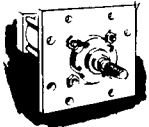
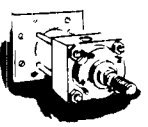
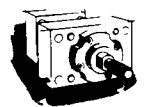
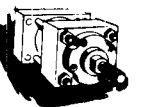
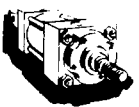
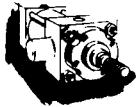
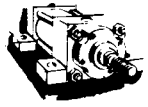


Series 3H for Heavy-Duty Service

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

SERIES 3H HYDRAULIC CYLINDERS

10.00" thru 24.00" Bores

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

TECHNICAL INFORMATION

Stroke Limitation Data	112
Stop Tube Data	113
Hydraulic Force Data	114
Fastener Torques	115
Cylinder Weights	115
Tie Rod Layout	116
INSTALLATION, OPERATION AND MAINTENANCE DATA	117
Parts List	118
MOUNTING ACCESSORIES	120
HOW TO ORDER	121

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.

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

Series 3H Features

1. Piston Rod End

Integral thread construction, precision-machined for close concentricity.

2. Duralon Rod Bearing

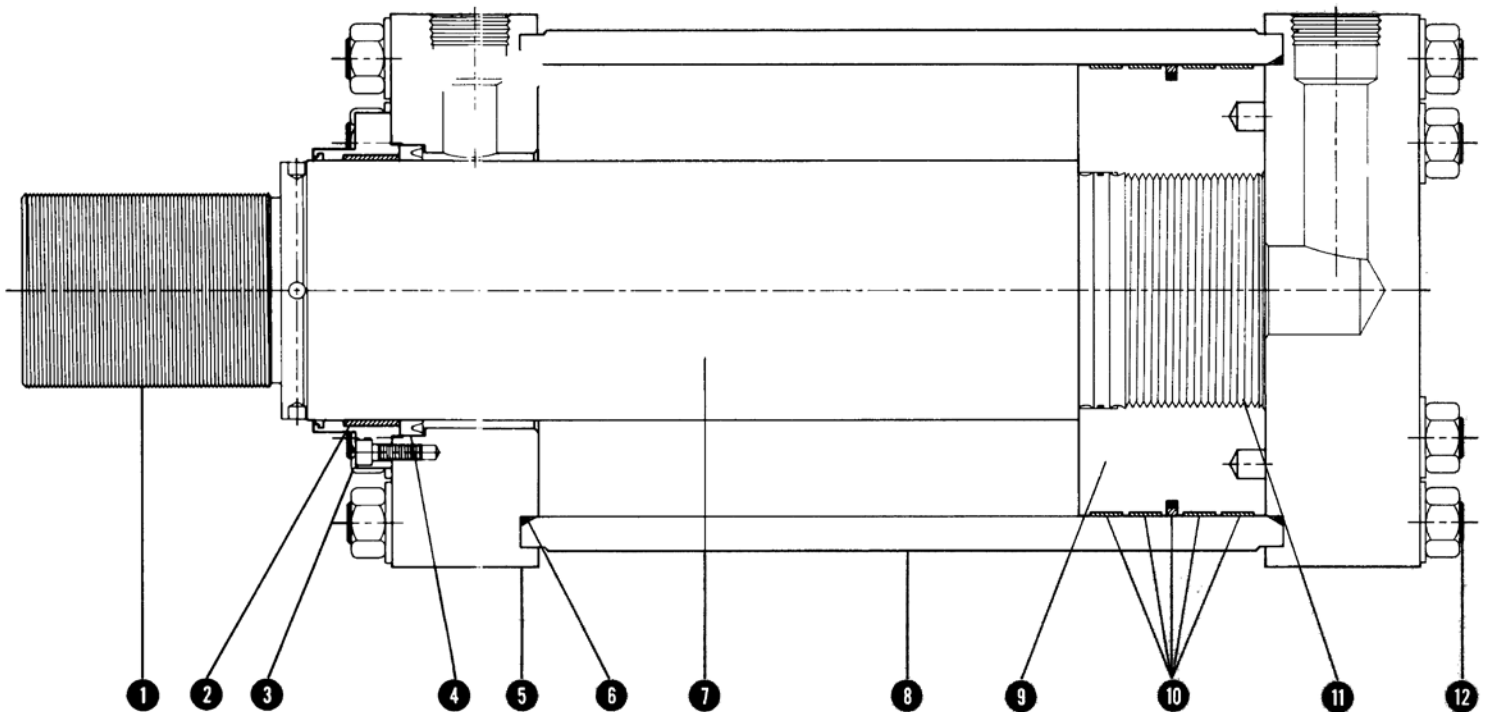
Hanna's high-tech Duralon rod bearing is designed to perform under poorly lubricated, high-load conditions. The exact combination of woven Teflon and Dacron®, plus the fiberglass structural shell, increases load-carrying capabilities and eliminates "cold-flow" associated with Teflon. Duralon bearings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

3. Rod Bearing Cartridge Construction

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

4. Rod Seal

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



5. Heads

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

6. Tube Seal

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

7. Piston Rod

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

8. Tubing

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

9. Piston

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

10. Piston Sealing System

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

11. Piston-to-Rod Connection

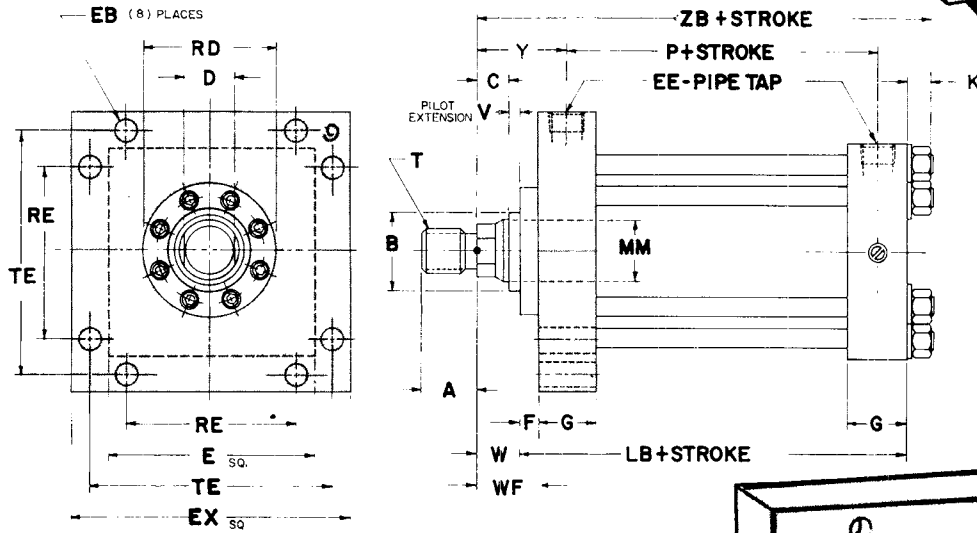
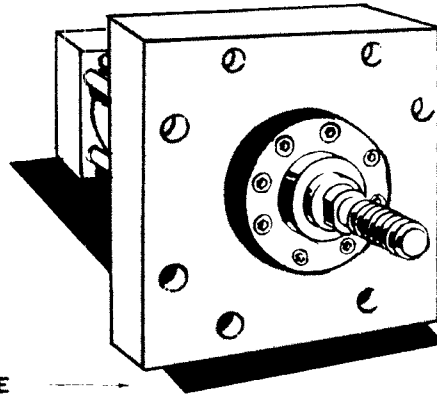
Piston rods are piloted to the piston to ensure concentricity, then bonded by an anaerobic adhesive, torqued and pinned.

12. Tie Rods

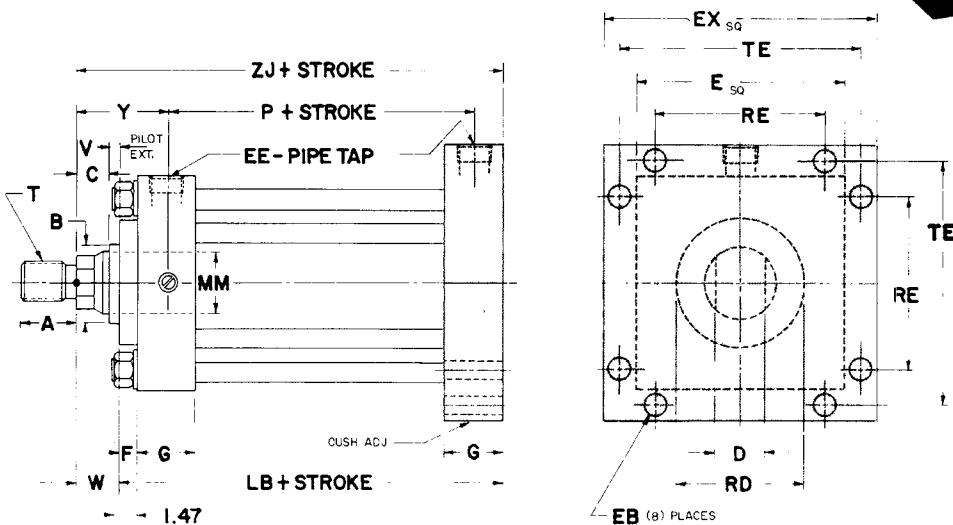
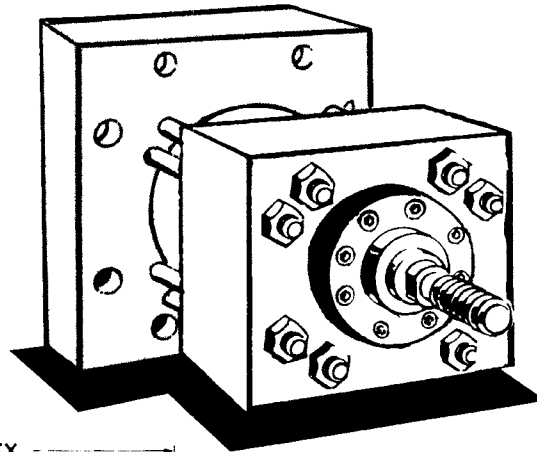
Made from high-strength steel, the tie rods are pre-stressed for fatigue resistance.

SERIES 3H 10.00"-24.00" Bores

ME3 Head Square Mount



ME4 Cap Square Mount



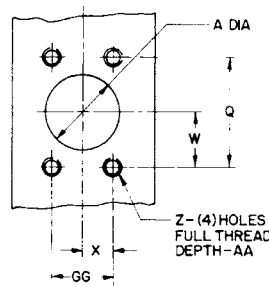
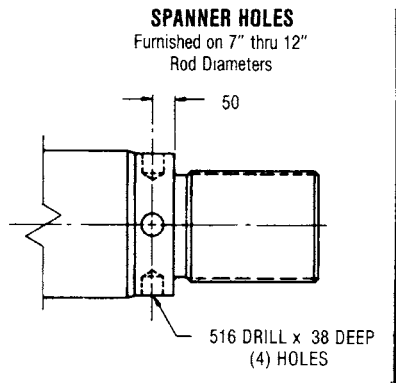
Dimensions are Constant
Regardless of Rod Diameter

ME3, ME4

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

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



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

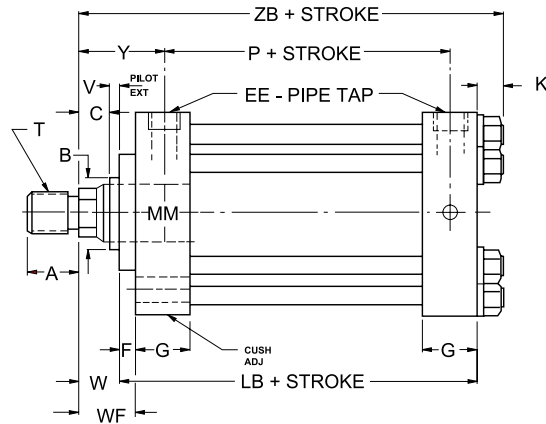
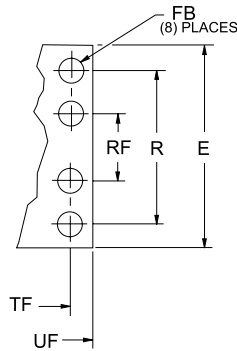
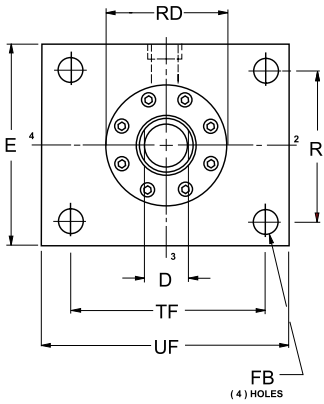
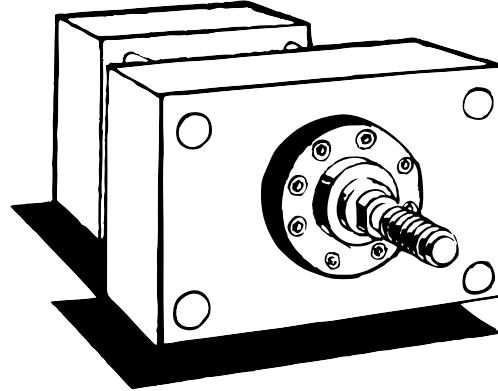
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	2.94	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	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	U	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	T	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.

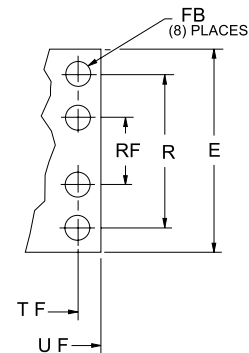
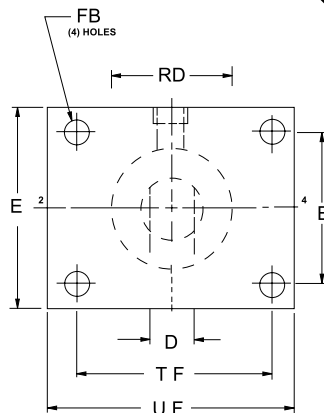
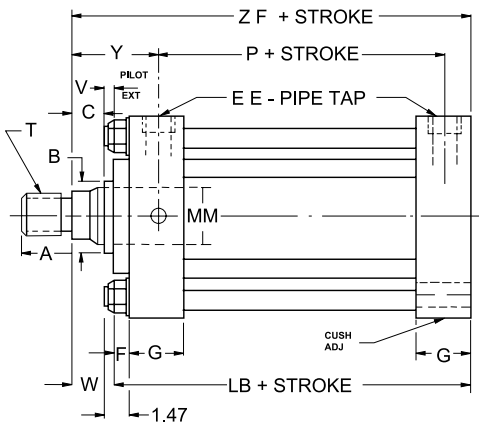
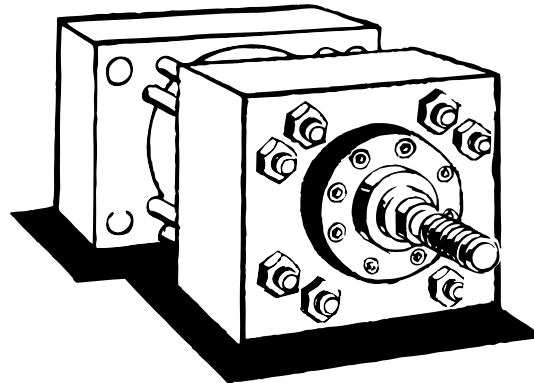
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression

SERIES 3H 10.00"-24.00" Bores

ME5 Head Rectangular Flange Mount



ME6 Cap Rectangular Flange Mount



Dimensions are Constant
Regardless of Rod Diameter

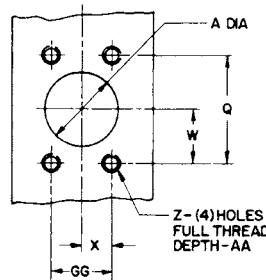
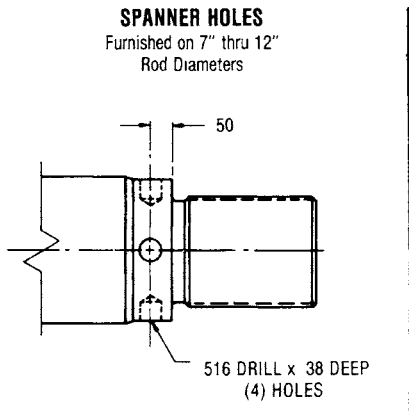
ME5, ME6

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

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



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

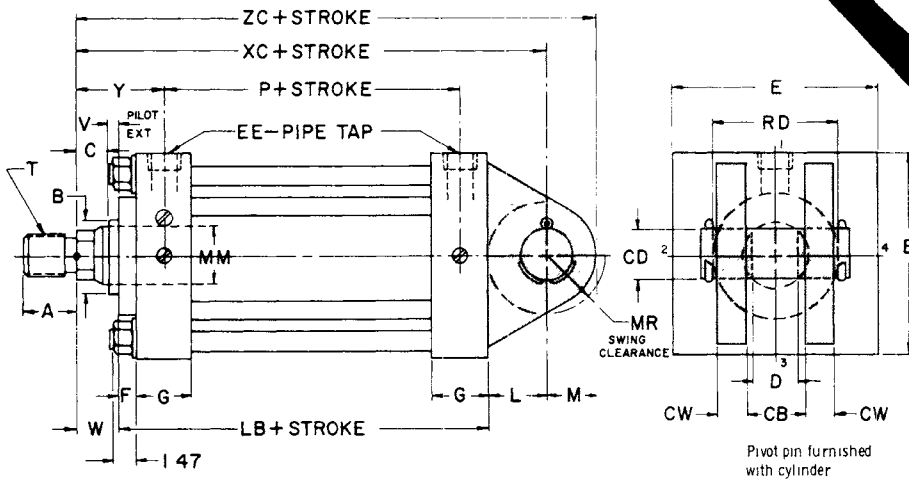
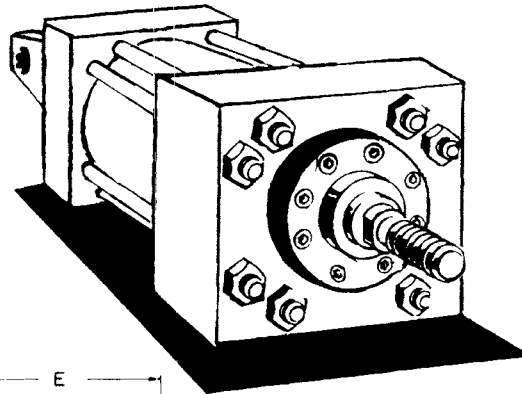
BORE	MM ROD DIA.	ROD CODE	A	B -.001 -.003	C	D	F	LB	RD	T	V	W	WF	Y	ZB	ZJ	PSI RATING†
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	.25	1.94	2.94	4.75	16.53	15.06	3000
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	.25	2.19	3.19	5.00	16.78	15.31	3000
10.00	5.50	S	5.50	6.250	1.94	4.62	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.

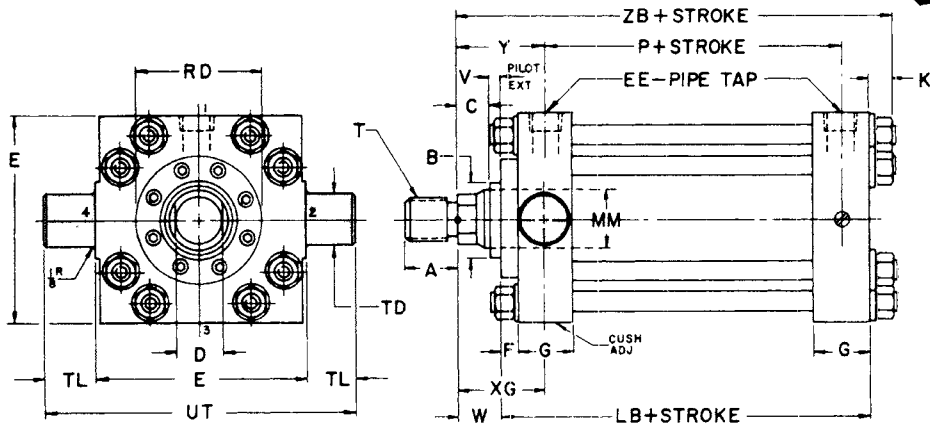
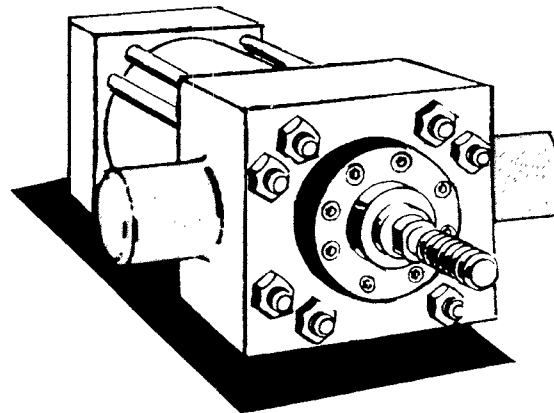
NOTE: Dimensions are nominal except where specifically toleranced. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

SERIES 3H 10.00"-24.00" Bores

MP1 Fixed Clevis Mount



MT1 Head Trunnion Mount



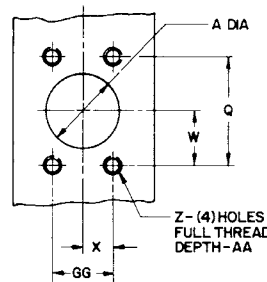
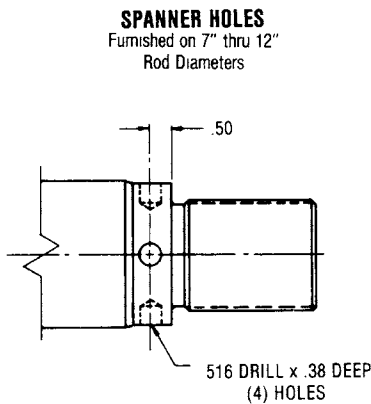
MP1, MT1

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	CD	CW	E	EE*	EE**	G	K	L	M	MR	P	TD	TL	UT
	+0.016 +0.047				N.P.T.F.	S.A.E. FLANGE PORT									
10.00	4.00	3.50	2.00	12.62	2	2	3.69	1.09	4.00	3.50	3.62	8.50	3.50	3.50	19.62
12.00	4.50	4.00	2.25	14.88	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.



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

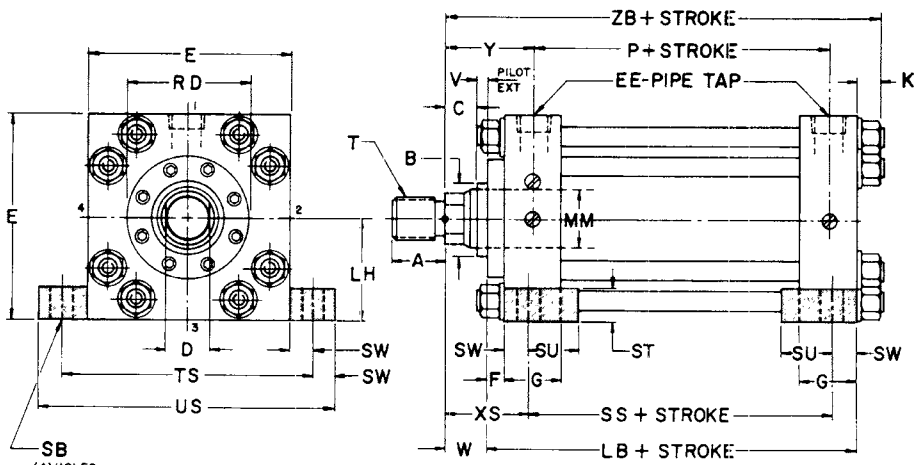
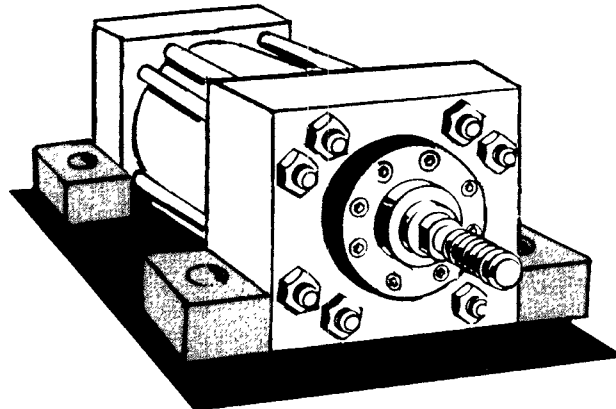
BORE	MM ROD DIA.	ROD CODE	A	B -0.001 -0.003	C	D	F	LB	RD	T	V	W	XC	XG	Y	ZB	ZC	PSI RATING†	
																		MP1	MT1
10.00	4.50	P	4.50	5.250	1.69	3.88	1.00	13.12	8.00	3.25-12	25	1.94	19.06	4.75	4.75	16.53	22.56	3000	1365
10.00	5.00	R	5.00	5.750	1.94	4.25	1.00	13.12	8.00	3.50-12	25	2.19	19.31	5.00	5.00	16.78	22.81	3000	1365
10.00	5.50	S	5.50	6.250	1.94	4.62	1.00	13.12	8.00	4.00-12	25	2.19	19.31	5.00	5.00	16.78	22.81	3000	1365
10.00	7.00	T	7.00	7.750	1.00	—	1.06	13.19	10.00	5.50-12	1.38	2.38	19.56	5.25	5.25	17.03	23.06	3000	1365
12.00	5.50	S	5.50	6.250	1.94	4.62	1.00	15.50	8.00	4.00-12	25	2.19	22.19	5.38	5.50	19.16	26.19	3000	1250
12.00	7.00	T	7.00	7.750	1.00	—	1.06	15.56	10.00	5.50-12	1.38	2.38	22.44	5.62	5.75	19.41	26.44	3000	1250
12.00	8.00	U	8.00	8.750	1.00	—	1.12	15.62	11.00	6.00-12	1.31	2.31	22.44	5.62	5.75	19.41	26.44	3000	1250
14.00	7.00	T	7.00	7.750	1.00	—	1.06	16.69	10.00	5.50-12	1.38	2.38	24.81	5.81	6.06	20.53	29.81	3000	1150
14.00	8.00	U	8.00	8.750	1.00	—	1.12	16.75	11.00	6.00-12	1.31	2.31	24.81	5.81	6.06	20.53	29.81	3000	1150
14.00	10.00	V	10.00	10.750	1.00	—	1.12	16.75	13.00	7.50-12	1.31	2.31	24.81	5.81	6.06	20.53	29.81	3000	1150
16.00	8.00	U	8.00	8.750	1.00	—	1.12	18.75	11.00	6.00-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
16.00	9.00	Z	9.00	9.750	1.00	—	1.12	18.75	12.00	6.50-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
16.00	10.00	V	10.00	10.750	1.00	—	1.12	18.75	13.00	7.50-12	1.31	2.31	28.06	6.38	6.38	22.16	34.06	3000	1100
18.00	9.00	Z	9.00	9.750	1.00	—	1.12	21.75	12.00	6.50-12	1.31	2.31	31.69	6.88	6.88	25.16	38.19	3000	1250
18.00	10.00	V	10.00	10.750	1.00	—	1.12	21.75	13.00	7.50-12	1.31	2.31	31.69	6.88	6.88	25.16	38.19	3000	1250
20.00	10.00	V	10.00	10.750	1.00	—	1.12	24.75	13.00	7.50-12	1.31	2.31	35.81	7.38	7.38	28.53	43.31	3000	1365
20.00	12.00	W	12.00	13.000	.94	—	1.19	24.81	15.50	9.00-12	1.31	2.25	35.81	7.38	7.38	28.53	43.31	3000	1365
22.00	10.00	V	10.00	10.750	1.00	—	1.12	27.75	13.00	7.50-12	1.31	2.31	40.06	7.88	7.88	31.53	48.06	3000	1475
22.00	12.00	W	12.00	13.000	.94	—	1.19	27.81	15.50	9.00-12	1.31	2.25	40.06	7.88	7.88	31.53	48.06	3000	1475
24.00	12.00	W	12.00	13.000	.94	—	1.19	31.19	15.50	9.00-12	1.31	2.25	44.44	8.44	8.44	34.91	53.44	3000	1575

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

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

SERIES 3H 10.00"-24.00" Bores

MS2 Side Lug Mount



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

MS2

Dimensions are Constant Regardless of Rod Diameter

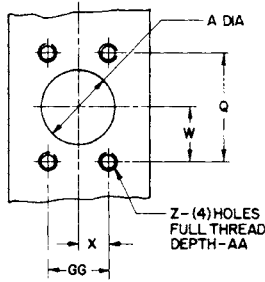
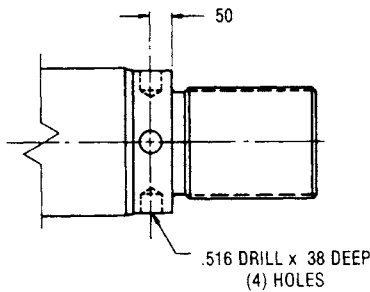
BORE	E	EE*	EE**	G	K	LH -.000 -.006	P	SB	SS	ST	SU	SW	TS	US
		N.P.T.F.	S.A.E. FLANGE PORT											
10.00	12.62	2	2	3.69	1.09	6.312	8.50	1.56	8.88	2.19	3.50	1.62	15.88	19.12
12.00	14.88	2½	2½	4.44	1.09	7.437	9.88	1.56	10.50	2.94	4.25	2.00	18.88	22.88
14.00	17.12	2½	2½	4.88	1.19	8.562	10.38	2.31	11.12	3.94	4.75	2.25	21.62	26.12
16.00	19.25	2½	2½	5.88	1.09	9.625	11.75	2.56	12.12	4.50	3.12	2.75	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 tolerated. Tolerances on "Plus Stroke" dimensions will vary slightly from dimensions shown due to manufacturing tolerances and tube compression.

TECHNICAL INFORMATION

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":

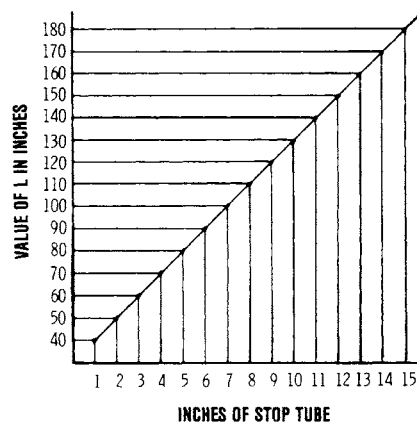
ADD:	MP1	"XC" Dimension	19.06"
	V-10	"CE" Dimension	8.50"
		Two times stroke (2 x 27)	54"
		Total Value of "L"	81.56"

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.

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" = 0.7 X D 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

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:

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

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

Chart C1 shows the force produced by specific cylinder bore sizes at various pressures. Forces not listed on the chart can be calculated by using the formula given ($F = A \times \text{PSI}$). 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								Gallons of Oil Consumed Per Inch of Travel
		250 PSI	500 PSI	750 PSI	1000 PSI	1500 PSI	2000 PSI	2500 PSI	3000 PSI	
10.00	78.54	19640	39270	58900	78540	117800	157100	196350	235620	.3393
12.00	113.10	28280	56550	84820	113100	169600	226200	282750	339300	.4886
14.00	153.94	38480	76970	115455	153940	230910	307880	384850	461820	.6664
16.00	201.06	50270	100530	150800	201060	301590	402120	502650	603180	.8686
18.00	254.47	63620	127240	190850	254470	381710	508940	636180	763410	1.0993
20.00	314.16	78540	157080	235620	314160	471240	628320	785400	942480	1.3572
22.00	380.13	95030	190070	285100	380130	570200	760260	950330	1140390	1.6422
24.00	452.39	113100	226200	339290	452390	678590	904780	1130980	1357170	1.9543

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

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

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

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

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

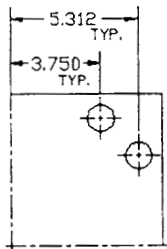
3H SERIES TIE ROD TORQUES		
BORE	SIZE	TORQUE
10.00	1 12-12	600 ft-lbs
12.00	1 12-12	600 ft-lbs
14.00	1 25-12	850 ft-lbs
16.00	1 12-12	600 ft-lbs
18.00	1 12-12	600 ft-lbs
20.00	1 50-12	1500 ft-lbs
22.00	1 50-12	1500 ft-lbs
24.00	1 50-12	1500 ft-lbs

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

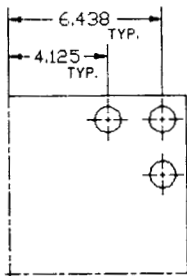
CYLINDER WEIGHTS

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

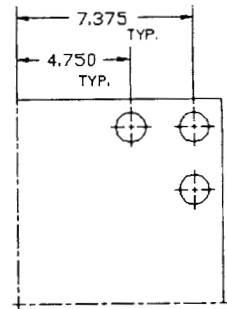
TIE ROD LAYOUT



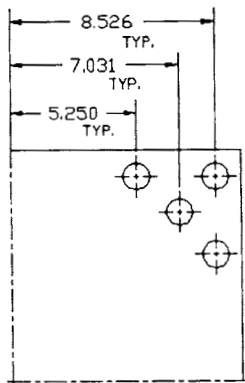
10.00 BORE
1 1/8" TIE RODS



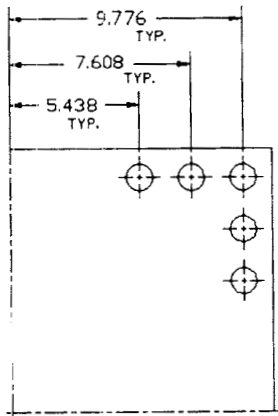
12.00 BORE
1 1/8" TIE RODS



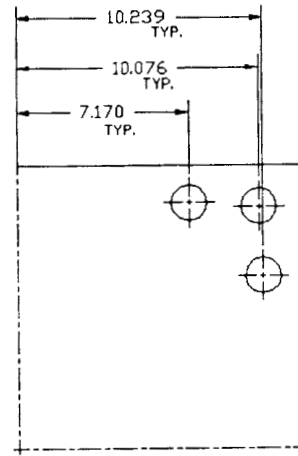
14.00 BORE
1 1/4" TIE RODS



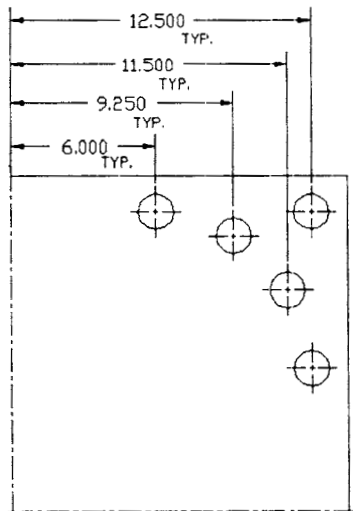
16.00 BORE
1 1/8" TIE RODS



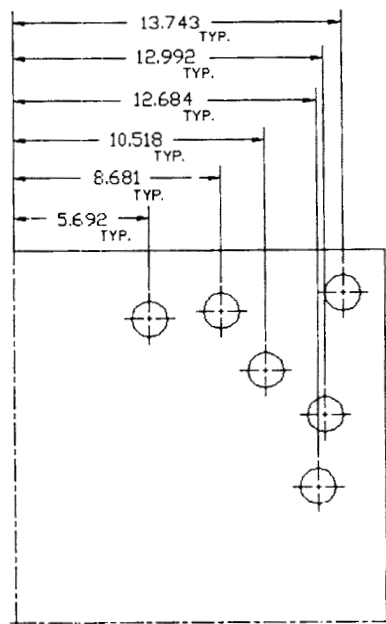
18.00 BORE
1 1/8" TIE RODS



20.00 BORE
1 1/2" TIE RODS



22.00 BORE
1 1/2" TIE RODS



24.00 BORE
1 1/2" TIE RODS

INSTALLATION, 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.

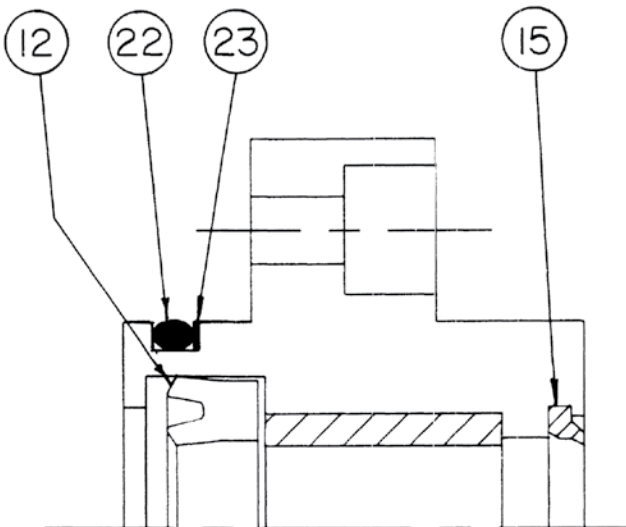
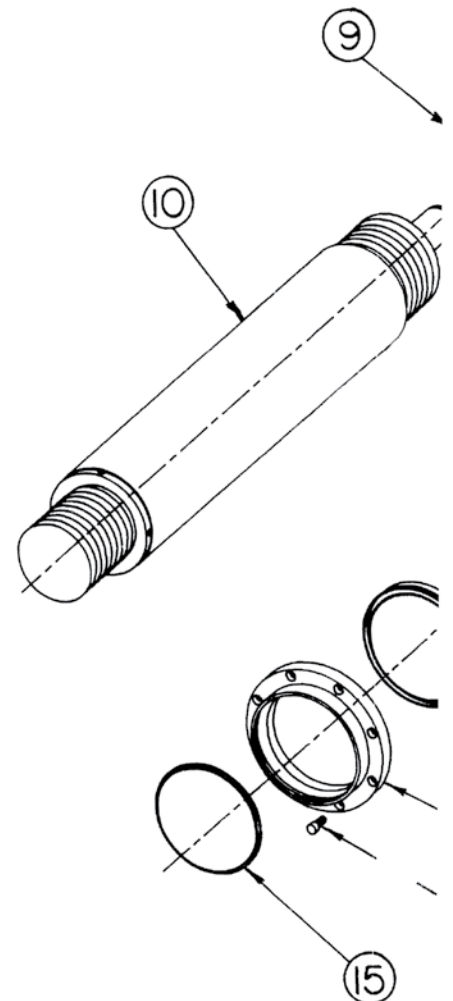
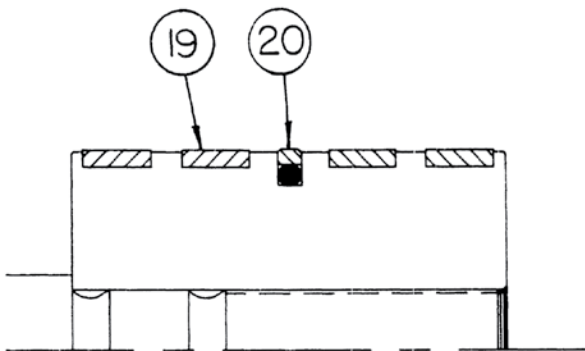
If the cylinder fails to perform the job for which it is ordered, check the following items: 1. That the correct cylinder diameter has been chosen to do the job required. 2. That there is adequate line pressure at the cylinder, under both static and dynamic conditions. 3. That the piston rod is aligned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

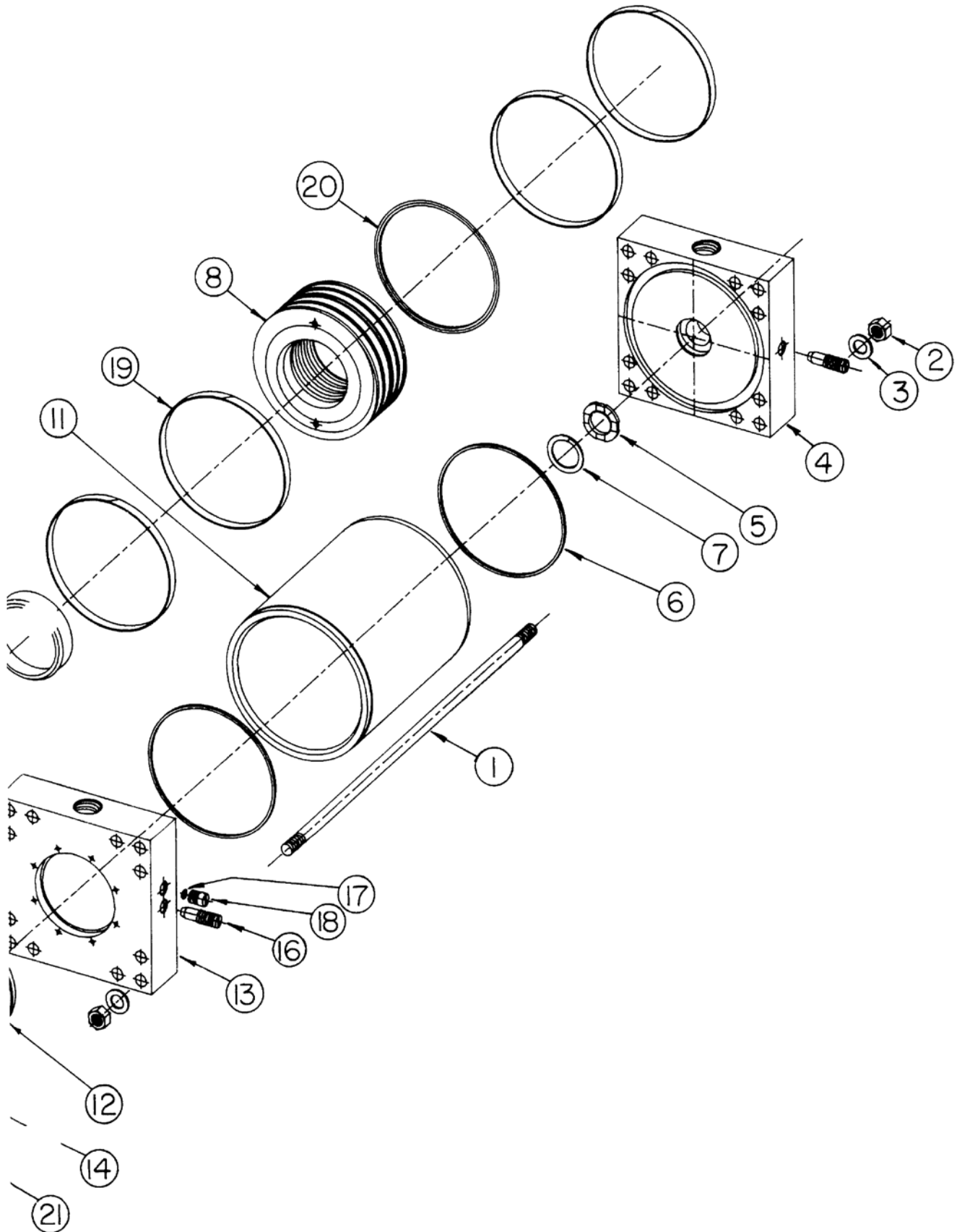
Replacement packings can be furnished quickly, if you will indicate the serial number of the cylinder as shown on the name plate, and the part name and number, as shown. The cylinder illustrated is for reference purposes only, and does not represent any particular model.

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		





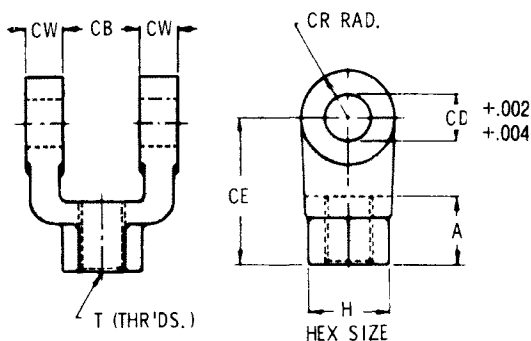
MOUNTING ACCESSORIES

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:**

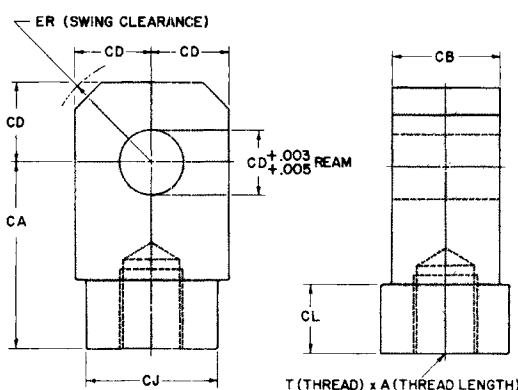
Accessory load rating may be lower than maximum force available from cylinder. Accessories load ratings are in pounds. Before specifying, compare maximum operating pull force in pounds developed by cylinder with load rating of accessory. Accessory load rating is the maximum recommended operating load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

Rod Clevis



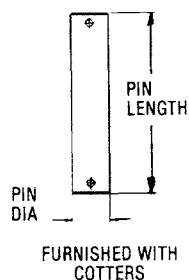
ROD CLEVIS ITEM NO.	PISTON ROD CODE	A	CB	CD	CE	CR	CW	H	T	*LBS. CAPACITY
V-10	P	4.50	4.00	3.50	8.50	3.88	2.00	5.00	3.25-12	210,000
V-12	S	5.50	4.50	4.00	10.00	4.38	2.25	6.19	4.00-12	270,000

Rod Eye



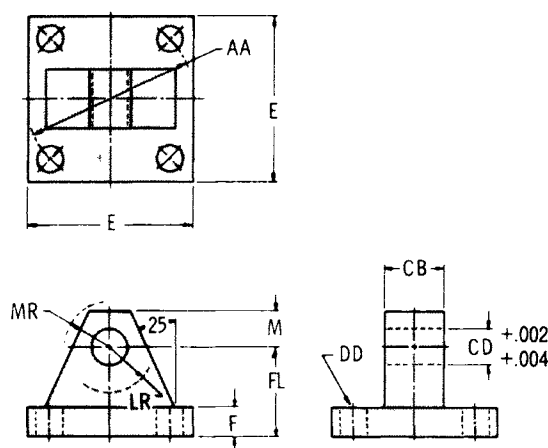
ROD EYE ITEM NO.	PISTON ROD CODE	A	CA	CB	CD	CJ DIA.	CL	ER	T	*LBS. CAPACITY
Y-10	P	4.50	7.62	4.00	3.50	6.12	3.50	5.00	3.25-12	189,000
Y-12	S	5.50	9.12	4.50	4.00	7.00	4.50	5.75	4.00-12	243,000

Pin



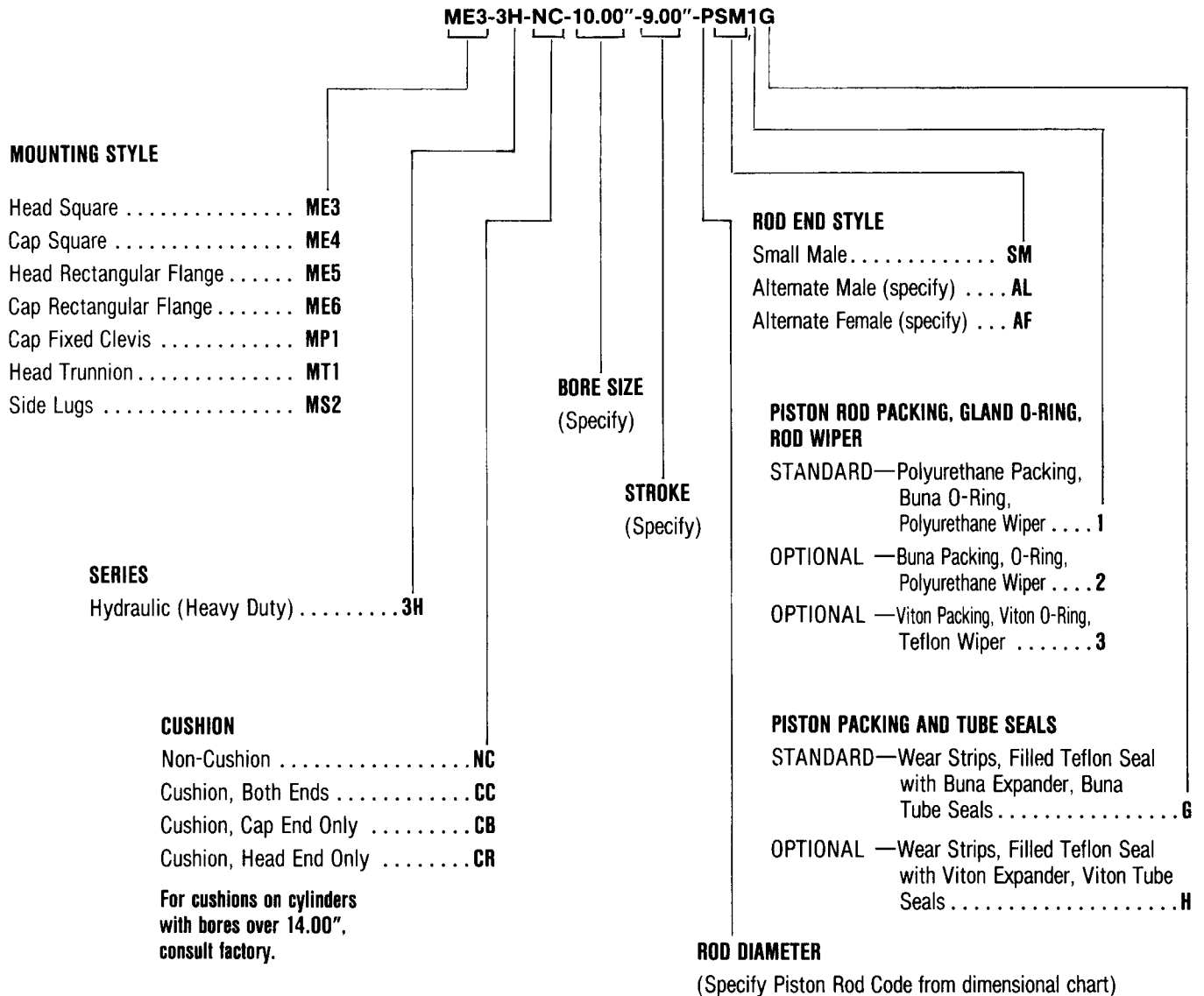
PIN ITEM NO.	LENGTH	DIAMETER	*LBS. CAPACITY
P10	9.31	3.50	300,650
P12	10.31	4.00	307,850

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

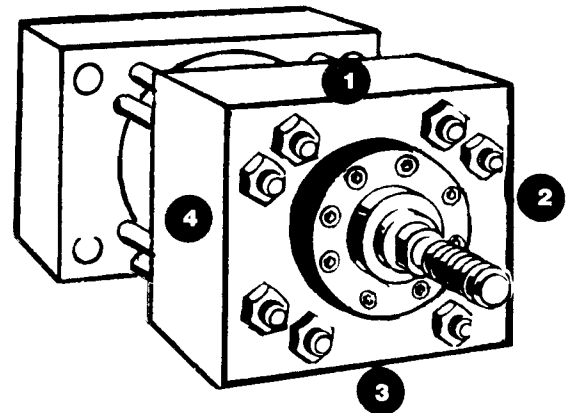


When ordering a stop tube, specify actual (working) stroke and nominal stroke. State length of stop tube.

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.