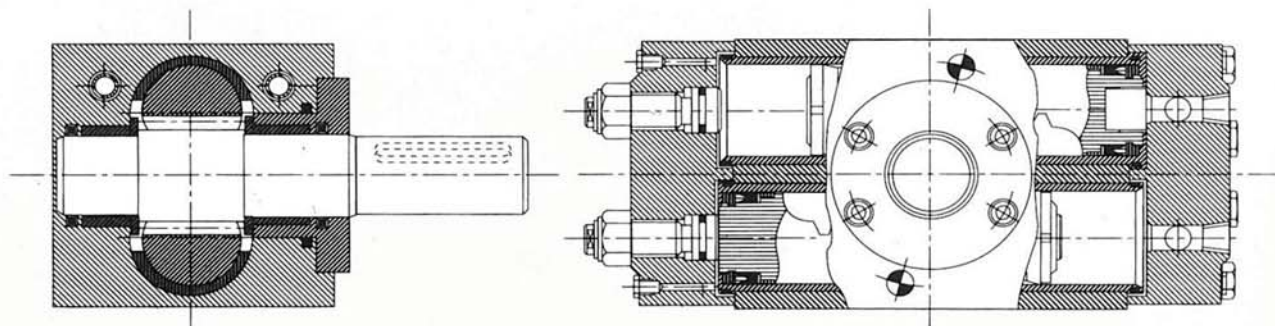


# Torqmaster Semi-Rotary Actuators



## Description

TORQMASTER SEMI ROTARY ACTUATORS are of a rack and pinion construction providing constant torque over the total rotation. Designed for long life and arduous duty over many cycles.

## Operating principle

In most cases, the Torqmaster incorporates twin rack pistons which operate on a centrally located pinion/output shaft. Pressure applied to the piston moves the rack against the pinion creating rotary movement. In the case of twin rack models, pressure and flow is applied to alternate ends of the Torqmaster via internal transfer tubes. Four port models are available see TM 30.

## Advantages - Constant torque

Regardless of shaft angular position, predictable, positive, constant, mechanically balanced torque is produced in either direction.

## Balanced bearings

Twin rack construction ensures the pinion shaft bearing is balanced by each rack under pressure.

## Variable speed

Speed can be varied by adjusting the hydraulic flow rate.

## Variable torque

Torque can be varied by adjusting the hydraulic pressure.

## Efficiency

100% volumetric efficiency. Mechanical losses within the actuator have already been taken into account in the published torque figures.

## Cushioning - Option 630

Cushioning is available as an optional extra to slow down operation at the end of stroke. Normally effective over the last 10 to 15 degrees of stroke in each direction. Note if cushioning is used with end stops, (option 632) the end stop adjustment reduces the length of cushioning accordingly.

## End stops - Option 631

End stops are available as an optional extra to trim the stroke. Each adjuster can reduce the total rotation by ten degrees.

## Combined cushioning and end stops - Option 633

To ensure that cushioning is maintained irrespective of end stop position. This feature is an optional extra on TM12, TM30, MT50, TM140, TM300 models. Cushioning commences approximately 15 degrees from the end of rotation.

## Economy

Torqmaster is more compact than a hydraulic cylinder with crank arm, more reliable than an electric motor and gearbox. Rated for continuous industrial duty, it is ideal for continuous automation requirements, subject to speed of

operation and suitability of the hydraulic circuit control system and inertial loads. Please check with our application department for suitability of your selection.

## Applications

For process valve operation, crane grabs, container spreader arms, mixing machines, machine guards, machine loading systems, index tables, steel works equipment, coal mining machines and undersea applications.

## Torqmaster construction

Rack pistons - high tensile alloy steel.  
Pinion - hardened and tempered high tensile alloy steel.  
Body - S.G. Iron or alloy steel.  
Shaft Seal - Quad seal Nitrile.  
Piston Seal - 'U' Type Nitrile.

## Additional Features

### Valve actuator variant

With spring return, spring centred, mechanical override, and various position indication devices. Standard Spring Life  $10^5$  cycles.

### Drive style

Single and double output shafts with keyways are standard. On some models, hollow and splined drives are available as shown on the individual actuator dimension drawings.

### Output Shaft Datum

When Torqmaster actuators are provided with a keyway, this will be at the twelve o'clock position at the mid-rotation point

## Hollow Shaft

Hollow pinion shafts should not be used at pressures above 100 BAR (1500psi).

## Mounting

Mounting is by four blind tapped holes in the 'Q' face of the main body and bolt clearance holes in 'S' Face (TM1 & TM2 have tapped holes) TM Models only. Mounting on 'S' Face is available as an option for MT Models-Quote "Z7". Alternatively, four tapped holes in the 'P' face of the main body are available as an option - Quote "Z4". The face mounting carries a mounting spigot. Dowel holes are provided on most models to take the torque reaction.

## Port position

The standard port position will always be supplied unless the alternative is specified by quoting "Z10".

## Additional shaft keyway

Shaft styles 610 and 611 can be supplied with 2 keyways spaced at 180 degrees to the same datum, at extra charge by quoting "Z6".

## Viton seals

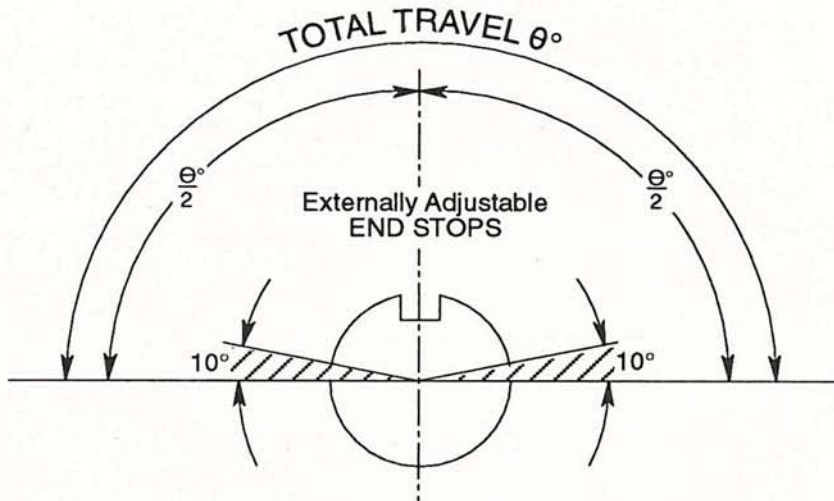
All standard actuators are supplied fitted with medium NITRILE rubber seals for use with compatible fluids up to temperatures of 80°C. The alternative of VITON rubber to suit higher temperatures up to 150°C can be supplied (subject to availability) at extra charge by specifying "Z1".

## Marinised paint finish

Full Epoxy marinised finish for extra protection is available - quote "Z2".

ACTUATOR TECHNICAL DATA						
MODEL REF.	BACKLASH		FIXING BOLT TORQUE		PINION DIMENSIONS	
	DEGREES	BOLT SIZE	TORQUE(Nm/Kgfm)	PCD	No of TEETH	ROTATION per tooth pitch
TM 1	0.88°/0.39°	M8	28 (2.8)	1.1670"	14	25.75°
TM 2	0.88°/0.39°	M8	28 (2.8)	1.1670"	14	25.75°
MT 3	0.88°/0.39°	M10	55 (5.6)	1.1670"	14	25.75°
MT 6	0.72°/0.33°	M10	55 (5.6)	1.750"	14	25.75°
TM 12	0.52°/0.23°	M12	95 (9.7)	2.000"	12	30°
MT 20	0.47°/0.21°	M16	235 (24.0)	2.666"	16	22.5°
TM 30	0.39°/0.18°	M16	235 (24.0)	3.200"	16	22.5°
MT 50	0.25°/0.13°	M24	800 (81.5)	5.500"	22	16.35°
MT 100	0.25°/0.13°	M24	800 (81.5)	5.500"	22	16.35°
TM 140	0.23°/0.11°	M20	460 (46.8)	6.000"	24	15°
TM 300	0.21°/0.09°	M30	1585 (161.6)	8.000"	24	15°

# KEYWAY POSITION AND ROTATION



With keyway at 12 o'clock datum (as shown) actuator rotates each direction ( $\theta^\circ/2$ ) equal to one half of total travel.

When end stop adjusters are fitted the total angular adjustment is  $20^\circ$ . i.e.  $10^\circ$  at each adjuster.

The above diagram illustrates a  $180^\circ$  rotation which is adjustable down to  $160^\circ$ . when ordering always specify the **TOTAL ROTATION**.

*NOTE!* Production tolerance on rotation is  $+0.5$  to  $+2.5$  degrees for all models.

## SPLINE TOOTH POSITION

Spline tooth positions change with actuator size. Please see individual actuator dimension drawings.

### End stop adjustment

MODEL REF.	THREAD PITCH		ANGULAR MOVEMENT PER REVOLUTION OF ADJUSTER SCREW	TOTAL ANGULAR ADJUSTMENT PER ADJUSTER
	INS	MM		
TM 1	0.10	2.54	$9.82^\circ$	$10^\circ$
TM 2	0.06	1.52	$5.90^\circ$	$10^\circ$
MT 3	0.10	2.54	$9.82^\circ$	$10^\circ$
MT 6	0.07	1.78	$4.58^\circ$	$10^\circ$
TM 12	0.10	2.54	$5.73^\circ$	$10^\circ$
MT 20	0.11	2.79	$4.74^\circ$	$10^\circ$
TM 30	0.12	3.00	$4.29^\circ$	$10^\circ$
MT 50	0.09	2.29	$1.18^\circ$	$10^\circ$
MT 100	0.09	2.29	$1.18^\circ$	$10^\circ$
TM 140	0.12	3.00	$2.26^\circ$	$10^\circ$
TM 300	0.12	3.00	$1.69^\circ$	$10^\circ$

Torque Output Tables for Standard Range Actuators at applied Hydraulic pressure values of -

MODEL REF.	70 BAR (1000 psi)		100 BAR (1500 psi)		140 BAR (2000 psi)		210 BAR (3000 psi)		Standard Nominal ROTATION available Degrees
	Newton Metres	LB.f.ins (LB.f.ft.)	Newton Metres	LB.f.ins (LB.f.ft.)	Newton Metres	LB.f.ins (LB.f.ft.)	Newton Metres	LB.f.ins (LB.f.ft.)	
TM 1	65	600 (50)	100	900 (75)	135	1200 (100)	208	1850	90/100; 180/190
TM 2	135	1200 (100)	206	1822 (152)	278	2460 (205)	418	3700	90/100; 180/190
MT 3	230	2000 (167)	348	3080 (256)	465	4110 (342)	NA	NA	Ditto
MT 6	290	2600 (216)	444	3925 (327)	590	5240 (436)	875	7735 (644)	*90/100; 180/190 270/280; 360/370
TM 12	580	5000 (416)	880	7780 (648)	1170	10350 (862)	1750	15500 (1291)	*Ditto
MT 20	1000	9000 (750)	1530	13520 (1127)	2035	18000 (1500)	3015	26634 (2219)	*Ditto
TM 30	1485	13142 (1095)	2230	19735 (1644)	2970	26285 (2190)	4460	39472 (3289)	*Ditto
MT 50	2500	22500 (1875)	3800	33700 (2808)	5100	45000 (3750)	7486	66389 (5532)	*90/100; 180/190 270/280; 360/370
MT 100	5000	45000 (3750)	7600	67100 (5580)	10150	90000 (7500)	14972	132187 (11015)	*Ditto
TM 140	7000	62000 (5165)	10500	93000 (7750)	14000	124000 (10330)	20000	185000 (15416)	*Ditto
TM 300	15000	132000 (11000)	21400	190000 (15830)	30000	265000 (22000)	42000	375000 (31250)	*Ditto

Torqmaster Fluid Displacement Tables. The max W.P is 210 bar, MT3 is limited to 140 bar.

MODEL REF.	PER ANGULAR ROTATION			1. Cubic inches 2. Cubic Centimetres			PER 10° OF TRAVEL
	60°	90°	120°	180°	270°	360°	
TM 1	0.75 12.30	1.13 18.50	1.51 24.60	2.26 37.00	NA	NA	0.126 2.050
TM 2	1.51 24.6	2.26 37.0	3.02 49.3	4.52 74.0	NA	NA	0.252 4.100
MT 3	2.53 41.5	3.80 62.3	5.06 83.0	7.60 124.5	NA	NA	0.422 6.920
MT 6	3.24 53.10	4.87 79.8	6.48 106.2	9.74 159.6	14.61 240.0	19.48 319.2	0.540 8.85
TM 12	6.61 108.3	9.92 162.50	13.20 216.5	19.84 324.9	29.76 487.5	39.68 650.0	1.100 18.100
MT 20	11.40 186.5	17.10 280.1	22.80 373.0	34.20 560.2	51.30 840.3	68.40 1,120.4	1.90 31.10
TM 30	16.44 270	24.66 405	32.88 540	49.32 810	73.98 1215	98.64 1620	2.74 45
MT 50	28.0 458.5	42.0 688.0	56.0 917.0	84.0 1,376.0	126.0 2,064.0	168.0 2,752.0	4.67 76.50
MT 100	56.0 917.0	84.0 1,376.0	112.0 1,833.0	168.0 2,752.0	252.0 4,128.0	336.0 5,504.0	9.35 153.0
TM 140	76.5 1253	114.7 1880	153.0 2507	229.5 3760	344.2 5640	459.0 7521	12.75 208.9
TM 300	169.3 2775	253.9 4162	338.6 5549	507.9 8324	761.9 12485	1016.0 16,647	28.22 462.4

Note: For displacement per CYCLE double the above figures.

*Max. operating speed*

2 port models 30 reversals/min at reduced Working Pressures (70 BAR subject to application approval)

4 port models 60 reversals/min at reduced Working Pressures (70 BAR subject to application approval)

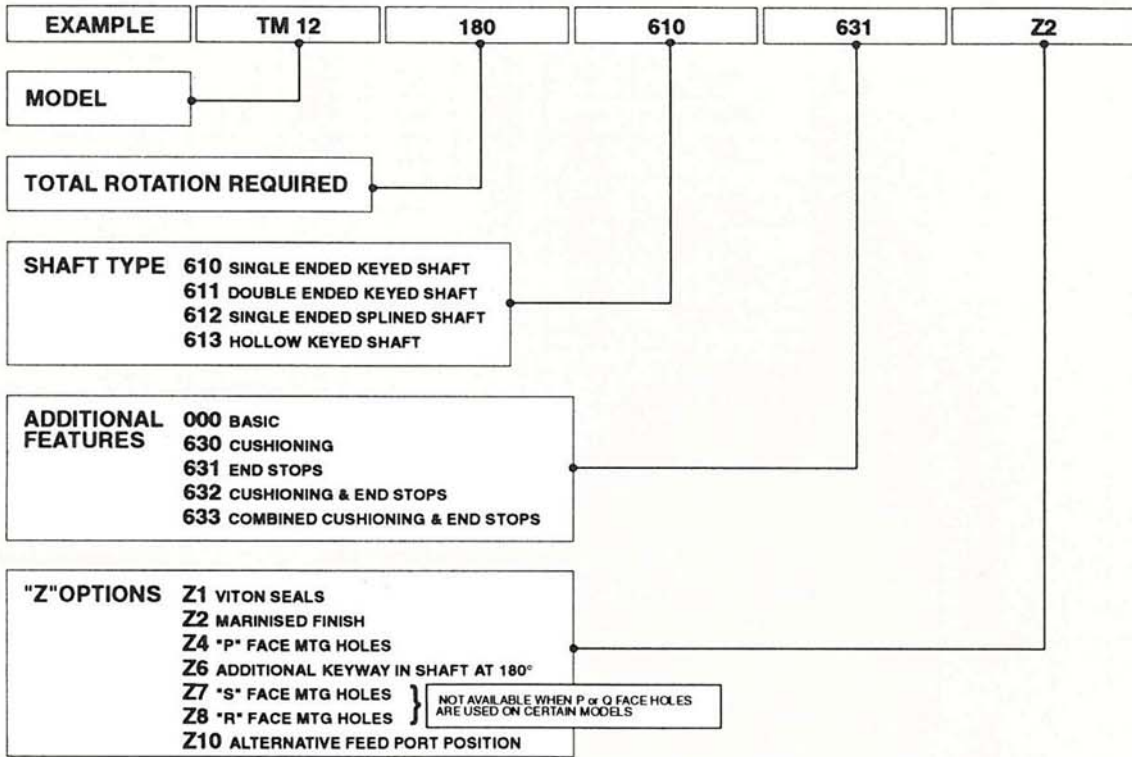
For higher operating speeds consult Forward Industries Technical Department

### Valve Actuator Variant

MODEL REF.	Basic Actuator		Spring Return Actuator			
	Max Torque		Spring Torque Closing Valve		Pressure to Open Valve	
	210 Bar	3000 psi	NM	lb.ins.	NM	lb.ins.
VA 1	208	1850	32.5	288	110	1600
VA 2	418	3700	65	575	110	1600
VA 3	465*	4110*	77	680	90	1300
VA 6	875	7735	120	1062	110	1600
VA 12	1750	15500	226	2000	100	1450
VA 20	3015	26634	365	3230	90	1300
VA 30	4460	39470	550	5310	110	1600
VA 50	7486	66389	1000	8850	90	1300
VA 100	14972	132187	2000	17700	90	1300
VA 140	2000	185000	3246	28727	110	1600
VA 300	42000	375000	6000	53100	110	1600

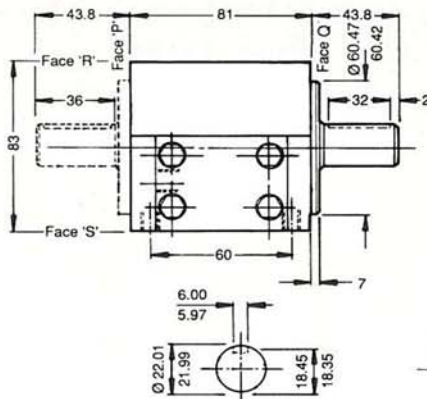
\*The Max Working Pressure on VA3 is 140 BAR (2000 p.s.i.)

# METHOD OF ORDERING

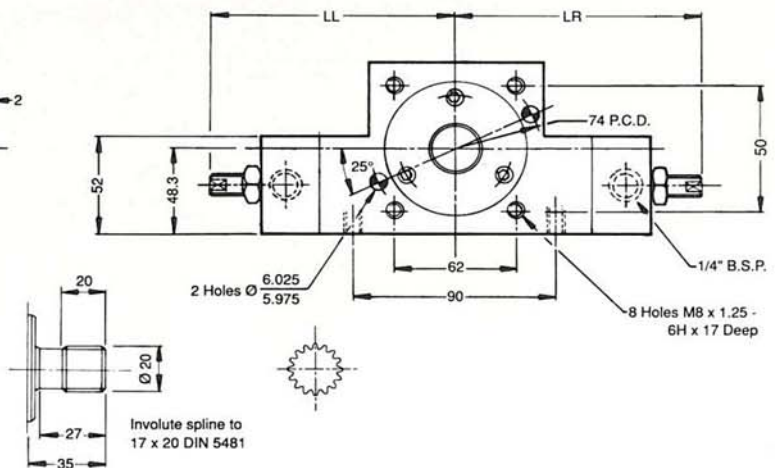


## TM 1

	REF 630		REF 631		MODEL WT		
	BASIC		CUSHIONED			END STOPS	
	LL	LR	LL	LR		LL	LR
90° & 100°	85	85	97	97	108	108	5.7 Kg
120° & 130°	108	108	121	121	132	132	7.15 Kg
180° & 190°	108	108	121	121	132	132	7.05 Kg



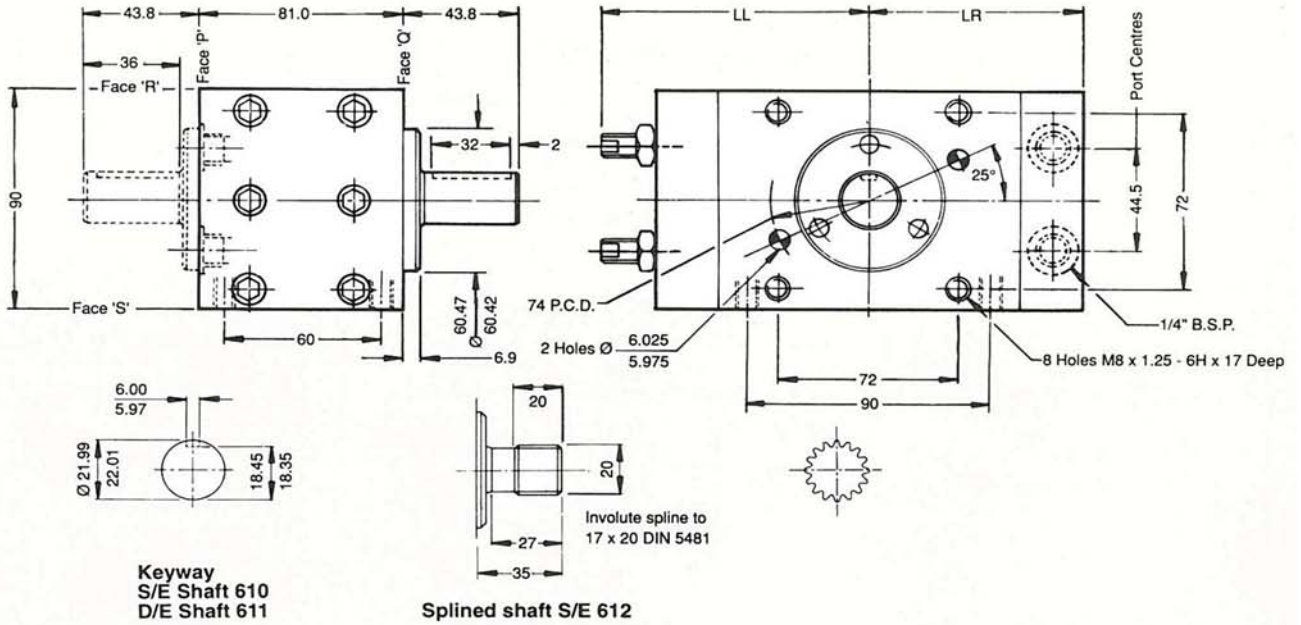
Keyway  
S/E Shaft 610  
D/E Shaft 611



Splined shaft S/E 612

# TM 2

	REF 630		REF 631		REF 632		MODEL WT		
	BASIC		CUSHIONED		END STOPS				
	LL	LR	LL	LR	LL	LR			
90° & 100°	85	85	85	97	108	85	108	97	6.6 Kg
120° & 130°	108	108	108	121	132	108	132	121	8.8 Kg
180° & 190°	108	108	108	121	132	108	132	121	8.6 Kg

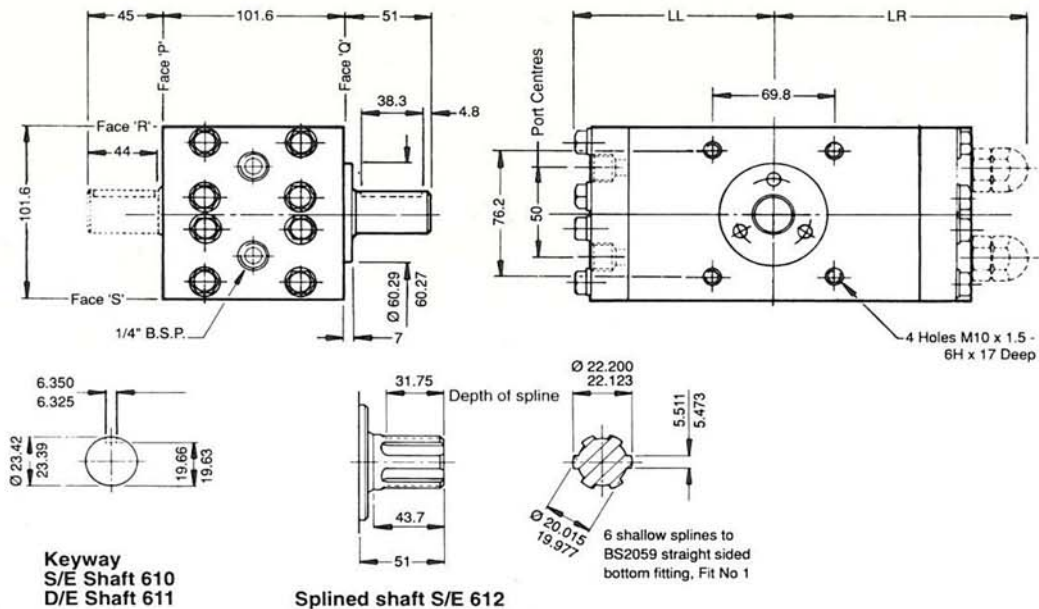


Keyway and spline shown at middle of stroke

# MT 3

MAX PRESSURE 140 BAR

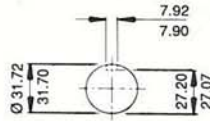
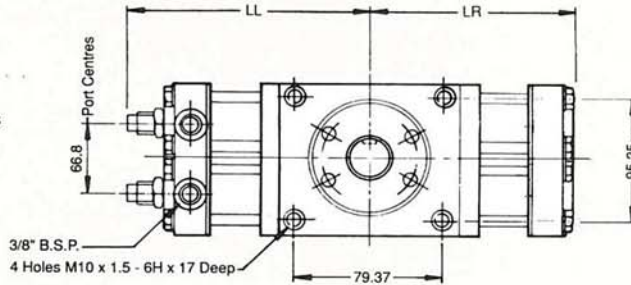
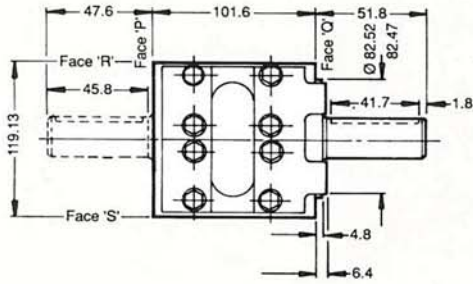
	REF 630		REF 631		REF 632		MODEL WT		
	BASIC		CUSHIONED		END STOPS				
	LL	LR	LL	LR	LL	LR			
90° & 100°	86	86	93	86	86	159	93	159	11 Kg
120° & 130°	102	102	109	102	102	175	109	175	13 Kg
180° & 190°	109	109	117	109	109	182	117	182	14 Kg



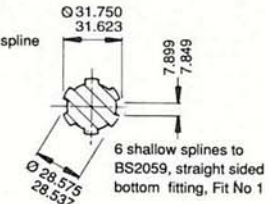
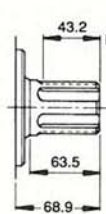
Keyway and spline shown at middle of stroke

# MT 6

	REF 630		REF 631		REF 632		MODEL WT		
	BASIC		CUSHIONED		END STOPS			CUSHIONED & END STOPS	
	LL	LR	LL	LR	LL	LR		LL	LR
90° & 100°	140	140	140	140	181	140	181	140	15.9 Kg
120° & 130°	164	164	164	164	205	164	205	164	16.5 Kg
180° & 190°	175	175	175	175	216	175	216	175	17 Kg
270° & 280°	210	210	210	210	251	210	251	210	18.1 Kg
360° & 370°	245	245	245	245	286	245	286	245	19.5 Kg



**Keyway  
S/E Shaft 610  
D/E Shaft 611**

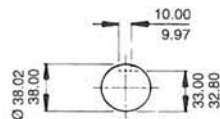
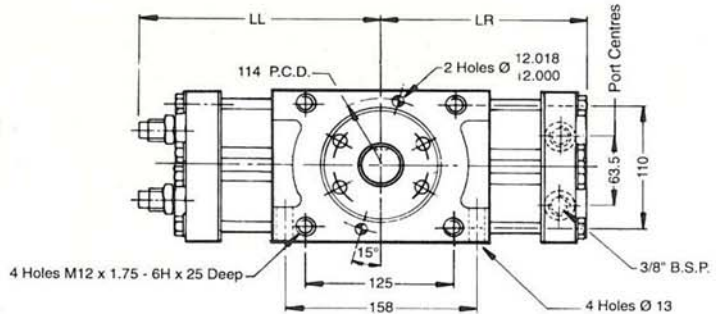
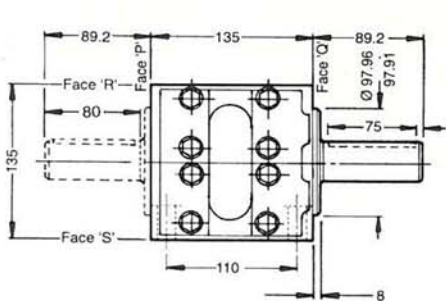


**Splined shaft S/E 612**

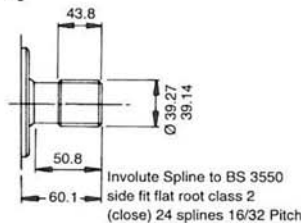
Keyway and spline shown at middle of stroke

# TM 12

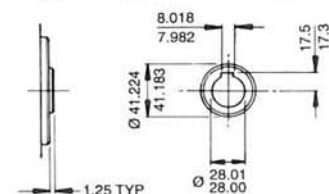
	REF 630		REF 631		REF 632		REF 633		MODEL WT		
	BASIC		CUSHIONED		END STOPS		CUSHIONED & END STOPS			Combined Cushions & End Stops	
	LL	LR	LL	LR	LL	LR	LL	LR		LL	LR
90° & 100°	133	133	133	142	176	133	176	142	211	133	27 Kg
120° & 130°	160	160	160	169	202	160	202	169	237	160	31 Kg
180° & 190°	174	174	174	183	216	174	216	183	251	174	34 Kg
270° & 280°	247	247	247	247	276	247	276	247	311	247	39 Kg
360° & 370°	267	267	267	267	296	267	296	267	331	267	42 Kg



**Keyway  
S/E Shaft 610  
D/E Shaft 611**



**Splined shaft S/E 612**

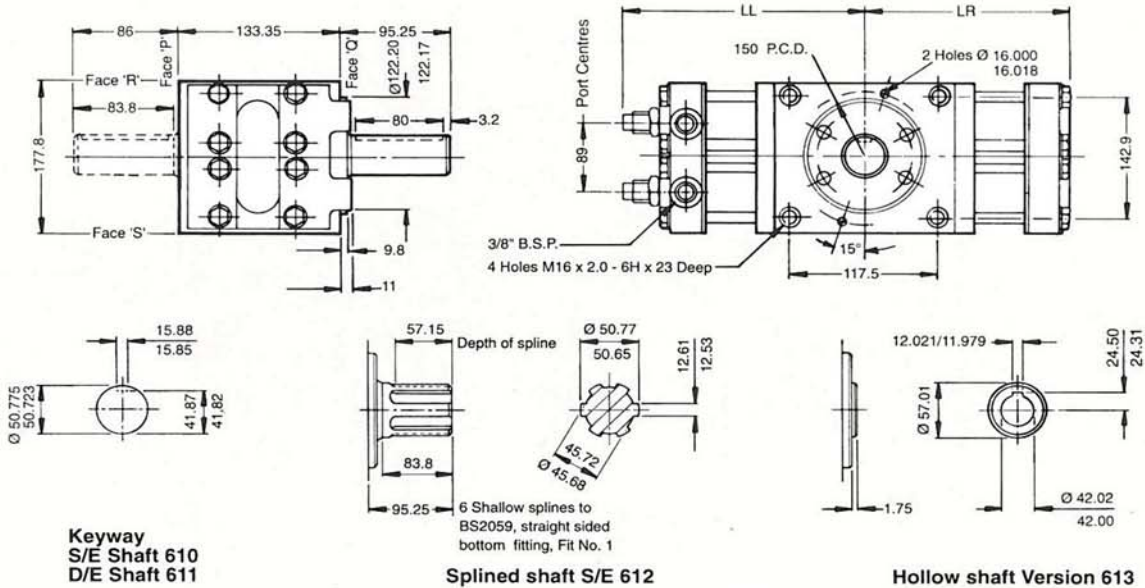


**Hollow shaft 613**

Keyway and spline shown at middle of stroke

# MT 20

	REF 630		REF 631		REF 632		MODEL WT		
	BASIC		CUSHIONED		CUSHIONED & END STOPS				
	LL	LR	LL	LR	LL	LR			
90° & 100°	186	186	186	186	235	186	235	186	42.5 Kg
120° & 130°	222	222	222	222	271	222	271	222	44 Kg
180° & 190°	239	239	239	239	288	239	288	239	46 Kg
270° & 280°	293	293	293	293	342	293	342	293	50 Kg
360° & 370°	346	346	346	346	395	346	395	346	53.5 Kg



Keyway  
S/E Shaft 610  
D/E Shaft 611

Splined shaft S/E 612

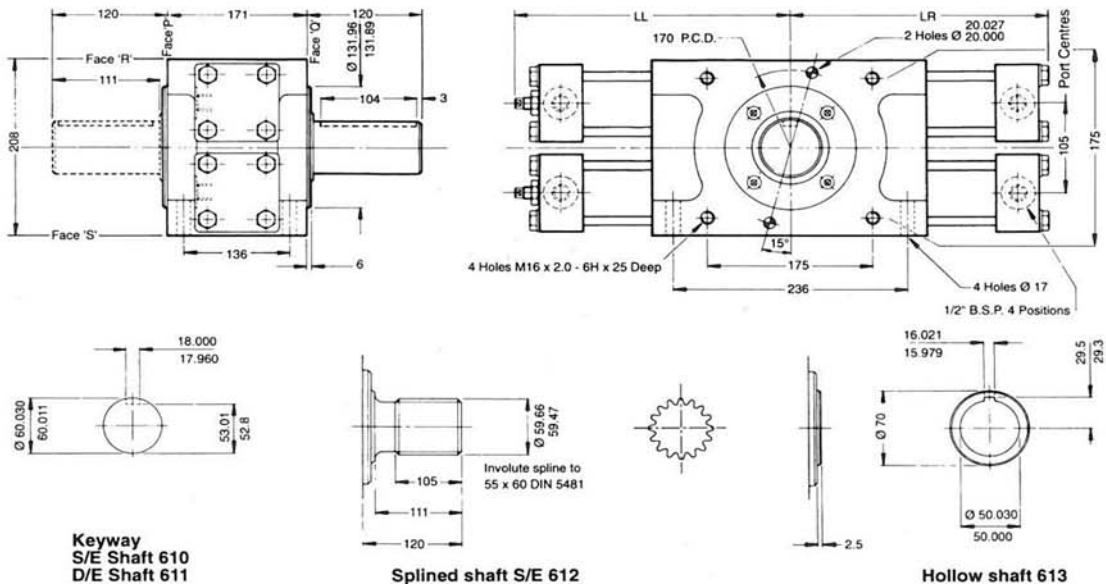
Hollow shaft Version 613

Keyway and spline shown at middle of stroke

# TM 30

## 4 PORT ACTUATOR

	REF 633				MODEL WT
	BASIC		Combined Cushions & End Stops		
	LL	LR	LL	LR	
90° & 100°	198	198	268	198	95 Kg
120° & 130°	242	242	310	242	115 Kg
180° & 190°	262	262	332	262	128 Kg
270° & 280°	358	358	426	358	140 Kg
360° & 370°	390	390	460	390	155 Kg



Keyway  
S/E Shaft 610  
D/E Shaft 611

Splined shaft S/E 612

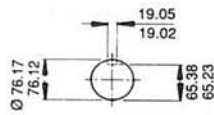
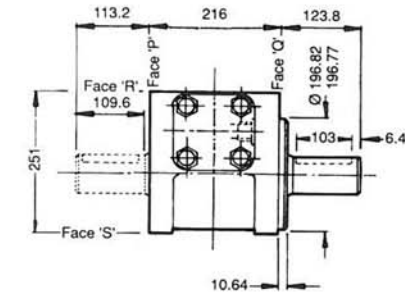
Hollow shaft 613

Keyway and spline shown at middle of stroke

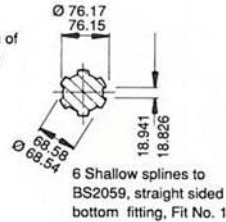
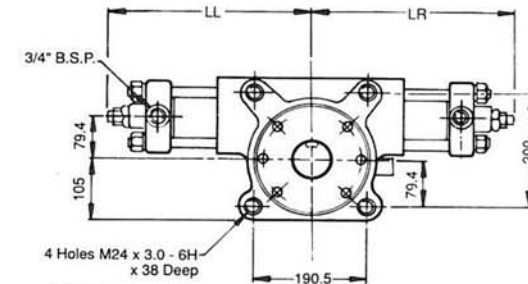
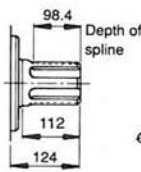


# MT 50

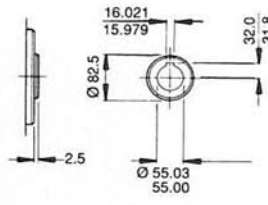
	REF 630		REF 631		REF 633		MODEL WT	
	BASIC		CUSHIONED		END STOPS			
	LL	LR	LL	LR	LL	LR		
90° & 100°	326	326	326	326	393	393	384	94 Kg
120° & 130°	399	399	399	399	466	466	457	103 Kg
180° & 190°	435	435	435	435	502	502	493	106 Kg
270° & 280°	545	545	545	545	612	612	603	118 Kg
360° & 370°	655	655	655	655	722	722	713	131 Kg



**Keyway**  
S/E Shaft 610  
D/E Shaft 611



**Splined shaft S/E 612**

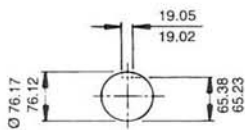
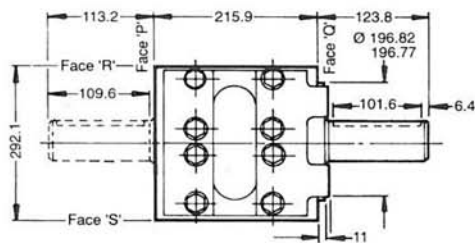


**Hollow shaft 613**

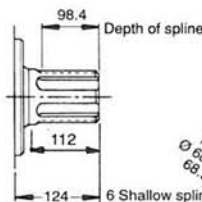
Keyway and spline shown at middle of stroke

# MT 100

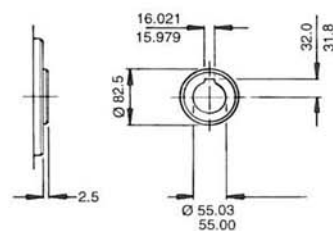
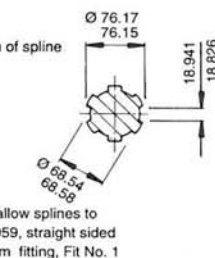
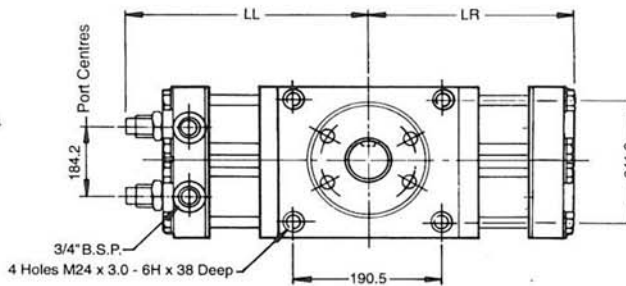
	REF 630		REF 631		REF 632		MODEL WT	
	BASIC		CUSHIONED		CUSHIONED & END STOPS			
	LL	LR	LL	LR	LL	LR		
90° & 100°	326	326	326	326	393	326	326	176 Kg
120° & 130°	399	399	399	399	466	399	399	193 Kg
180° & 190°	435	435	435	435	502	435	435	199 Kg
270° & 280°	545	545	545	545	612	545	545	222 Kg
360° & 370°	655	655	655	655	722	655	655	245 Kg



**Keyway**  
S/E Shaft 610  
D/E Shaft 611



**Splined shaft S/E 612**

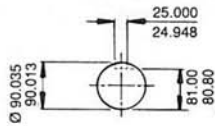
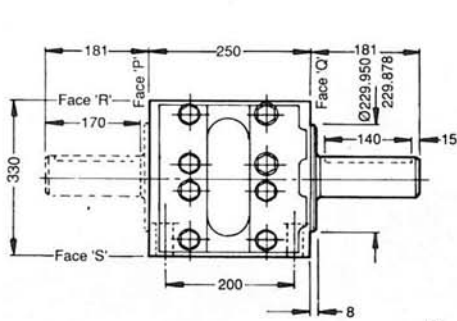


**Hollow shaft 613**

Keyway and spline shown at middle of stroke

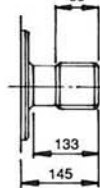
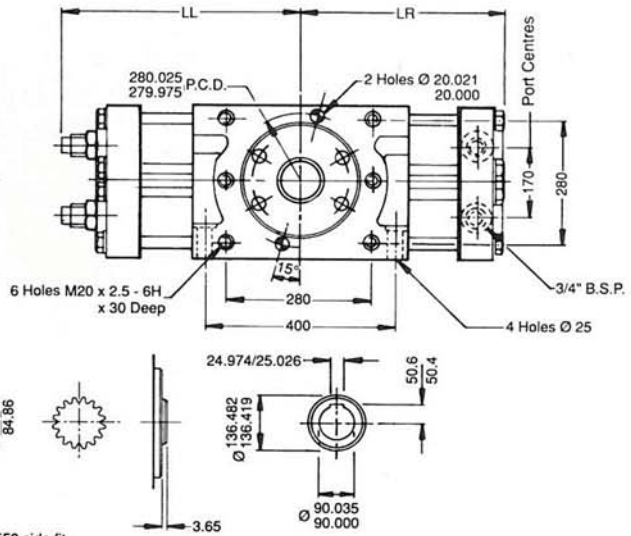
# TM 140

	REF 630		REF 631		REF 632		REF 633		MODEL WT		
	BASIC		CUSHIONED		END STOPS		CUSHIONED & END STOPS				
	LL	LR	LL	LR	LL	LR	LL	LR			
90° & 100°	335	335	335	335	398	335	398	335	461	335	246 Kg
120° & 130°	415	415	415	415	478	415	478	415	541	415	269 Kg
180° & 190°	454	454	454	454	517	454	517	454	580	454	279 Kg
270° & 280°	634	634	634	634	697	634	697	634	756	634	311 Kg
360° & 370°	694	694	694	694	757	694	757	694	820	694	344 Kg



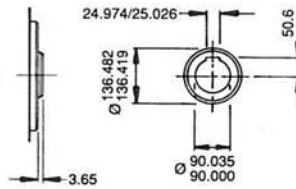
**Keyway**  
S/E Shaft 610  
D/E Shaft 611

Keyway and spline shown at middle of stroke



Involute spline to BS 3550 side fit, flat roof, class 2 (Close), 26 splines 8/16 pitch.

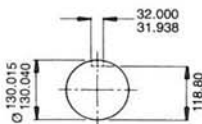
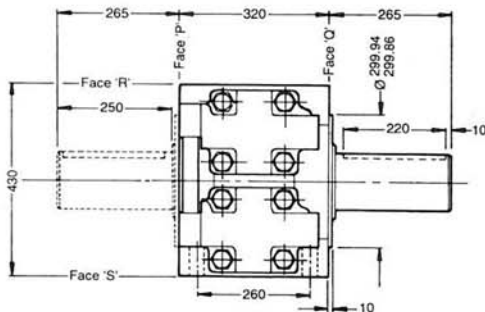
**Splined shaft Version S/E 612**



**Hollow shaft Version 613**

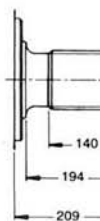
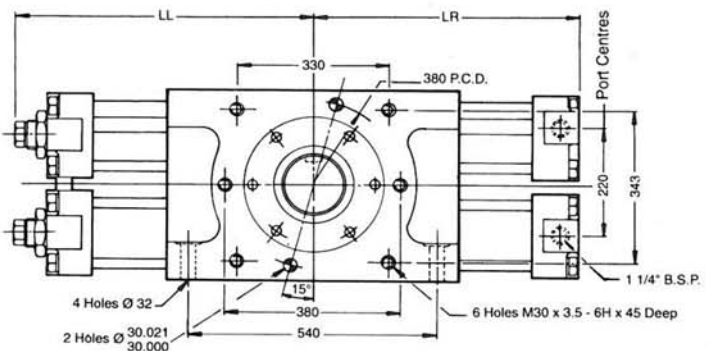
# TM 300

	REF 630		REF 631		REF 632		REF 633		MODEL WT		
	BASIC		CUSHIONED		END STOPS		CUSHIONED & END STOPS				
	LL	LR	LL	LR	LL	LR	LL	LR			
90° & 100°	415	415	415	415	553	415	553	415	613	415	458 Kg
120° & 130°	521	521	521	521	659	521	659	521	719	521	495 Kg
180° & 190°	575	575	575	575	712	575	712	575	772	575	518 Kg
270° & 280°	814	814	814	814	952	814	952	814	1012	814	578 Kg
360° & 370°	895	895	895	895	1032	895	1032	895	1092	895	638 Kg



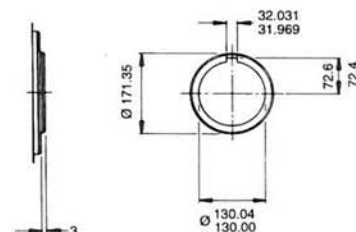
**Keyway**  
S/E Shaft 610  
D/E Shaft 611

Keyway and spline shown at middle of stroke



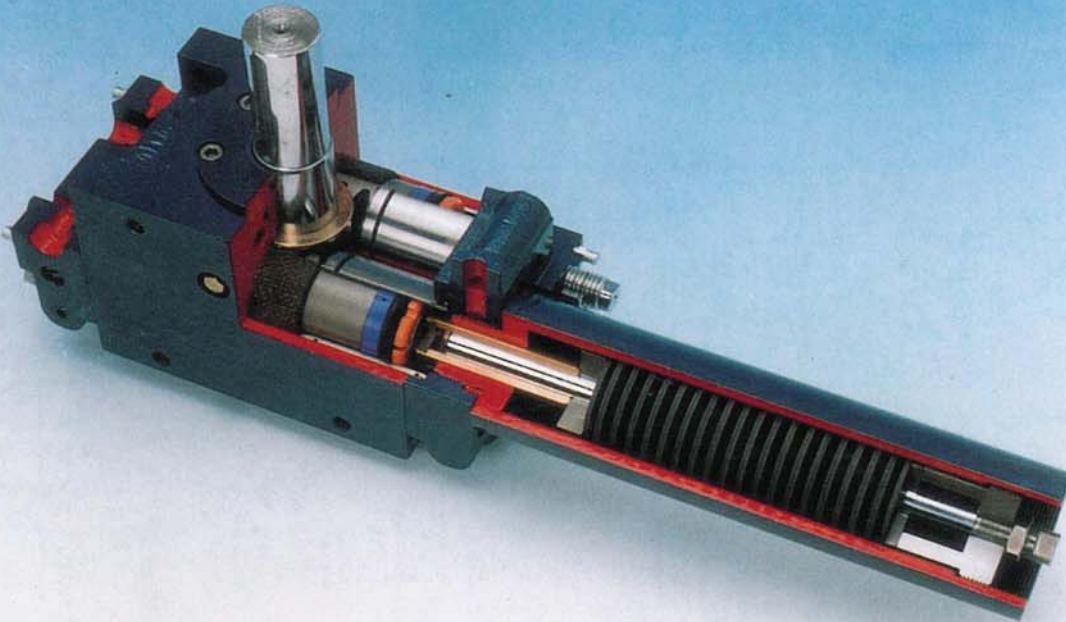
Involute spline to BS 3550 side fit, flat roof, class 2 (Close), 31 splines 6/12 pitch.

**Splined shaft Version S/E 612**



**Hollow shaft Version 613**

## Special Purpose Designs



The Torqmaster precision built high quality semi rotary actuator can be tailored to suit individual applications. Special features include, shaft interfaces, valve mountings, non standard rotations, end of stroke electrical switches and potentiometers.

We have a history of over thirty years in the supply of actuators for Oil Tankers, Offshore Safety Systems, Submarine control valve actuators and wide ranging industrial applications.

Forward Industries also manufacture the BENMAR rack and pinion actuator which is widely accepted by Lloyds, U.S.C.G., DNV, Bureau Veritas, RINA and all leading classification Societies. Please ask our sales department for details of our BENMAR product range.



### **Mini Actuators**

We also manufacture a low cost range of light duty actuators for such application as Camera Tilts, Tooling Clamps, Mobile Lift Baskets and general Industrial Automation Applications. Please ask our technical department for more details.