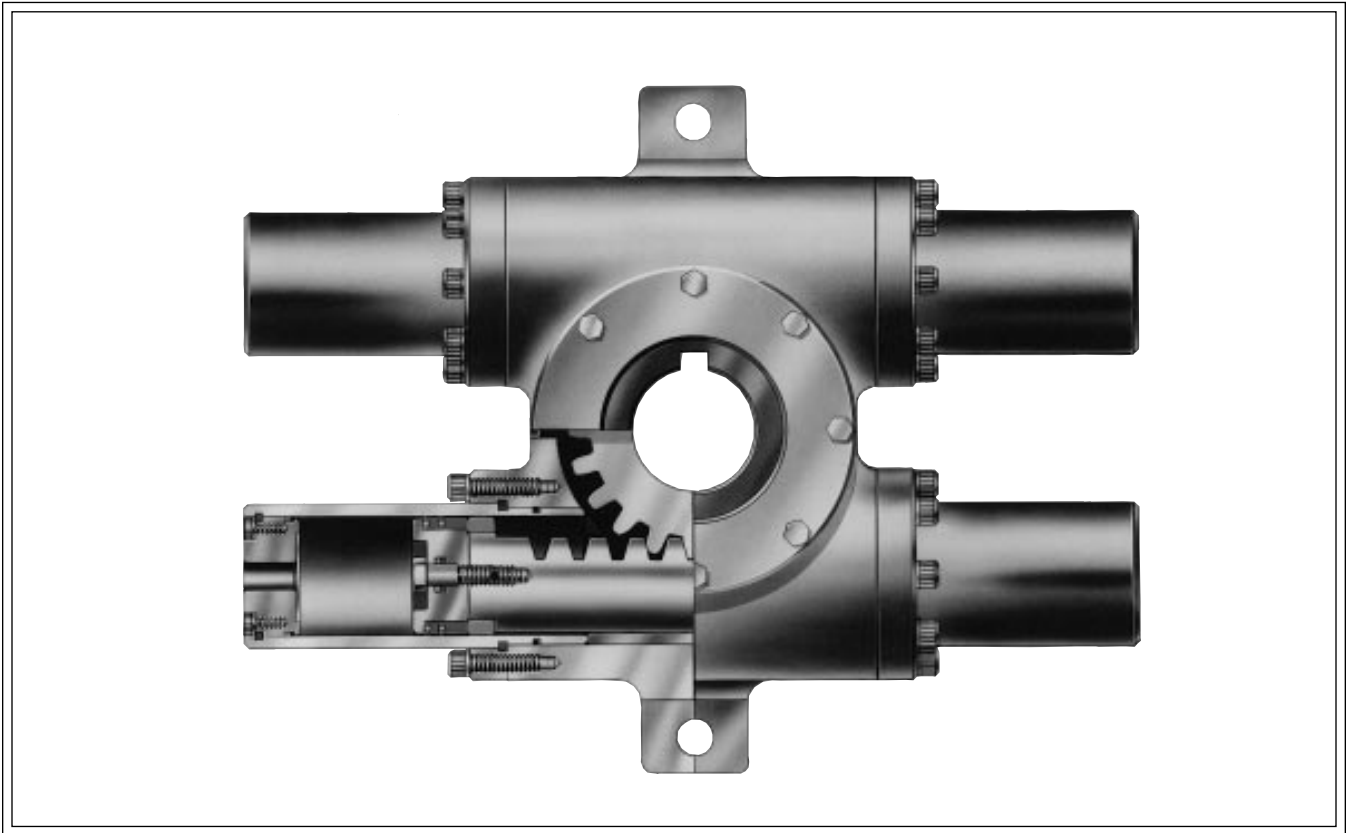


# M Series

## Heavy Duty Mill Series Rotary Actuator



### M Series Features

#### ■ HEAVY DUTY MILL CYLINDER CONSTRUCTION

Precision finished, thick-walled mill cylinder tubes and end caps for heavy duty mill service installations.

#### ■ TAPERED ROLLER BEARINGS

Large diameter, tapered roller bearings employed to support both the pinion shaft and large external radial and thrust loads. The actuator can be used as a motorized pillow block.

#### ■ SAE PORTS

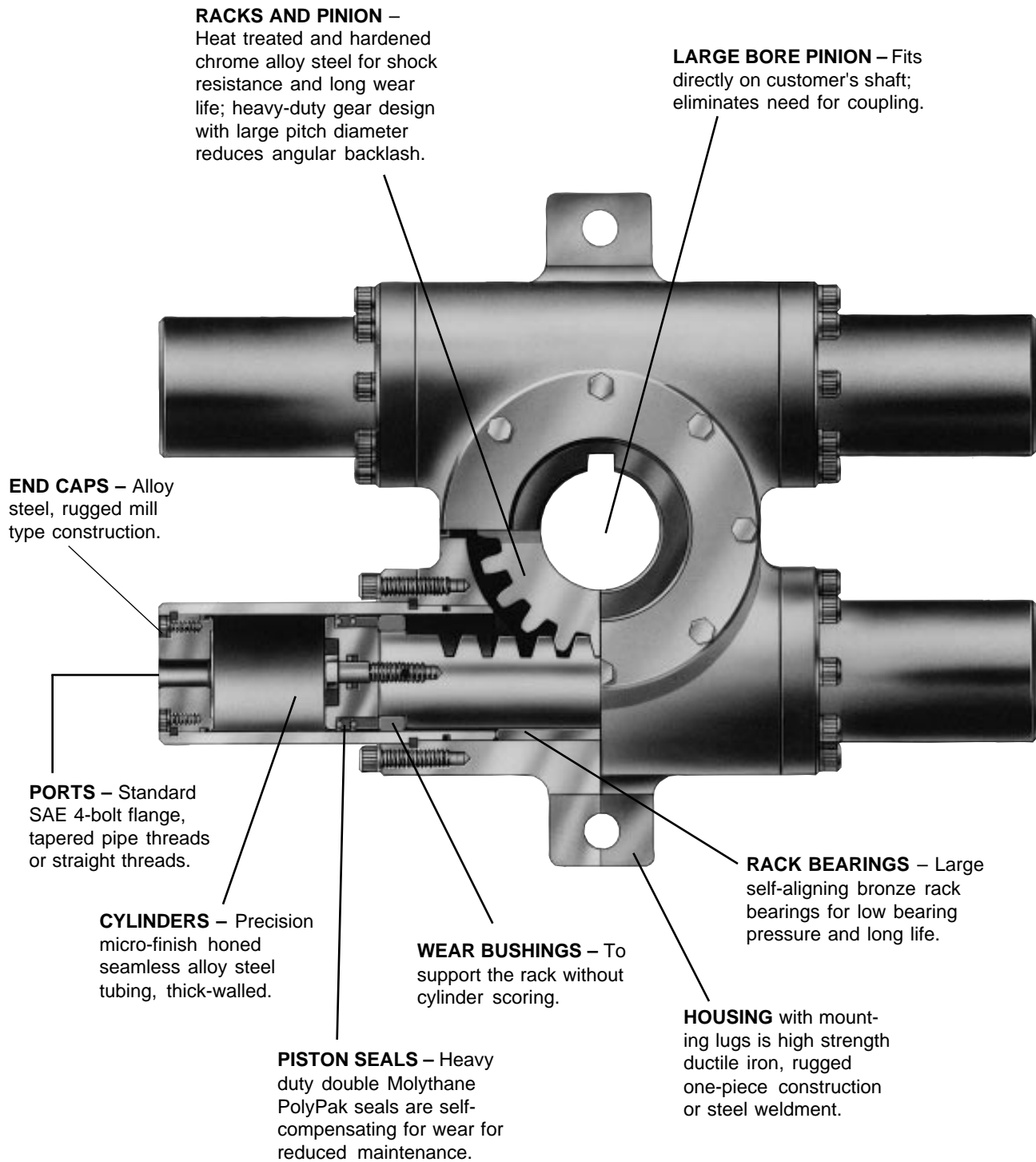
SAE (flange or o-ring) ports available for secure and leak free plumbing connections.

#### ■ BRONZE RACK BUSHINGS AND WEAR-PAK® PISTONS

We support the rack gear at both ends and in the middle with large bearings for smooth low speed rotation, cylinder tube protection and efficient torque generation.

#### ■ LARGE DIAMETER CHROME ALLOY STEEL PINION

The large diameter pinion gear provides superior service life and reduces back lash — all else being equal — when compared to smaller diameter pinion gears. The heat treated chromium alloy steel rack and pinion gear set is suitable for heavy duty service. The large diameter hollow bore pinion can be installed directly onto the customer's line shaft.



**NOTE:**  
All pressure-containing seals can be inspected or replaced without removing the actuator from customer's shaft.

## **M Series Heavy Duty Mill Rotary Actuator**

Designed to meet steel mill specifications. These non-tie rod units incorporate a range of features to provide heavy duty service dependability. The larger than normal heat treated pinions provide low tooth contact pressures and permit hollow shaft configurations with bore sizes capable of transmitting full operating torques, including shock loadings. In order to negate the chances of galling or scoring of the cylinder barrels, the Series M units are fitted with wear ring bushings that provide full support and eliminate the possibility of contact between cylinder and piston. The use of large diameter, tapered roller bearings on the pinion permit the actuator to absorb considerable thrust, radial and overhung loads. For ease of maintenance, all pressure seals on Series M can be inspected or replaced without removing the actuator from the customer's shaft. To ensure shipment of only the highest quality product, each actuator is fully tested and has an individual test sheet completed before final painting and shipment.

### **SPECIFICATIONS**

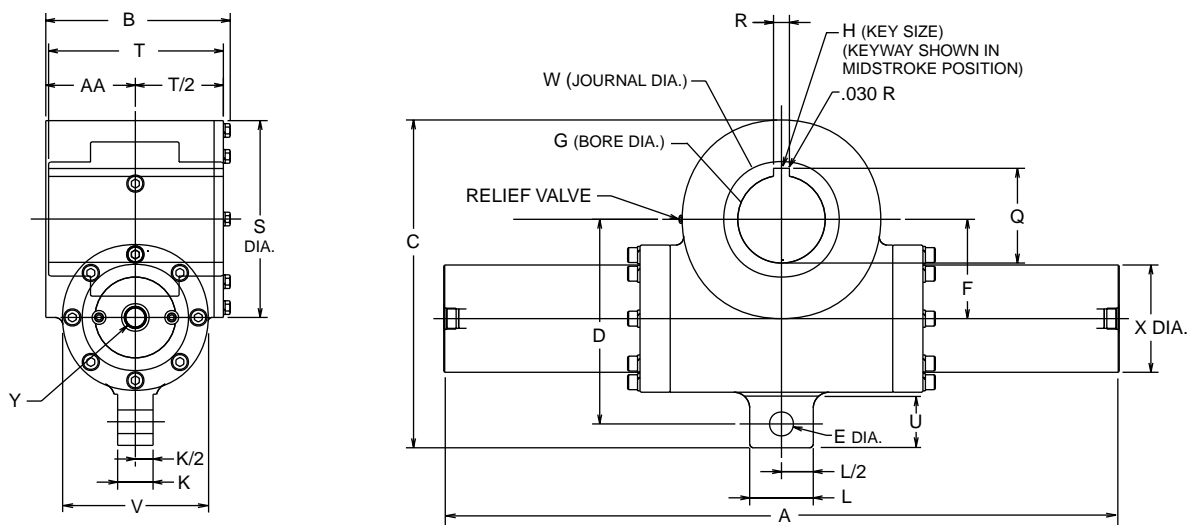
- Maximum operating pressure: 3000 psi (207 Bar) hydraulic
- Standard rotations: 90°, 180°, 360°
- Rotational tolerances: -0°, +2°
- Output torques @ 3000 psi (207 Bar): 75,000 lb-in to 50,000,000 lb-in
- Maximum breakaway pressure: 75 psi (5 Bar)
- Operating temperature: Standard nitrile seals -40° to 180°F (-40° to 82°C)  
Fluorocarbon seals -20° to 250°F (-29° to 121°C)
- Mounting orientation: Unrestricted
- Timing: Keyway located at 12:00 position at midstroke of actuator
- Housing: Heavy duty ductile iron (units up to 1000M),  
steel weldments (units larger than 1000M)

**SPECIFICATION TABLE**

Model		Maximum Pressure Rating, psi	Actual Output Torque, lb-in at Specified Pressure			Max. Angular Backlash (Minutes)	Standard Rotation Degrees	Displacement (Cubic Inches)	Standard Unit Weight (lb)
Single Rack	Double Rack		1000 psi (68 Bar)	2000 psi (136 Bar)	3000 psi (204 Bar)				
75M		3,000	25,000	50,000	75,000	15	90 180 360	43.4 86.9 174.0	202 217 259
	150M	3,000	50,000	100,000	150,000	15	90 180 360	86.9 174.0 347.0	301 331 415
300M		3,000	100,000	200,000	300,000	10	90 180 360	176.0 351.0 703.0	648 727 881
	600M	3,000	200,000	400,000	600,000	10	90 180 360	351.0 703.0 1,405.0	1033 1191 1499
	1,000M	3,000	333,000	667,000	1,000,000	10	90 180 360	556.0 1,112.0 2,224.0	1526 1774 2294
	1,500M	3,000	500,000	1,000,000	1,500,000	10	90 180 360	833.0 1,666.0 3,332.0	2100 2500 3300
	2,000M	3,000	667,000	1,333,000	2,000,000	10	90 180 360	1,248.0 2,496.0 4,992.0	3800 4480 5850
	3,000M	3,000	1,000,000	2,000,000	3,000,000	10	90 180 360	1,727.0 3,454.0 6,908.0	4900 5700 7300
	4,000M	3,000	1,333,000	2,667,000	4,000,000	10	90 180 360	2,389.0 4,778.0 9,556.0	Consult Factory
	5,000M	3,000	1,667,000	3,333,000	5,000,000	10	90 180 360	2,937.0 5,874.0 11,748.0	Consult Factory
	6,000M	3,000	2,000,000	4,000,000	6,000,000	10	90 180 360	3,552.0 7,104.0 14,208.0	Consult Factory
	7,000M	3,000	2,333,000	4,667,000	7,000,000	10	90 180 360	3,910.0 7,820.0 15,640.0	Consult Factory
	8,000M	3,000	2,667,000	5,333,000	8,000,000	10	90 180 360	4,640.0 9,280.0 18,560.0	Consult Factory
	9,000M	3,000	3,000,000	6,000,000	9,000,000	10	90 180 360	5,020.0 10,040.0 20,080.0	Consult Factory
	10,000M	3,000	3,333,000	6,667,000	10,000,000	10	90 180 360	5,840.0 11,680.0 23,360.0	Consult Factory
	15,000M	3,000	5,000,000	10,000,000	15,000,000	10	90 180 360	8,710.0 17,420.0 34,840.0	Consult Factory
	20,000M	3,000	6,667,000	13,333,000	20,000,000	10	90 180 360	11,476.0 22,952.0 45,904.0	Consult Factory
	25,000M	3,000	8,333,000	16,667,000	25,000,000	10	90 180 360	14,262.0 28,524.0 57,048.0	Consult Factory
	30,000M	3,000	10,000,000	20,000,000	30,000,000	10	90 180 360	17,815.0 35,630.0 71,260.0	Consult Factory
	40,000M	3,000	13,333,000	26,667,000	40,000,000	10	90 180 360	23,687.0 47,374.0 94,748.0	Consult Factory
	50,000M	3,000	16,667,000	33,333,000	50,000,000	10	90 180 360	27,369.0 54,738.0 109,476.0	Consult Factory

Note: All dimensions in inches unless otherwise specified.

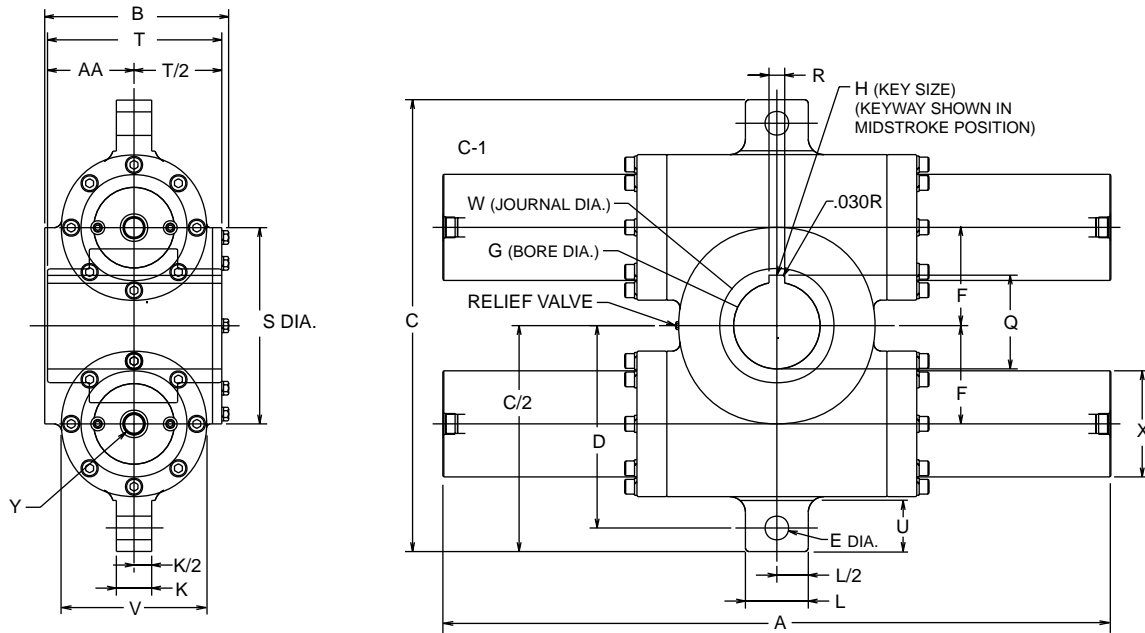
**SINGLE RACK with Standard Lug Mount (L) and Hollow Keyed Shaft (A)**



Model	Rotation Degrees	A	B	C (+.13, -.00)	D	E	F	G	K	L (+.13, -.00)	Q
75M	90	24.50	8.00	14.25	8.63	1.000	4.13	3.500 3.505	1.50	3.00	3.840
	180	34.50									
	360	55.50									
300M	90	34.25	11.88	20.63	12.88	1.500	6.25	5.500 5.505	2.25	4.00	5.960
	180	48.50									
	360	76.75									
Model	Rotation Degrees	R	S (+.13, -.00)	T	U	V (+.25, -.00)	W	X	Y	AA	
75M	90, 180, 360	.750	9.25	7.50	2.13	6.00	5.00	4.00	1 1/16-12 SAE #12	3.81	
		.753									
300M	90, 180, 360	1.000	12.50	11.25	3.25	9.25	7.25	6.75	1 5/16-12 SAE #16	5.69	
		1.003									

Note: All dimensions in inches unless otherwise specified.

**DOUBLE RACK with Standard Lug Mount (L) and Hollow Keyed Shaft (A)**



**Dimensions**  
**Sizes from 150 to 1000 lb-in**

Model	Rotation Degrees	A	B	C (+.13, -.00)	D	E	F	G	K	L (+.13, -.00)	Q
150M	90	24.50	8.00	19.25	8.63	1.000	4.13	3.500 3.505	1.50	3.00	3.840
	180	34.50									
	360	55.50									
600M	90	34.25	11.88	28.75	12.88	1.500	6.25	5.500 5.505	2.25	4.00	5.960
	180	48.50									
	360	76.75									
1000M	90	40.25	13.88	32.50	14.75	1.500	7.25	7.250 7.255	2.25	4.00	7.725
	180	57.00									
	360	90.50									
Model	Rotation Degrees	R	S (+.13, -.00)	T	U	V (+.25, -.00)	W	X	Y	AA	
150M	90, 180, 360	.750 .753	9.25	7.50	2.13	6.00	5.00	4.00	1 1/16-12 SAE #12	3.81	
600M	90, 180, 360	1.000 1.003	12.50	11.25	3.25	9.25	7.25	6.75	1 5/16-12 SAE #16	5.69	
1000M	90, 180, 360	1.000 1.003	14.50	13.00	3.25	10.25	9.13	7.75	1 5/16-12 SAE #16	6.75	

Note: All dimensions in inches unless otherwise specified.

**DOUBLE RACK with Standard Lug Mount (L) and Hollow Keyed Shaft (A)**

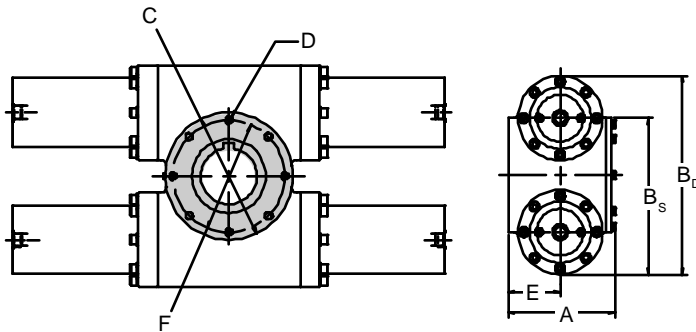
**Dimensions\***  
**Sizes from 1500 to 50000 lb-in**

Model	Rotation Degrees	A	B	C	D	E	F	G	H	K
1,500M	90	44	16 <sup>1</sup> / <sub>2</sub>	35	16	1 <sup>1</sup> / <sub>2</sub>	8 <sup>1</sup> / <sub>4</sub>	8	1 <sup>1</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>4</sub>
	180	62							x	
	360	101 <sup>1</sup> / <sub>2</sub>							13 <sup>1</sup> / <sub>2</sub>	
2,000M	90	48	19	41 <sup>1</sup> / <sub>4</sub>	18 <sup>7</sup> / <sub>8</sub>	1 <sup>3</sup> / <sub>4</sub>	9 <sup>3</sup> / <sub>8</sub>	9 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>4</sub>
	180	70							x	
	360	114							14 <sup>1</sup> / <sub>2</sub>	
3,000M	90	48 <sup>1</sup> / <sub>2</sub>	21	45 <sup>3</sup> / <sub>4</sub>	20 <sup>7</sup> / <sub>8</sub>	2	10 <sup>1</sup> / <sub>8</sub>	9 <sup>3</sup> / <sub>4</sub>	1(2)	3
	180	70 <sup>1</sup> / <sub>2</sub>							x	
	360	114 <sup>1</sup> / <sub>2</sub>							16	
4,000M	90	54	23 <sup>1</sup> / <sub>2</sub>	51 <sup>1</sup> / <sub>4</sub>	23 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>4</sub>	11 <sup>3</sup> / <sub>8</sub>	11 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>
	180	79							x	
	360	129							18 <sup>1</sup> / <sub>2</sub>	
5,000M	90	55	25	54 <sup>3</sup> / <sub>4</sub>	25 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>4</sub>	12 <sup>5</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>2</sub>	1 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>
	180	80 <sup>1</sup> / <sub>2</sub>							x	
	360	130 <sup>1</sup> / <sub>2</sub>							18 <sup>1</sup> / <sub>2</sub>	
6,000M	90	63 <sup>1</sup> / <sub>2</sub>	25 <sup>1</sup> / <sub>2</sub>	57 <sup>1</sup> / <sub>2</sub>	26 <sup>1</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>2</sub>	13	13 <sup>1</sup> / <sub>2</sub>	1 <sup>3</sup> / <sub>4</sub>	3 <sup>3</sup> / <sub>4</sub>
	180	95							x	
	360	158							21 <sup>1</sup> / <sub>2</sub>	
7,000M	90	74 <sup>1</sup> / <sub>2</sub>	26 <sup>1</sup> / <sub>2</sub>	61 <sup>1</sup> / <sub>2</sub>	28	2 <sup>3</sup> / <sub>4</sub>	14	15	2	4
	180	109 <sup>1</sup> / <sub>2</sub>							x	
	360	179							22	
8,000M	90	76	26 <sup>1</sup> / <sub>2</sub>	63 <sup>3</sup> / <sub>4</sub>	29 <sup>1</sup> / <sub>4</sub>	2 <sup>3</sup> / <sub>4</sub>	15	16	2 <sup>1</sup> / <sub>4</sub>	4
	180	114							x	
	360	190							22	
9,000M	90	80	26 <sup>1</sup> / <sub>2</sub>	67	30 <sup>1</sup> / <sub>2</sub>	3	16	18	2 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>2</sub>
	180	121							x	
	360	203							18 <sup>1</sup> / <sub>2</sub>	
10,000M	90	85	28	69	31 <sup>1</sup> / <sub>2</sub>	3	17	20	2 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>2</sub>
	180	129							x	
	360	217							22	
15,000M	90	102	28	82	37 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	21 <sup>1</sup> / <sub>2</sub>	22	2 <sup>1</sup> / <sub>2</sub>	5
	180	159							x	
	360	272							22	
20,000M	90	110	29	87	39 <sup>1</sup> / <sub>2</sub>	4	23 <sup>1</sup> / <sub>2</sub>	31	2 <sup>1</sup> / <sub>2</sub> (2)	5
	180	173							x	
	360	298 <sup>1</sup> / <sub>2</sub>							22	
25,000M	90	110	30 <sup>1</sup> / <sub>2</sub>	95	42 <sup>1</sup> / <sub>2</sub>	5	24 <sup>1</sup> / <sub>2</sub>	31	2 <sup>1</sup> / <sub>2</sub> (2)	5
	180	173							x	
	360	298 <sup>1</sup> / <sub>2</sub>							26	
30,000M	90	112	32 <sup>1</sup> / <sub>2</sub>	98	44	5	25	31	2 <sup>1</sup> / <sub>2</sub> (2)	5
	180	175							x	
	360	300 <sup>1</sup> / <sub>2</sub>							28	
40,000M	90	132	36	108	49	5	28 <sup>1</sup> / <sub>2</sub>	38	3(2)	6
	180	207 <sup>1</sup> / <sub>2</sub>							x	
	360	358							30	
50,000M	90	133	37	111	50 <sup>1</sup> / <sub>2</sub>	5	29 <sup>1</sup> / <sub>4</sub>	38	3(2)	6
	180	209							x	
	360	359 <sup>1</sup> / <sub>2</sub>							32	

\* Units 1500M and above have dimensions that are subject to change. Consult factory on these dimensions before any design implementation is initiated.

Note: All dimensions in inches unless otherwise specified.

**FACE MOUNTING (A)**



Model	Torque lb-in @ 3,000 psi	A	B <sub>s</sub>	B <sub>d</sub>	C	D	E	F
75M	75,000	8	11.75	N/A	9.25	5/8-18 x 15/16 DP	3.81	8.000
150M	150,000	8	N/A	14.25	9.25	5/8-18 x 15/16 DP	3.81	8.000
300M	300,000	11-7/8	17.13	N/A	12.50	3/4-16 x 1-1/8 DP	5.69	11.000
600M	600,000	11-7/8	N/A	21.75	12.50	3/4-16 x 1-1/8 DP	5.69	11.000
1,000M	1,000,000	13-5/8	N/A	24.75	14.50	1-1/4-12 x 1-7/8 DP	6.75	12.000

**Face Mounting Bi-directional Torque Capacity**  
 (without dowel devices)

Model	Bolt Size	Suggested Bolt Torque ( lb - ft)	Bi-Directional Torque Capacity* ( lb - in)
75M	5/8-18 x 15/16 dp	100	105,495
150M	5/8-18 x 15/16 dp	100	105,495
300M	3/4-16 x 1-1/8 dp	160	167,200
600M	3/4-16 x 1-1/8 dp	160	167,200
1,000M	1-1/4-12 x 1-7/8 dp	720	496,800

\* With additional reinforcement.

Bi-directional bolt torque capacity is equal to:

$$\mu \times \text{clamp load} \times \text{lever arm length from center of rotation}$$

( $\mu = .3$  assumed).

**Suggested Reinforcement**

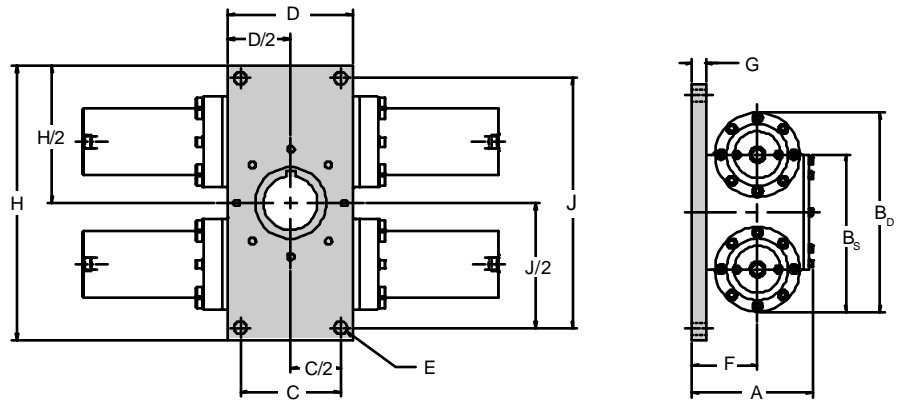
Model	Dowel Ø	Qty.	Bolt Circle Diameter
150M	.75	2	8
300M	.75	4	11
600M	1.00	4	11
1,000M	1.00	8	12

Note: All dimensions in inches unless otherwise specified.



### FLANGE MOUNTING (F)

In addition to the flange shown, made to order sizes can be manufactured.

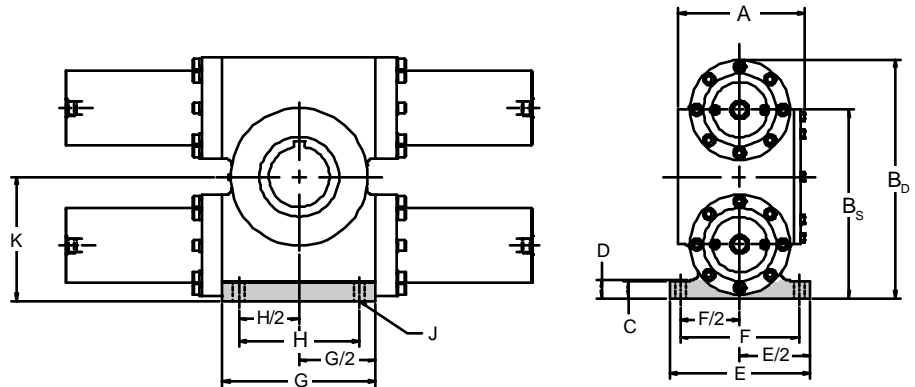


Model	Torque lb-in @ 3000 psi	A	B <sub>s</sub>	B <sub>D</sub>	C	D	E	F	G	H	J
75M	75,000	9-1/4	11.75	N/A	7.500	9.500	1.063	5.06	1.25	19.25	17.250
150M	*	9-1/4	N/A	14.25	7.500	9.500	1.063	5.06	1.25	19.25	17.250
300M	*	13-3/8	17.13	N/A	10.250	12.750	1.313	7.19	1.50	28.00	25.500
600M	*	13-3/8	N/A	21.75	10.250	12.750	1.313	7.19	1.50	28.00	25.500
1,000M	*	15-3/8	N/A	24.75	11.500	16.750	1.563	8.50	1.75	32.25	29.250

\* Consult factory with applications data.

### FOOT MOUNTING (G)

The foot is an integral part of the housing, machined on all sides to accommodate shear block mounting. (1,000M & smaller).



Model	Torque lb-in @ 3000 psi	A	B <sub>s</sub>	B <sub>D</sub>	C	D	E	F	G	H	J	K
75M	75,000	8	12.00	N/A	1.38	1.50	11.00	9.500	10.00	7.500	.781	7.375
150M	150,000	8	N/A	14.50	1.38	1.50	11.00	9.500	10.00	7.500	.781	7.375
300M	300,000	11-7/8	17.50	N/A	1.63	1.75	13.00	11.000	14.00	11.000	1.031	11.250
600M	600,000	11-7/8	N/A	22.13	1.63	1.75	13.00	11.000	14.00	11.000	1.031	11.250
1,000M	1,000,000	13-7/8	N/A	25.13	1.88	2.00	16.00	13.500	16.75	13.000	1.281	12.750

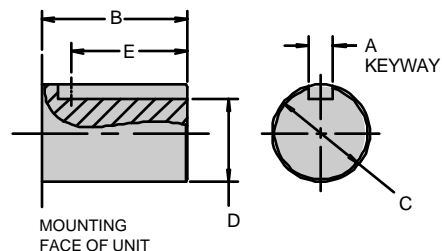
Note: All dimensions in inches unless otherwise specified.

### SHAFT OPTIONS (B, D, E)

All shaft options shown in mid-stroke position.

#### Male Keyed Shaft (B)

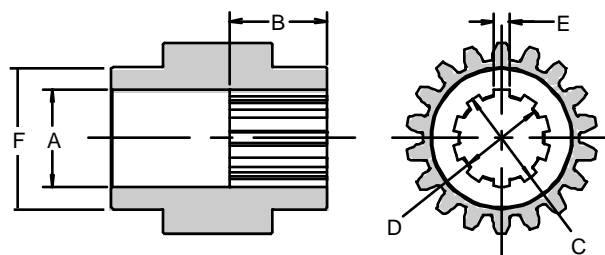
Model	A	B	C	D	E	Torque Rating
75M 150M	.749 .750	4.50	3.000 2.999	2.577 2.572	3.38	102,000 lb-in
300M 600M	1.249 1.250	7.50	5.000 4.999	4.297 4.292	6.00	475,000 lb-in
1000M	2.000 2.002	12.00	8.000 7.999	6.873 6.868	10.00	1,000,000 lb-in



Suggested Key Materials			
Model	A / □	E	Material
75M	.750/.749	3.38	C1018 CR
150M	.750/.749	3.38	C1045 CR
300M	1.250/1.249	6	C1018 CR
600M	1.250/1.249	6	C1018 CR

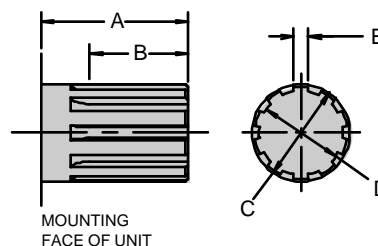
#### Female SAE 10B Spline (D)

Model	A	B	C	D	E	F
75M 150M	3.03	3.00	3.000 2.998	2.580 2.578	.468 .465	4.999 4.997
300M 600M	39T, 30° involute splined shaft is available. Consult factory.					
1000M						



#### Male SAE 10B Spline (E)

Model	A	B	C	D	E
75M 150M	4.50	2.88	2.997 2.995	2.573 2.568	.464 .463
300M 600M	39T, 30° involute splined shaft is available. Consult factory.				
1000M					



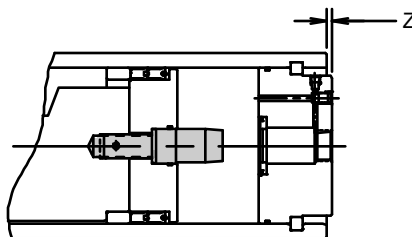
Note: All dimensions in inches unless otherwise specified.

### CUSHIONS (1, 2, 3, 4)

The standard cushions operate over the last 20° of rotation in either or both directions. A floating bushing ensures no binding of cushion spear. For severe operating conditions, 4 cushions should be fitted on double rack units.

All cushions are fully adjustable. Double rack units should be fitted with Type 4 cushions.

**NOTE:** Proportional valves are recommended instead of cushions for high inertial loads.



Model	Z
75M	.50
150M	.50
300M	.25
600M	.25
1000M	.00

Cushion Kinetic Energy Capacity				
Model	Cushion Code	Dissipation (Inch lbf)	Cushion Code	Cushion Work (in-lb)
75M	3	27,630	1,2	27,165
150M	4	55,300	1,2,3	27,165*
300M	3	84,190	1,2	104,700
600M	4	168,370	1,2,3	104,700*
1,000M	4	192,000	1,2,3	192,000*

\* Must deduct work done by any existing drive pressure and work done to control potential energy.

Note: All dimensions in inches unless otherwise specified.

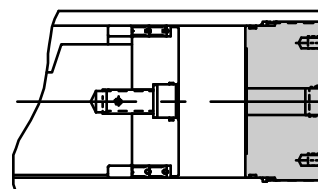
**PORTS (1, 2, 3)**

SAE straight thread ports or 4 bolt flanges are recommended for all applications. NPT ports are available but not recommended.

Model	Standard SAE Straight Thread (1)	NPT (2)	4 Bolt Flange (3) SAE J518 (3000 psi)
75M 150M	1-1/16 -12 (SAE 12)	3/4	3/4
300M 600M	1-5/16 -12 (SAE 16)	1	1
1000M	1-5/16 -12 (SAE 16)	1	1

**5° STROKE ADJUSTERS (A, B, C)**

Model	(1) Turn Adj.	Max. Adj.
75M 150M	1°	5° (+2°, -3°)
300M 600M	8°	5° (+2°, -3°)
1000M	7°	5° (+2°, -3°)



**NOTE:**

1. Maximum unit rotation is equal to rotation specified in model code. Adjusters allow rotational positioning equal to or less than the maximum rotation.
2. Stroke adjusters are available with or without cushions. Double rack units will have cushions and stroke adjusters on lower rack.

**SEALS (V, W)**

Seal Class	Seal Type	Wear Ring Type	Fluid Medium	Temperature Range	Filtration
Standard	Molythane PolyPak	Filled PTFE	General purpose, petroleum-based fluids	-40°F to 180°F -40°C to 82°C	ISO Class 17/14 Cleanliness Level
Viton (V)	Fluorocarbon	Filled PTFE	High Temperature and/or Synthetic Fluids	-20°F to 250°F -29°C to 121°C	
Nitrile (W)	Carboxilated Nitrile*	Filled PTFE	Water Glycol, High Water Content Fluids	30°F to 180°F 0°C to 82°C	

\* Not available in every size. Factory will automatically make appropriate substitutions as necessary.

Note: All dimensions in inches unless otherwise specified.

## KINETIC ENERGY CAPACITY

The energy values below assume drive pressure is maintained through cushion stroke.

### Single Rack Units with Single Set of Cushions (20°)

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*													
	0 psi		500 psi		1000 psi		1500 psi		2000 psi		2500 psi		3000 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
75M	26175	14245	21812	14245	17448	14245	13088	13088	8724	8724	4362	4362	0	0
300M	194700	54400	87247	54400	69793	54400	52350	52350	34897	34897	17449	17449	0	0

### Double Rack Units with Single Set of Cushions (20°)

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*													
	0 psi		500 psi		1000 psi		1500 psi		2000 psi		2500 psi		3000 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
150M	26175	14245	17450	14245	8727	8727	0	0	0	0	0	0	0	0
600M	104700	54400	69801	54400	34907	34907	0	0	0	0	0	0	0	0
1000M	174500	97107	116336	97107	58178	58178	0	0	0	0	0	0	0	0

### Double Rack Units with Double Set of Cushions (20°)\*\*

Model	Kinetic Energy Rating(in-lb) of Cushion at Specified Drive Pressure*													
	0 psi		500 psi		1000 psi		1500 psi		2000 psi		2500 psi		3000 psi	
	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability	Max.	Durability
150M	52350	30168	43623	30168	34879	30168	26175	26175	17448	17448	8725	8725	0	0
600M	209400	115216	174493	115216	139586	115216	104700	104700	69793	69793	34899	34899	0	0
1000M	349000	194215	290822	194215	232643	194215	174500	174500	116322	116322	58164	58164	0	0

\* Must deduct work (energy) done to overcome potential energy effects of load.  $W_{PE} = T_{PE} \times \theta$ , where  $\theta$  is in radians.

\*\* Extreme care must be exercised so that both cushions are adjusted equally for each direction or dangerous pressure intensification and gear train stresses could result. (Suggest high performance cushion option.)

## CUSHION DECELERATION CONTROL

The cushion causes the resisting torque that can be used to decelerate a rotational load. Please note the cushion has to provide enough resistance to control: drive torque caused by the hydraulic system pressure; plus the torque caused by gravity pulling on the rotational load; and the kinetic energy associated with the motion of the inertia load. Since the actuator's cushion has to be able to control the sum of all three torque factors, we suggest including cushion capacity as one of the actuator's selection criteria.

It is strongly suggested that proportional valves be used instead of cushions to control (decelerate) high inertial loads. This provides the ability to reduce inlet pressure while generating deceleration pressure. It also allows for longer ramp times, thus increasing deceleration stroke.

### SUPPLEMENTAL INFORMATION KINETIC ENERGY BASIC FORMULA

$$KE = 1/2 J_m \omega^2$$

$$\omega = 0.0175 \times \frac{2\theta_A + \theta_C + 2\theta_D}{\text{Rotation Time (sec.)}}$$

where:

KE = Kinetic Energy (in-lb)

$J_m$  = Rotational Mass Moment of Inertia (in-lb-sec<sup>2</sup>)

$\omega$  = Peak Velocity (rad/sec)  
 (Assuming twice average velocity)  
 See Section A, Page 19 for formulas.

$\theta_A$  = Acceleration Angle (deg)

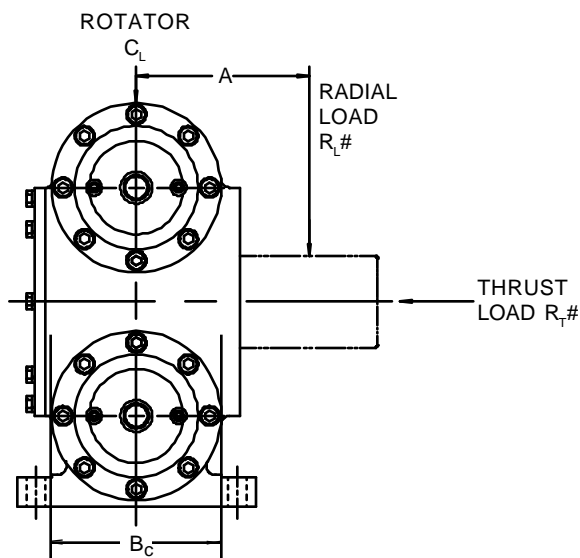
$\theta_C$  = Constant Velocity Angle (deg)

$\theta_D$  = Deceleration Angle (deg)

### BEARING LOAD CAPACITIES

Each M Series Actuator is fitted with heavy duty tapered roller bearings as standard and can support high external loads. The table provides load capacities for each unit.

Any distance "A" possible as long as bearing limits are observed. See overhung moment equation.



BEARING CAPACITIES "M" SERIES ROTATOR							
Model	Radial Load-lbs. Per Bearing ( $R_L$ )		Thrust Load-lbs. ( $R_T$ )		Bearing Center ( $B_C$ ) Distances	Overhung Moment, Inch-lbs. $R_L \times (A + B_C/2)$	
	Dynamic	Static	Dynamic	Static	Inch	Dynamic	Static
75M	34,000	51,000	15,000	22,500	3.40	115,600	173,400
150M	42,000	63,000	15,000	22,500	3.40	142,800	214,200
300M	42,000	63,000	20,000	30,000	5.65	237,300	355,950
600M	57,000	85,500	20,000	30,000	5.65	322,050	493,075
1000M	50,000	75,000	20,000	30,000	7.40	370,000	555,000

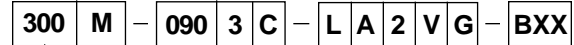
### UNIT WEIGHTS

Model	Rotation					
	90°		180°		360°	
	lb	kg	lb	kg	lb	kg
75M	202	92	217	99	259	118
150M	301	137	331	150	415	188
300M	648	294	727	330	881	400
600M	1033	469	1191	541	1499	681
1000M	1526	693	1774	805	2294	1041
1500M	2100	953	2500	1135	3300	1498
2000M	3800	1725	4500	2043	5900	2679
3000M	4900	2225	5700	2588	7300	3314

Note: All dimensions in inches unless otherwise specified.

**MODEL CODE AND ORDERING INFORMATION**

Example: 300M-0903C-LA2VG-B



**Size**

Torque Output in '000 lb-in at 3000 psi  
 75 = 75,000 lb-in  
 150 = 150,000 lb-in  
 300 = 300,000 lb-in  
 600 = 600,000 lb-in

**Series**

Heavy Duty Mill Series

**Degrees Rotation**

090 = 90°  
 180 = 180°  
 360 = 360°

**Cushion**

Omit - None	3 - Both Rotations
1 - CW Rotation *	4 - Four Cushions **
2 - CCW Rotation*	9 - Special

**Stroke Adjusters**

Omit - None	C - 0-5° Both Rotations
A - 0-5° CW Rotation*	X - Special
B - 0-5° CCW Rotation*	

**Mounting Style**

L - Lug Mount (STD)	F - Flange Mount
A - Face Mount	X - Special Mount
G - Foot Mount	

**Shaft Configuration**

A - Hollowed Keyed Shaft (STD)	E - Male SAE 10B Spline^
B - Male Keyed Shaft	X - Special Shaft
D - Female SAE 10B Spline^	

**Port Type**

1 - SAE Straight Thread (STD)	3 - Flange (3000 psi)
2 - NPTF	9 - Special

**Seals**

Omit - Molythane & Nitrile (STD)  
 V - Fluorocarbon  
 W - Carboxilated Nitrile  
 X - Special Seals

**Options**

Omit - None  
 G - Air Bleeds  
 J - Feedback Potentiometer

**Special Actuator Code**

Omit - Standard Unit  
 (Two digit code assigned by factory and applies when any "X" or "9" appears in the model number or when special options or features are required.)

**Design Series**

Assigned by Factory

\* Viewed from Shaft End

\*\* Double Rack Models Only

^ Not available with 300M or 600M actuators. A 39T involute spline shaft is available.

Note: All dimensions in inches unless otherwise specified.