.1	48.6	49.1	49.2	49.5
600							8.52	14.8	19.7	23.7	27.2	29.8	31.8	34.2	35.8	37.3	38.6	39.6	40.6	41.5	42.4	43.2	44.1	44.7	45.1	45.6	46.4	46.7	47.1	47.5
700								7.45	13.3	17.8	21.5	24.9	27.4	29.8	31.8	33.4	35.2	36.3	37.5	38.6	39.6	40.5	41.6	42.2	42.7	43.3	44.1	44.5	45.0	45.5
800									6.61	11.8	16.3	19.9	22.8	25.6	27.9	29.6	31.6	33.0	34.3	35.6	36.7	37.8	38.7	39.8	40.6	41.3	41.7	42.6	43.1	43.5
900										5.94	10.7	14.8	18.4	21.3	23.9	26.0	28.1	29.6	31.2	32.6	34.0	35.1	36.3	37.3	38.2	38.8	39.8	40.5	41.2	41.7
1000											5.42	9.92	13.6	17.1	19.9	22.2	24.6	26.3	28.1	29.6	31.1	32.4	33.5	34.8	35.6	36.7	37.6	38.4	39.2	39.8
1100												4.94	9.00	12.8	15.8	18.5	21.1	23.1	25.0	26.7	28.2	29.9	31.1	32.3	33.4	34.5	35.3	36.1	37.1	37.5
1200													4.58	8.48	11.8	14.8	17.6	19.7	21.8	23.7	25.4	27.1	28.3	29.8	30.8	32.1	33.3	34.0	35.0	35.6
1300														4.26	7.95	11.1	14.1	16.6	18.7	20.7	22.6	24.2	25.8	27.4	28.7	29.6	30.9	31.8	32.8	33.8
1400															3.96	7.45	10.6	13.1	15.5	17.8	19.7	21.5	23.3	24.7	26.3	27.5	28.8	29.8	30.9	31.8
1500																3.73	7.01	9.90	12.4	14.8	17.0	18.8	20.8	22.4	23.7	25.1	26.3	27.8	28.7	29.6
1600																	3.51	6.61	9.37	11.8	14.1	16.1	18.1	19.7	21.3	22.8	24.1	25.6	26.8	27.7
1700																		3.31	6.25	8.91	11.2	13.4	15.6	17.3	19.1	20.7	22.0	24.5	24.7	25.9
1800																			3.12	5.94	8.50	10.7	12.8	14.8	16.6	18.4	19.9	21.3	22.6	23.9
1900																				2.98	5.65	8.11	10.5	12.3	14.4	16.1	17.7	19.3	20.4	21.7
2000																					2.83	5.42	7.76	9.92	11.8	13.8	16.1	17.1	18.6	19.7
2100																						2.68	5.18	7.43	9.51	11.3	13.3	14.7	16.3	17.7
2200																							2.56	4.94	7.13	9.14	11.1	12.8	14.2	15.7
2300																								2.43	4.75	6.84	8.78	10.5	12.3	13.7
2400																									2.37	4.56	6.58	8.51	10.1	11.8
2500																										2.28	4.41	6.36	8.21	9.92
2600																											2.21	4.27	6.18	7.91
2700																												2.15	4.11	5.95

Size: ½ 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		64.6	68.3	87.0	90.1	99.6	101	103	105	107	112	113	115																	
200			43.0	64.6	77.6	86.5	92.6	97.0	102.	103.	105.	107	108.	112.	113.	114.	115.	116.													
300				32.3	51.7	64.6	74.3	81.0	86.4	90.5	94.1	97.2	99.6	101.	103.	104.	106.	107	108.	111.	110.	112.	114.	115.								
400					25.8	43.2	55.6	64.5	72.1	77.5	82.3	86.4	89.7	92.2	94.7	97.0	99.1	102.	104.	105.	106.	108.	108.	109.	109.	109.	111.	110.	111.	
500						21.7	37.1	48.4	57.6	64.6	70.6	75.6	80.8	83.1	86.3	89.0	91.6	93.6	95.6	97.0	99.3	100.	102.	103.	104.	105.	106.	107.	108.	109.
600							18.6	32.3	43.1	51.7	58.7	64.8	69.6	74.1	77.5	81.1	83.8	86.6	88.6	90.7	92.2	94.3	95.5	98.1	98.2	99.6	102.	103.	104.	105.
700								16.1	28.6	38.7	47.0	54.1	59.7	64.6	69.0	72.6	76.2	79.1	81.8	84.0	86.3	88.5	90.1	91.5	93.2	94.6	95.9	97.2	98.1	99.3
800									14.3	25.8	35.3	43.2	49.9	55.4	60.4	64.5	68.6	72.1	75.0	77.7	80.2	82.5	84.3	86.4	89.0	89.7	91.0	92.4	93.6	94.7
900										12.8	23.4	32.5	39.9	46.1	51.7	56.5	61.1	64.9	68.1	71.3	73.8	76.6	78.8	80.8	82.9	84.7	86.5	87.8	89.4	90.5
1000											11.7	21.7	29.9	37.0	43.0	48.4	53.3	57.6	60.0	64.8	67.9	70.8	73.3	75.6	77.7	80.8	81.6	83.1	85.1	86.3
1100												10.9	19.9	27.6	34.4	40.3	45.8	50.3	54.6	58.4	61.5	64.8	67.6	70.1	72.6	74.8	76.7	78.8	80.7	82.0
1200													9.94	18.4	25.8	32.3	38.2	43.0	47.9	51.9	55.4	58.6	61.8	64.9	67.5	69.6	72.0	74.3	76.4	77.5
1300														9.23	17.2	24.2	30.5	35.0	40.8	45.4	49.3	53.1	56.4	59.4	62.6	64.8	67.2	69.5	71.6	73.3
1400															8.63	16.1	22.9	28.9	34.0	38.9	43.2	47.1	50.6	54.1	56.8	59.7	62.5	64.8	67.1	69.1
1500																8.11	15.3	21.4	27.3	32.3	37.1	41.1	45.0	48.6	51.9	54.8	57.4	60.3	62.6	64.6
1600																	7.60	14.3	20.5	25.8	30.7	35.3	39.1	43.2	46.5	49.9	52.7	55.6	58.1	60.4
1700																		7.18	13.8	19.3	24.5	29.3	33.9	37.9	41.3	44.8	48.0	50.9	53.6	56.1
1800																			6.80	12.8	18.6	23.4	28.2	32.5	36.2	39.9	43.2	46.3	47.9	51.7
1900																				6.46	12.4	17.8	22.6	27.0	31.0	34.9	38.5	41.8	44.7	47.4
2000																					6.15	11.9	17.5	21.7	25.8	29.7	34.9	37.1	40.3	43.0
2100																						5.81	11.3	16.3	20.6	24.7	28.8	32.2	35.8	38.7
2200																							5.55	10.9	15.4	19.7	23.8	27.7	31.3	34.4
2300																								5.30	10.2	14.8	19.0	23.3	26.7	30.0
2400																									5.16	9.96	14.4	18.6	22.3	25.7
2500																										4.90	9.57	13.7	17.9	21.5
2600																											4.79	9.32	13.5	17.1
2700																												4.66	8.93	12.8

Series Accumulators/Nuclear Actuators

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	68.6	78.2	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	69.5	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: 1½ 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	328
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	300	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	95.1	112	122	132	142	148	156	163
1800																			20.1	38.0	54.4	59.1	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: 2½ 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		304	406	457	486	507	523	533	541	549	555	559	562	565	577	570	573	576												
200			202	304	365	406	434	457	474	487	499	507	416	523	528	533	538	541	544	549	553	555	557	560	561	561	563	566	568	569
300				151	243	304	349	381	406	427	443	457	468	479	487	495	502	507	514	517	523	526	529	533	536	540	541	544	547	549
400					121	202	255	304	339	365	388	406	422	434	446	457	466	474	481	486	493	498	504	507	512	515	519	523	545	527
500						101	174	228	270	304	333	355	379	391	406	419	431	440	450	457	464	470	476	483	487	491	496	500	504	506
600							87.2	151	202	243	277	304	324	349	365	381	394	406	416	427	433	443	448	457	457	468	473	479	483	487
700								76.3	134	182	221	253	281	304	324	342	358	372	385	396	405	416	424	432	440	445	451	456	461	467
800									67.6	121	165	202	233	255	284	304	322	338	353	363	377	387	397	405	414	422	427	431	441	445
900										60.9	110	152	186	217	243	266	287	304	321	334	348	360	370	381	390	398	405	414	420	425
1000											55.4	101	139	174	202	228	253	270	287	304	318	333	344	355	364	378	383	390	400	406
1100												50.7	93.7	130	162	190	215	246	256	274	290	303	317	330	341	350	361	370	378	385
1200													46.8	87.3	120	151	179	202	223	243	261	276	289	304	316	324	339	349	359	365
1300														43.5	81.1	113	142	167	191	213	230	247	264	278	291	304	314	326	336	345
1400															40.6	76.3	106	134	160	182	202	221	238	253	267	281	293	304	315	324
1500																38.1	71.5	101	127	151	173	193	211	228	243	257	270	283	294	304
1600																	35.8	67.6	96.2	121	144	165	184	202	220	233	247	254	273	283
1700																		33.7	64.1	91.5	115	137	158	176	193	210	225	239	251	262
1800																			31.9	61.0	87.1	110	131	152	170	186	202	217	230	243
1900																				30.4	58.1	82.8	105	126	144	163	181	196	210	223
2000																				28.4	55.4	79.2	100	121	138	163	174	187	201
2100																					27.3	53.2	76.3	97.5	115	134	151	167	182
2200																						26.1	50.6	73.2	93.9	110	130	146	162
2300																							24.9	47.8	70.1	90.2	108	124	141
2400																								24.3	46.8	67.6	87.1	104	121
2500																									23.1	45.1	65.2	84.1	101
2600																										22.5	43.9	63.3	81.1
2700																											21.8	42.1	60.9

Size: 4 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		474	630	715	764	798	820	834	852	860	872	876	884	885	891	895	902	902	904	906	909	912	915	917	918	921				
200			318	475	573	638	685	715	743	769	784	794	808	821	830	836	843	851	855	862	864	871	875	878	880	881	883	885	889	892
300				240	385	480	549	599	634	671	694	714	736	751	767	778	786	794	803	815	820	824	830	834	840	845	851	853	857	862
400					190	320	415	476	530	576	610	635	665	684	700	715	732	743	757	764	773	781	792	794	804	810	814	820	824	828
500						165	274	355	427	477	523	558	598	617	637	658	676	692	706	719	728	738	747	756	764	772	778	784	792	794
600							136	238	317	382	434	477	508	546	572	596	618	636	652	670	681	694	705	715	725	734	743	751	758	764
700								120	211	286	346	397	441	477	510	537	562	583	603	621	637	651	664	676	686	697	705	715	725	733
800									105	190	260	317	367	410	446	477	505	531	552	573	590	610	623	636	650	662	671	681	690	715
900										95.5	173	238	292	340	381	416	450	477	501	525	544	564	580	596	611	624	637	648	658	668
1000											86.7	160	220	272	317	358	393	423	451	477	500	521	540	555	573	594	601	614	626	637
1100												79.6	146	203	254	297	336	371	401	430	454	477	498	516	534	551	565	580	593	604
1200													73.4	136	190	238	280	317	351	382	419	433	454	477	496	508	530	546	562	572
1300														68.1	126	178	223	264	301	333	363	390	415	436	451	476	494	511	528	541
1400															63.6	120	167	211	250	286	317	345	373	397	420	441	460	471	494	509
1500																59.6	111	158	200	238	272	303	330	357	381	403	423	441	461	477
1600																	56.2	105	150	190	227	260	290	317	343	367	387	410	428	446
1700																		53.2	100	142	180	215	248	277	305	330	353	374	394	412
1800																			50.2	95.7	135	173	206	238	267	293	317	340	361	381
1900																				47.9	89.8	130	165	198	228	256	282	307	328	349
2000																					45.4	86.8	123	160	190	220	256	272	295	317
2100																						43.1	83.2	118	152	182	211	238	263	286
2200																							41.1	79.4	114	146	176	203	230	254
2300																								39.1	76.4	110	140	170	176	222
2400																									38.1	73.6	105	136	163	190
2500																										36.2	70.6	101	131	159
2600																											35.3	68.1	99.6	126
2700																												34.3	65.8	95.5

Series Accumulators/Nuclear Actuators

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 5 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		595	794	894	955	993	1021	1044	1061	1074	1086	1093	1100	1106	1113	1119	1123	1126	1129	1133	1134	1138	1142	1141	1145	1148					
200			398	597	714	794	850	893	927	953	976	993	1010	1021	1033	1044	1053	1061	1063	1072	1077	1084	1088	1092	1095	1101	1105	1106	1111	1113	
300				299	479	595	683	747	794	836	868	894	918	936	953	971	982	996	1004	1013	1024	1031	1039	1044	1051	1053	1061	1066	1071	1072	
400					239	396	512	595	663	714	761	794	827	852	873	896	912	927	942	953	967	974	984	995	1003	1008	1017	1023	1028	1033	
500						198	342	448	531	575	650	694	744	766	796	821	843	861	878	893	908	922	933	943	953	961	972	981	985	995	
600							171	297	396	478	544	595	634	681	716	746	772	796	816	834	851	868	881	894	905	916	925	937	945	955	
700								148	264	357	433	496	551	575	636	671	703	727	755	774	796	813	831	846	857	871	883	893	903	914	
800									132	239	324	397	458	512	558	598	631	665	691	714	736	761	775	796	810	825	838	852	863	873	
900										118	215	299	378	426	476	522	562	575	629	654	681	706	722	746	762	777	796	811	821	834	
1000											107	198	273	342	398	446	491	531	562	575	624	652	673	696	714	744	752	766	784	794	
1100												99.1	182	256	319	373	422	465	503	535	566	597	623	644	666	688	706	723	742	754	
1200													91.5	171	238	299	351	399	438	478	513	543	568	598	621	634	665	683	704	716	
1300														86.1	159	225	281	331	379	418	455	486	519	545	573	595	617	641	661	675	
1400															79.4	149	212	265	313	359	396	433	467	496	524	551	574	575	619	634	
1500																74.6	141	198	252	299	342	378	416	446	476	506	528	555	578	595	
1600																	70.0	133	189	239	283	324	362	396	428	458	484	512	534	555	
1700																		66.1	126	178	225	272	312	347	381	411	443	468	495	515	
1800																			62.8	118	171	215	258	296	333	378	396	423	451	476	
1900																				59.7	114	161	209	246	285	322	352	371	413	438	
2000																					56.6	109	156	198	239	273	322	342	371	395	
2100																						53.5	103	148	192	229	263	297	328	359	
2200																							51.4	99.1	142	182	221	256	288	319	
2300																								48.8	95.4	136	175	215	245	279	
2400																									47.6	91.5	133	171	206	238	
2500																										45.2	88.1	128	166	198	
2600																											44.3	85.2	125	159	
2700																												43.0	82.3	119	

Size: 7½ 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		899	1203	1350	1439	1502	1543	1575	1600	1619	1637	1649	1660	1670	1678	1687	1692	1700	1704	1710	1714	1720	1722	1725	1730	1731					
200			598	898	1080	1202	1270	1350	1400	1440	1471	1500	1521	1543	1560	1575	1587	1600	1610	1620	1630	1637	1641	1650	1656	1660	1667	1670	1674	1678	
300				450	719	900	1030	1124	1199	1259	1307	1350	1381	1414	1446	1460	1481	1500	1516	1528	1541	1553	1564	1574	1582	1590	1600	1607	1613	1620	
400					360	599	772	900	1000	1080	1146	1200	1247	1270	1319	1350	1360	1400	1421	1440	1457	1471	1487	1500	1511	1521	1532	1543	1550	1560	
500						300	514	674	798	898	982	1050	1121	1157	1200	1237	1260	1300	1324	1350	1370	1390	1410	1424	1440	1450	1467	1480	1490	1500	
600							256	449	600	720	818	900	960	1030	1080	1124	1161	1199	1230	1260	1284	1307	1330	1350	1357	1381	1400	1414	1430	1440	
700								224	398	539	654	749	831	900	959	1011	1056	1100	1137	1169	1200	1225	1252	1273	1295	1313	1330	1350	1364	1380	
800									200	360	491	600	692	772	840	900	950	1000	1040	1080	1110	1146	1171	1206	1221	1247	1264	1270	1300	1320	
900										179	325	450	553	640	718	786	845	900	944	990	1024	1060	1091	1124	1151	1177	1200	1220	1240	1260	
1000											163	298	413	514	600	674	737	799	850	900	942	982	1014	1050	1080	1121	1130	1157	1180	1200	
1100												150	276	384	480	561	634	700	755	808	855	900	937	974	1008	1035	1062	1090	1117	1140	
1200													137	256	360	450	528	600	661	720	772	818	860	900	935	960	1000	1030	1060	1079	
1300														128	238	336	423	498	568	630	684	736	782	824	864	900	931	960	993	1020	
1400															120	225	315	398	472	539	600	654	704	750	791	831	865	900	914	959	
1500																112	210	300	380	450	514	572	625	674	720	760	800	835	871	900	
1600																	105	199	283	360	424	491	544	600	647	692	734	772	810	840	
1700																		100	190	269	341	416	470	524	578	621	666	706	744	780	
1800																			94.4	180	256	326	390	450	502	553	600	640	680	720	
1900																				89.9	170	244	312	374	431	484	531	580	620	659	
2000																					85.3	162	233	300	360	413	484	514	557	600	
2100																						79.8	156	224	287	344	400	450	495	540	
2200																							77.3	150	215	276	332	384	432	479	
2300																								73.7	143	206	265	321	370	420	
2400																									72.0	137	200	256	310	359	
2500																										68.3	132	192	247	300	
2600																											66.4	128	186	240	
2700																												64.8	123	179	

Series Accumulators/Nuclear Actuators

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 10 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		1191	1589	1788	1907	1983	2044	2084	2119	2144	2169	2184	2199	2209	2218	2234	2238	2248	2259	2265	2271										
200			793	1191	1429	1589	1704	1788	1849	1907	1971	1983	2019	2044	2064	2084	2098	2119	2129	2144	2157	2169	2174	2184	2189	2199	2204	2209	2214	2219	
300				595	952	1191	1362	1489	1589	1669	1734	1787	1831	1871	1907	1939	1961	1987	2009	2029	2044	2058	2074	2084	2096	2107	2119	2129	2139	2145	
400					475	793	1019	1191	1324	1425	1514	1588	1649	1704	1744	1788	1819	1849	1878	1907	1929	1951	1968	1983	1999	2019	2028	2044	2056	2064	
500						396	681	893	1057	1191	1299	1389	1484	1529	1588	1638	1681	1718	1757	1786	1814	1840	1862	1886	1905	1921	1941	1958	1971	1983	
600							340	595	793	952	1084	1191	1269	1362	1427	1489	1539	1589	1627	1669	1619	1734	1759	1787	1809	1831	1851	1871	1889	1907	
700								297	528	714	864	993	1099	1191	1269	1340	1399	1457	1504	1548	1588	1624	1659	1689	1717	1738	1764	1788	1808	1829	
800									263	475	649	793	916	1019	1111	1191	1259	1324	1379	1429	1474	1513	1552	1589	1620	1649	1674	1704	1721	1743	
900										237	432	595	732	849	953	1041	1120	1191	1252	1310	1358	1407	1447	1489	1524	1557	1589	1619	1644	1669	
1000											216	396	547	681	792	893	979	1057	1127	1191	1243	1299	1346	1389	1429	1484	1499	1528	1561	1589	
1100												197	365	509	635	742	841	924	1002	1071	1133	1191	1241	1288	1349	1374	1412	1447	1481	1508	
1200													182	340	476	595	700	792	876	952	1046	1084	1134	1191	1238	1269	1324	1362	1401	1427	
1300														171	316	446	558	659	752	834	907	975	1034	1088	1142	1191	1233	1279	1314	1349	
1400															157	297	418	527	625	714	793	864	932	993	1047	1099	1147	1191	1235	1269	
1500																148	279	396	501	594	681	757	829	893	953	1007	1157	1107	1152	1191	
1600																	138	263	375	475	566	649	721	793	851	916	969	1019	1069	1111	
1700																		131	249	357	451	341	621	695	762	824	884	912	985	1028	
1800																			124	236	340	432	516	595	666	732	793	849	903	953	
1900																				118	226	323	413	495	571	639	704	765	821	872	
2000																					113	216	309	396	475	547	639	681	738	792	
2100																						106	206	297	381	456	504	595	656	714	
2200																							101	197	285	365	441	509	573	635	
2300																								97.4	189	273	352	426	490	555	
2400																									95.3	182	263	340	409	476	
2500																										90.4	175	254	328	397	
2600																											88.1	171	247	316	
2700																												85.7	164	237	

Size: 12 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		1385	1843	2078	2217	2309																								
200			924	1385	1663	1847	1979	2078	2155	2217	2267	2309	2345																	
300				692	1108	1385	1583	1732	1847	1940	2015	2078	2132	2177	2217	2252	2282	2309	2334	2350										
400					554	923	1187	1385	1539	1663	1764	1847	1919	1979	2032	2078	2119	2155	2188	2217	2243	2267	2289	2309	2328	2345	2361			
500						461	791	1039	1231	1385	1511	1616	1705	1781	1846	1905	1955	2001	2042	2078	2110	2151	2169	2194	2217	2238	2258	2276	2294	2309
600							395	692	923	1108	1259	1385	1492	1583	1663	1732	1793	1847	1896	1940	1979	2015	2048	2078	2106	2132	2155	2177	2198	2217
700								346	615	831	1007	1154	1279	1385	1478	1559	1630	1693	1750	1801	1847	1889	1928	1963	1995	2025	2053	2078	2102	2125
800									307	554	755	923	1066	1187	1293	1385	1467	1539	1604	1663	1715	1763	1807	1847	1884	1919	1950	1979	2007	2002
900										277	503	692	852	989	1108	1212	1304	1385	1458	1524	1583	1637	1687	1732	1774	1812	1847	1880	1911	1940
1000											251	461	639	791	923	1039	1141	1231	1313	1385	1451	1511	1566	1616	1663	1705	1745	1781	1816	1847
1100												230	426	593	739	866	978	1077	1167	1247	1319	1385	1446	1501	1552	1599	1642	1682	1720	1755
1200													213	395	554	692	815	923	1021	1108	1187	1259	1325	1385	1436	1492	1539	1583	1624	1663
1300														197	369	519	652	769	875	970	1064	1133	1205	1270	1330	1385	1437	1484	1529	1570
1400															184	346	489	615	729	831	923	1007	1084	1154	1219	1279	1334	1385	1433	1478
1500																173	325	461	583	692	791	881	964	1039	1108	1172	1231	1286	1338	1385
1600																	163	307	437	554	659	755	843	923	997	1066	1129	1187	1233	1293
1700																		153	291	514	527	629	723	808	887	959	1026	1087	1147	1201
1800																			145	277	395	503	603	692	776	852	923	989	1051	1108
1900																				138	263	377	482	577	665	746	821	909	955	1016
2000																					131	251	361	461	554	639	718	791	860	923
2100																						125	241	346	443	533	615	692	764	831
2200																							120	230	332	426	513	593	669	739
2300																								115	221	319	410	494	573	646
2400																									110	213	307	395	477	554
2500																										106	205	296	382	461
2600																											102	193	286	369
2700																												98	191	277

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 15 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		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	559	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

OPERATING PRESSURE – PSI ISOTHERMAL

PRECHARGE PRESSURE – PSI

	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	4406	4436
600					760	1330	1774	2129	2419	2661	2866	3042	3194	3327	3444	3549	3642	3726	3801	3870	3935	3992	4046	4095	4140	4183	4222	4259
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	3421	3488	3548
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	1552	1703	1842	1971	2091	2203	2307
1800																	280	532	760	967	1157	1330	1490	1638	1774	1901	2019	2129
1900																		266	507	725	925	1109	1277	1433	1577	1711	1835	1952
2000																			253	483	694	887	1064	1228	1380	1521	1652	1774

Series Accumulators/Nuclear Actuators

ACCUMULATORS

OIL VOLUME AT INDICATED OPERATING PRESSURE (in cubic inches)

Size: 25 Gallon

OPERATING PRESSURE – PSI ISOTHERMAL

PRECHARGE PRESSURE – PSI

	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	1920	2880	3450	3830	4110	4320	4480	4600	4710	4795	4865	4928	4985	5032	5074	5110	5143	5172	5200	5225	5247	5268	5287	5307	5323	5340	5354	5367
300		1470	2330	2992	3310	3610	3850	4030	4190	4320	4430	4530	4610	4680	4740	4800	4850	4895	4935	4972	5005	5035	5065	5093	5116	5139	5160	5180
400			1150	1920	2470	2870	3200	3450	3660	3835	4085	4105	4215	4315	4400	4475	4540	4600	4655	4708	4750	4793	4830	4865	4898	4930	4957	4983
500				910	1600	2170	2520	2870	3110	3325	3520	3680	3815	3935	4045	4138	4221	4300	4368	4430	4490	4544	4590	4635	4675	4715	4745	4782
600					815	1430	1915	2290	2610	2890	3088	3275	3440	3585	3725	3830	3935	4022	4105	4180	4245	4310	4366	4420	4465	4515	4560	4595
700						715	1285	1726	2100	2398	2655	2880	3070	3220	3395	3520	3640	3745	3835	3925	4005	4075	4145	4205	4260	4315	4365	4413
800							630	1150	1565	1925	2215	2465	2690	2885	3050	3200	3335	3450	3565	3666	3755	3835	3915	3985	4050	4110	4165	4215
900								555	1050	1430	1775	2065	2300	2520	2710	2880	3030	3165	3290	3400	3500	3600	3675	3765	3835	3905	3970	4025
1000									520	965	1330	1650	1925	2165	2370	2560	2730	2875	3010	3140	3250	3360	3455	3540	3620	3700	3765	3835
1100										500	880	1230	1525	1815	2035	2200	2425	2600	2750	2880	3005	3210	3225	3325	3420	3500	3575	3650
1200											450	950	1160	1430	1690	1925	2115	2300	2465	2615	2750	2880	2990	3100	3200	3295	3370	3255
1300												420	770	1085	1350	1595	1815	2010	2190	2350	2500	2640	2751	2815	2980	3080	3170	3620
1400													380	715	1015	1280	1485	1715	1920	2080	2250	2393	2530	2650	2770	2875	2970	3065
1500														365	680	960	1220	1430	1640	1825	2000	2155	2300	2430	2555	2670	2775	2870
1600															330	625	900	1125	1320	1565	1740	1910	2065	2205	2330	2455	2570	2675
1700																330	620	875	1100	1320	1500	1685	1835	2085	2130	2270	2380	2485
1800																	300	565	815	1030	1250	1425	1610	1765	1910	2050	2180	2300
1900																		285	540	780	1005	1185	1375	1555	1705	1852	1975	2110
2000																			280	520	750	955	1140	1315	1475	1630	1775	1910
2100																				270	480	715	905	1100	1270	1415	1570	1705
2200																					250	475	678	875	1070	1225	1375	153o
2300																						220	450	645	830	1015	1185	1318
2400																							218	425	670	816	980	1130
2500																								415	430	515	775	935
2600																									225	410	605	765
2700																										185	375	530

Size: 30 Gallon

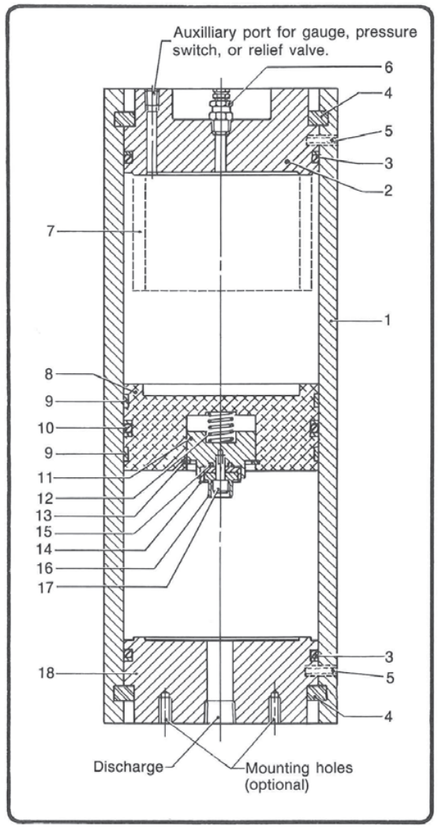
OPERATING PRESSURE – PSI ISOTHERMAL

PRECHARGE PRESSURE – PSI

	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	2330	3490	4185	4650	4990	5230	5425	5580	5700	5810	5900	5975	6040	6100	6150	6200	6240	6270	6310	6340	6364	6390	6415	6434	6454	6475	6940	6506
300		1750	2800	3490	3990	4360	4650	4880	5070	5230	5365	5480	5580	5665	5740	5810	5870	5930	5975	6020	6062	6100	6134	6166	6196	6224	6248	6273
400			1420	2330	3000	3490	3880	4190	4455	4650	4830	5000	5115	5230	5330	5420	5505	5580	5645	5710	5760	5810	5857	5900	5940	5946	6010	6042
500				1170	1975	2620	3110	3490	3810	4070	4290	4485	4650	4800	4945	5035	5135	5230	5310	5385	5455	5520	5575	5630	5680	5728	5770	5810
600						1740	2330	2795	3175	3490	3750	2990	4190	4360	4525	4650	4770	4880	4990	5070	5155	5230	5300	5365	5420	5478	5530	5590
700							1550	2100	2540	2910	3225	3490	3525	3930	4110	4260	4410	4530	4650	4750	4850	4940	5020	5095	5165	5230	5290	5325
800							780	1415	1910	2330	2690	2990	3250	3490	3690	3870	4035	4185	4325	4435	4550	4650	4740	4830	4905	4980	5048	5110
900								720	1280	1750	2150	2500	2830	3050	3255	3490	3670	3840	3990	4130	4248	4360	4470	4560	4650	4730	4810	4880
1000									645	1170	1620	2000	2330	2620	2870	3110	3310	3490	3650	3800	3940	4070	4185	4290	4390	4485	4570	4650
1100										590	1070	1490	1860	2180	2460	2710	2930	3130	3320	3490	3620	3780	3900	4020	4130	4230	4325	4415
1200											530	1000	1390	1740	2040	2320	2570	2790	2985	3170	3330	3490	3625	3750	3870	3980	4085	4180
1300												500	930	1310	1630	1940	2210	2440	2650	2850	3030	3200	3320	3490	3615	3735	3845	3951
1400													470	870	1230	1640	1830	2090	2330	2630	2720	2910	3070	3220	3355	3490	3605	3720
1500														440	830	1170	1480	1745	1995	2220	2430	2620	2795	2950	3100	3210	3370	3490
1600															410	770	1100	1395	1670	1895	2130	2330	2510	2690	2845	2990	3120	3260
1700																390	745	1045	1330	1595	1820	2030	2240	2415	2590	2745	2890	3025
1800																	370	695	995	1270	1520	1745	1945	2145	2330	2490	2645	2790
1900																		350	670	950	1220	1450	1680	1880	2070	2245	2400	2650
2000																			340	645	920	1170	1395	1610	1815	1995	2170	2350
2100																				320	610	870	1120	1345	1545	1745	1920	2070
2200																					310	580	840	1070	1290	1495	1690	1850
2300																						290	655	795	1030	1245	1445	1620
2400																							275	540	770	995	1195	1390
2500																								270	520	745	970	1170
2600																									255	495	720	940
2700																										250	590	710

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.

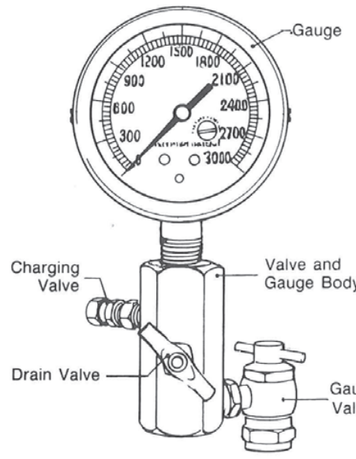
2A Part No.	No. Req'd.	Part Name
1	1	High strength steel tube
2	1	Steel end cap
3	2	"O" ring and back-up
4	2	Split shear ring
5	2	Set screw
6	1	Gas valve
7	1	Stop Tube (optional)
8	1	Light weight aluminum piston
9	2	Wear ring
10	1	"O" ring seal with back-ups
11*	1	Piston poppet
12*	1	Spring
13*	1	Poppet 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.

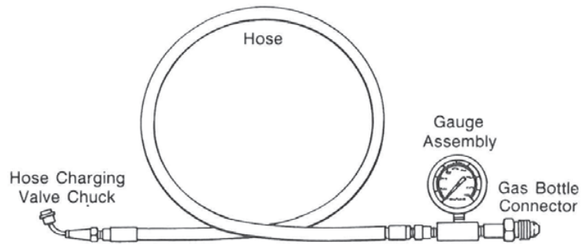
Series Accumulators/Nuclear Actuators

ACCUMULATORS

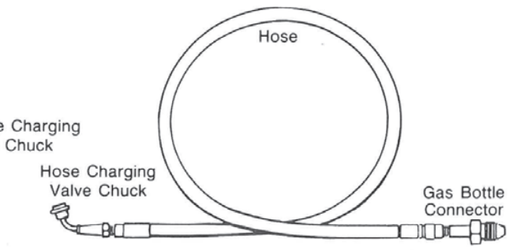
Accessories



VALVE ASSEMBLY



CHARGING HOSE & GAUGE ASSEMBLY



CHARGING HOSE ASSEMBLY

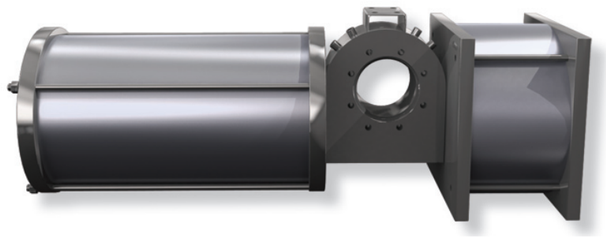
PARTS LIST

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
	V41371	Gauge
Complete Charging Hose Assy. No. CHA 300	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

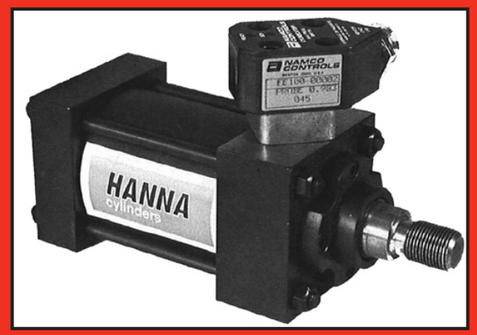
Heavy-Duty Custom Welded Cylinders

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

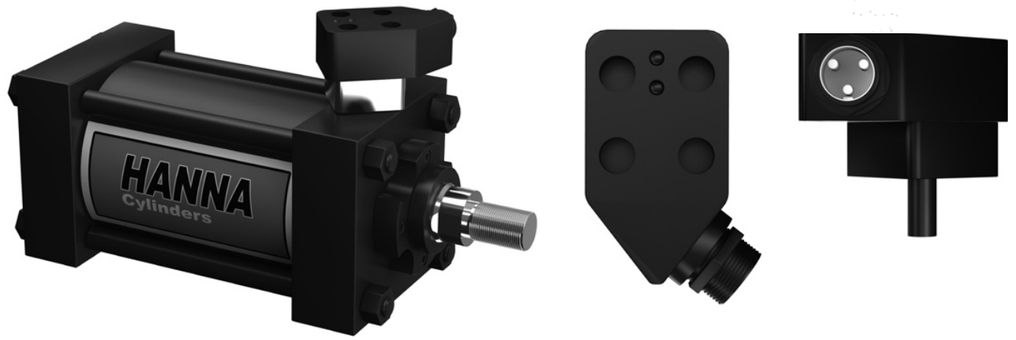
Widely used on high-quality, high-volume consumer and commercial lawn and garden equipment, Hanna's DW Series hydraulic cylinders are also ideal for material handling equipment, industrial cleaning machines, agricultural and many other “off-road” applications. Pressure ratings up to 3,000 p.s.i. are available. Standard bore sizes are 1.00" through 3.00" with larger sizes available if required.



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.

SPECIFICATIONS

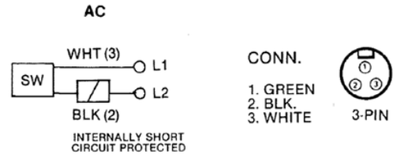
Pressure ..... 3000 psi
Sensing range ..... 0.04" ± .005"
Operating temperature range ..... -4° to +158° F
Repeatability ..... ±10%
Switching differential 10%
Supply voltage (50/60 Hz) ..... 20-230 VAC/DC*
"On-state" voltage drop ..... 10 V @ 5-30 mA
6V @ 31-500 mA
Load current maximum ..... 0.5 Amp
minimum ..... 5 mA
Inrush current (rms 1 cycle) ..... 3 Amp
"Off-state" current ..... 1.7 mA

Short circuit protection is standard

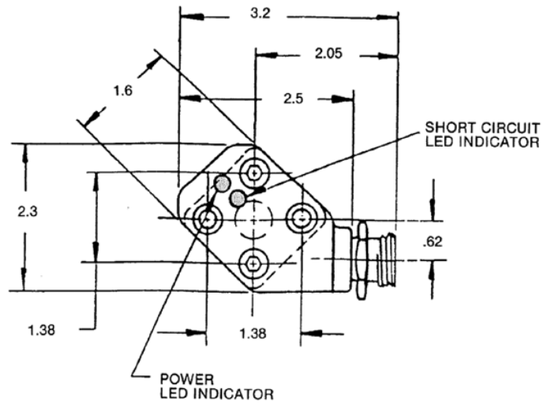
Indicating LED's
standard ..... 1) Power on/non-conducting
..... 2) Both LEDs flashing indicates a short circuit.

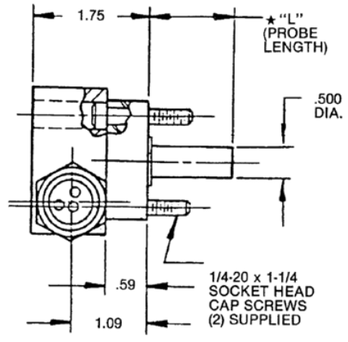
Meets NEMA 1, 12, 13 Ratings.
* 0.5 Henry inductive load Max. for DC applications.

WIRING DIAGRAMS



DIMENSIONS





Electrical Options

ORDERING INFORMATION

Availability

EE230 Series Cylindicator Proximity Switches are available on Hanna Series 2H, 3L, 3A, 3AN, and CA cylinders, 2.00" through 8.00" bores. The switches are not available on the front head of Series 3L, 3A, 3AN and CA cylinders on the following sizes: 2.00" bore, 1.38" diameter rod, and 2.50" bore, 1.75" diameter rod. See pages 4 and 5 for exact mounting position availability for Series 3L, 3A, 3AN and CA; see pages 6 and 7 for mounting position availability for Series 2H cylinders.

Specify switches for head end, cap end or both ends. Specify mounting position of switches and pipe port locations.

Use the following plug-in cables

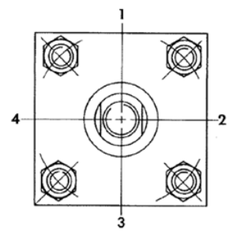
Brad Harrison Co.	Joy Mfg. Co.
40901 3' (.91 meters)	X-8984-3 3' (.91 meters)
40902 6' (1.83 meters)	X-8984-4 6' (1.83 meters)
40903 12' (3.66 meters)	X-8984-5 12' (3.66 meters)

Note: Cables not supplied by Hanna Corporation.

Mounting Information

EE230 Series Switches will be mounted at the factory according to customer specified locations. Refer to numbered positions on end view of cylinder as shown here.

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.



Electrical Options

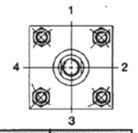
PROXIMITY SWITCH MOUNTING POSITIONS AVAILABLE FOR 3A,

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
*2.00	-	-	-	-	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
	-	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	-	-	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
*2.50	-	-	-	-	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
	-	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	-	-	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
3.25	-	-	-	-	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
	-	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	-	-	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
4.00	-	-	-	-	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
	-	-	-	-	-	4	4	-	-	4	4	-	4	4	4	4	-	-	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
5.00	-	-	-	-	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
	-	-	-	-	4	4	4	-	4	4	4	-	4	4	4	4	-	-	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
6.00	-	-	-	-	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
	-	-	-	-	4	4	4	-	4	4	4	-	4	4	4	4	4	4	-	-
	-	-	-	-	-	5	-	-	-	5	-	-	-	-	-	-	-	5	-	5
8.00	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
	4	4	4	4	-	-	-	-	-	-	-	-	4	4	4	4	4	4	-	-
	-	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

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.

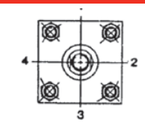
BORE	MS4		MS1/MS7		MT1		MT2		MT4		MX0		MX1		MX2		MX3		MX4	
	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H	F/H	B/H
1.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.	.	.	.	.	.
	-	5	-	-	-	5	-	5	-	5	-	5	-	-	-	-	-	5	-	-
*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
	4	4	4	4	-	4	4	-	4	4	4	4	4	4	4	4	4	4	4	4
	-	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	-	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	-	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	-	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	-	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

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	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	-	-	-	-
	-	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	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	-	-	-	-
	-	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	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	-	-	-	-
	-	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	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	-	-
	-	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	-	-
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
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	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
	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	-	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	-	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	-	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	-	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.

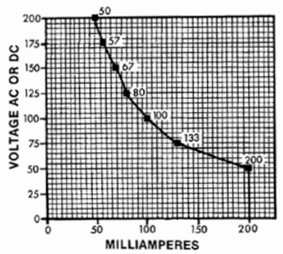
Standard switches can be operated on both AC or DC current. They are ideal for use as input for many types of sequences and programmable controllers. In some cases they can be used to drive some relays or valve solenoids.

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

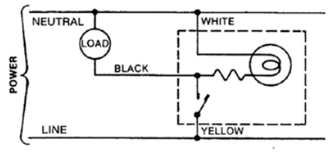
–40° to +170° F for standard cable.

Cable Specification

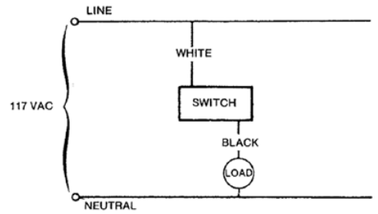
The conductors are tinned copper with polyethylene insulation. Conductors are cabled with rayon braid, a tinned copper braided shield and a chrome vinyl jacket on both AN12 and 13109-02-6 models.

WIRING DIAGRAMS

AN12 Switch Wiring Schematic



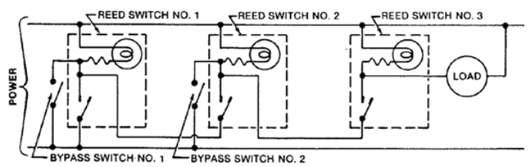
13109-02-6 3-Amp Switch Wiring Schematic



Caution: Do not connect switch without a load. Permanent damage to switch will result.

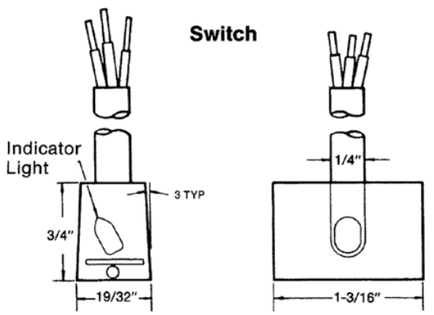
Note: Switch is internally protected against failure due to normal electrical transient levels. However it may be necessary to use additional transient protection if high levels exist.

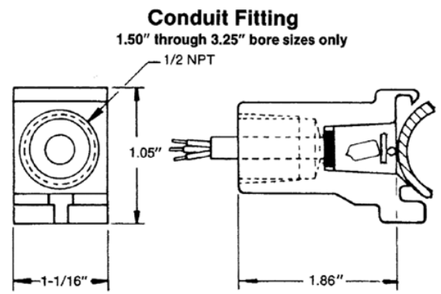
Series Connected Switches



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.

DIMENSIONS





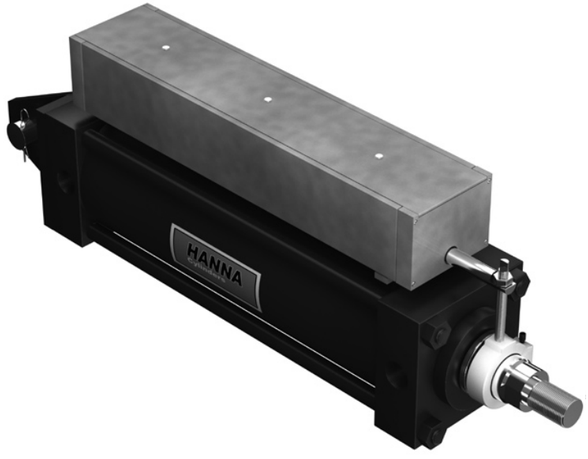
ORDERING INFORMATION

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

Electrical Options

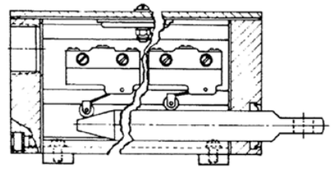
SWITCHES FOR MODEL PL-1 LIMIT SWITCH ASSEMBLY

(12 switches per foot, 6 each side, 6 positions.)

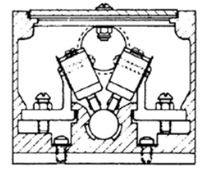
SWITCH	CIRCUIT	TERM'LS	125 VAC	250 VAC	480 VAC	125 VDC	250 VDC
MICRO* BZ-2RW822-A2	SPDT	3 Screw	15A 1/8 HP	15A 1/4 HP	15A	0.5A	0.25A
LICON 16-404	SPDT	4 Lug	10A	10A	—	—	—
MICRO RZ-3YWT822	SPDT (SPLIT)	5 Screw	5A	5A	—	—	—

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 locknuts 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:

A. Stroke in inches.

B. 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:

1. Miniature Micro BZ-2RW822-A2
2. Sub-Miniature Licon 16-404 up to 26 switches per foot.

Alternate Miniature MICRO 5 terminal switch BZ-3YWT822.

C. Optional hinged cover at small additional cost. Specify right or left hand opening, viewed from rod end.

D. 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:

A. Cylinder model number.

B. Piston rod diameter

C. Cushions, if required

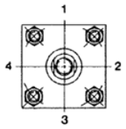
D. Rod end type

E. Cylinder diameter

F. Cylinder stroke

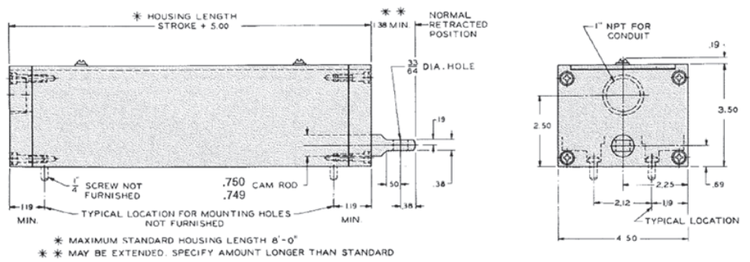
G. Side of cylinder on which the Limit Switch Assembly should be mounted. Refer to numbered positions on end view of cylinder as shown here.

H. Location of pipe ports and cushion needles (if cushioned). Pipe ports will normally be furnished at Position 4.

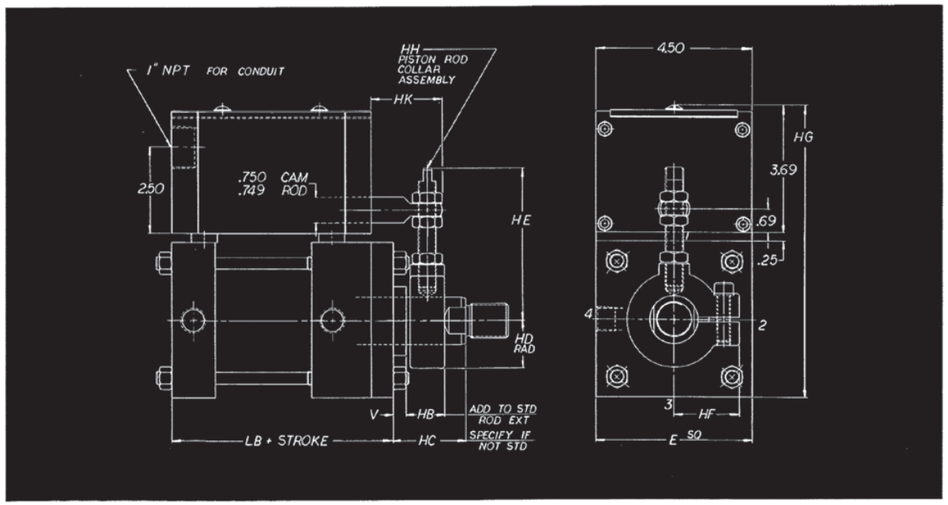


Position location for the Front Head and Blind Head is determined by viewing the cylinder at the Rod End.

DIMENSIONS



LIMIT SWITCH ASSEMBLY INSTALLATION WITH SERIES 3A AND 3AN PNEUMATIC, AND 3L HYDRAULIC CYLINDERS



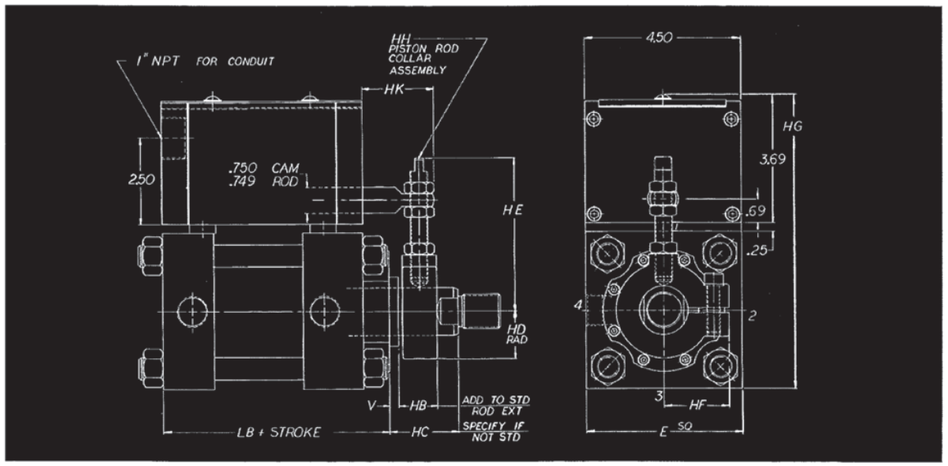
SERIES 3A, 3AN AND 3L CYLINDER DIMENSIONS

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		-8	2.00		.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		-8	2.00		.62
	1.75			2.62		3.62			-12	2.12		.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		1.12	2.12	1.38	4.50	1.88		-15	2.00		.38
	1.75			2.38		4.62			-17	2.12		.50
	2.00			2.50		4.75			-18			
4.00	1.00	4.50	.88	1.62	.88	4.25	1.50	8.44	-11	1.75	4.88	.25
	1.38		1.12	2.12	1.38	4.50	1.88		-15	2.00		.38
	1.75			2.38		4.62			-17	2.12		.50
	2.00			2.50		4.75			-18			
	2.50			2.75	2.12		2.75		-58	2.25		.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		1.12	2.12	1.38	4.75	1.88		-30	2.00		.38
	1.75			2.38		5.00			-31	2.12		.50
	2.00			2.50		4.75			-18			
	2.50			2.75	2.12		2.75		-58	2.25		.62
	3.00								-59			
	3.50					5.50			-29			
6.00	1.38	6.50	1.12	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			
	2.50			2.62	2.12	5.62	2.75		-27	2.25		.50
	3.00								-28			
	3.50					5.50			-29			
	4.00		1.38	2.88	3.12	5.25	3.75		-62	2.38		
8.00	1.38	8.50	1.12	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			.50
	2.50			2.62	2.12	7.00	2.75		-47	2.25		
	3.00					6.62			-65			
	3.50					6.50			-42			
	4.00		1.38	2.88	3.12		3.75		-43	2.38		
	4.50								-66			
	5.00					6.62			-44			
	5.50					6.50			-45			
10.00	1.75	10.62	1.12	2.25	1.38	7.25	1.88	14.56	-46	2.12	7.12	.38
	2.00			2.38					-48			
	2.50			2.62	2.12	7.62	2.75		-67	2.25		.50
	3.00								-68			
	3.50					7.38			-55			
	4.00		1.38	2.88	3.12	7.50	3.75		-69	2.38		
	4.50								-70			
	5.00					7.62			-71			
	5.50					7.88			-72			
12.00	2.00	12.75	1.12	2.38	1.38	8.31	1.88	16.69	-48	2.12	7.62	.38
	2.50			2.62	2.12		2.75		-50	2.25		.50
	3.00					8.62			-73			
	3.50					9.25			-51			
	4.00		1.38	2.88	3.12	8.50	3.75		-74	2.38		
	4.50								-75			
	5.00					8.62			-76			
	5.50					8.88			-77			
14.00	2.50	14.75	1.12	2.62	2.12	9.31	2.75	18.69	-50	2.25	8.88	.50
	3.00					9.62			-78			
	3.50					9.31			-51			
	4.00		1.38	2.88	3.12	9.50	3.75		-79	2.38		
	4.50								-80			
	5.00					9.62			-81			
	5.50					9.88			-82			

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		1.12	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		1.12	2.12	1.38		1.88		-12	2.00		.38
	1.75			2.38					-13	2.12		.50
3.25	1.38	4.50	1.12	2.00	1.38	4.44	1.88	8.44	-16	2.00	6.25	.25
	1.75			2.25					-17	2.12		.38
	2.00			2.38					-18			
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		1.38	2.50					-22	2.25		
	2.50			2.75	2.12		2.75		-23	2.38		.38
5.00	2.00	6.50	1.12	2.25	1.38	5.44	1.88	10.44	-26	2.12	7.12	.25
	2.50		1.38	2.75	2.12		2.75		-27	2.38		.38
	3.00								-28			
	3.50								-29			
6.00	2.50	7.50	1.38	2.62	2.12	5.94	2.75	11.44	-32	2.38	8.38	.25
	3.00								-33			
	3.50								-34			
	4.00				3.12		3.75		-35			
7.00	3.00	8.50	1.38	2.62	2.12	6.44	2.75	12.44	-36	2.38	9.50	.25
	3.50								-37			
	4.00				3.12		3.75		-38			
	4.50								-66			
	5.00								-39			
8.00	3.50	9.50	1.38	2.62	2.12	6.94	2.75	13.44	-42	2.38	10.50	.25
	4.00				3.12		3.75		-43			
	4.50								-66			
	5.00								-44			
	5.50								-45			

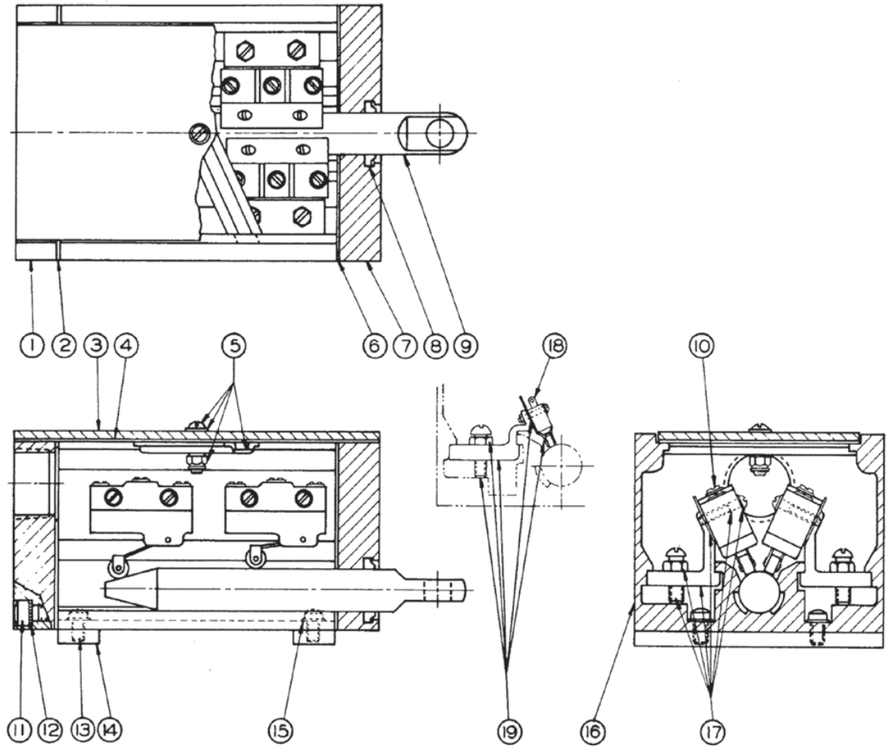
NOTE: 10.00, 12.00 and 14.00 bore dimensions and drawings available from factory upon request.

LIMIT SWITCH ASSEMBLY PARTS LIST

Part No.	Part Nomenclature
1	End plate blind end
2	Gasket blind end
3	Cover plate
4	Cover plate gasket
5	Cover clamp assembly
6	Gasket rod end
7	End plate rod end
8	Rod wiper
9	Cam rod
10	Switch
11	End plate screw
12	Lock washer
13	Mounting screw*
14	Mounting bar*
15	Lock washer*
16	Extrusion housing
17	Switch bracket assembly
18	Switch
19	Switch bracket assembly

* 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

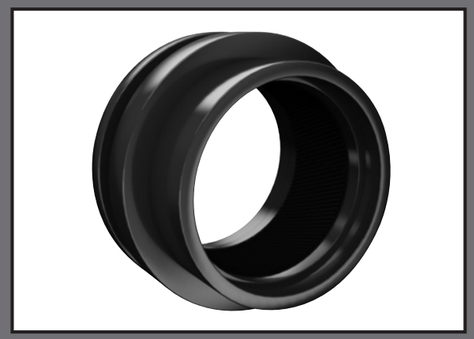
Electronic feedback devices such as MTS, Balluff, Temposonic & Gemco (partial listing).
(Hanna can supply & install upon customer request.)

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

Duralon® Cylinder
Rod Bearings

DURALON® CYLINDER ROD BEARINGS

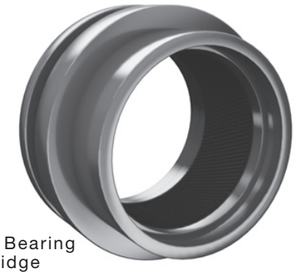
The high-tech Duralon rod bearing is supplied as standard on all Hanna Series 2H and 3L hydraulic cylinders. This state-of-the art bearing has proven to be superior to all other bearing materials in countless cylinder applications. Here's why:

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.

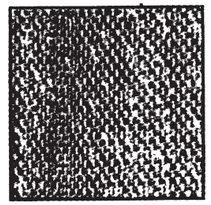
Traditional bronze or cast iron bearings require constant lubrication to help minimize friction and resultant wear. Once the cylinder rod bearing begins to wear, the piston moves off true center of the cylinder bore, thus shortening cylinder life. Additionally, the wear pattern accelerates, causing deterioration 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 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 Rod Bearing in steel cartridge



Enlarged view of Duralon

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.

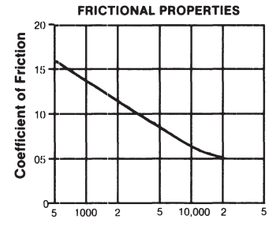
DURALON VS. COMPETITIVE BEARING MATERIALS

COMPARISON OF NON-LUBRICATED BEARINGS AND THEIR OPERATING LIMITS		LOAD CAPACITY (PSI)
Porous Bronze	***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

FRICTIONAL PROPERTIES



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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