FLOWSERVE®

VALTEK®

Spring Cylinder Rotary Actuators

Valtek Spring Cylinder Rotary Actuators
Introduction

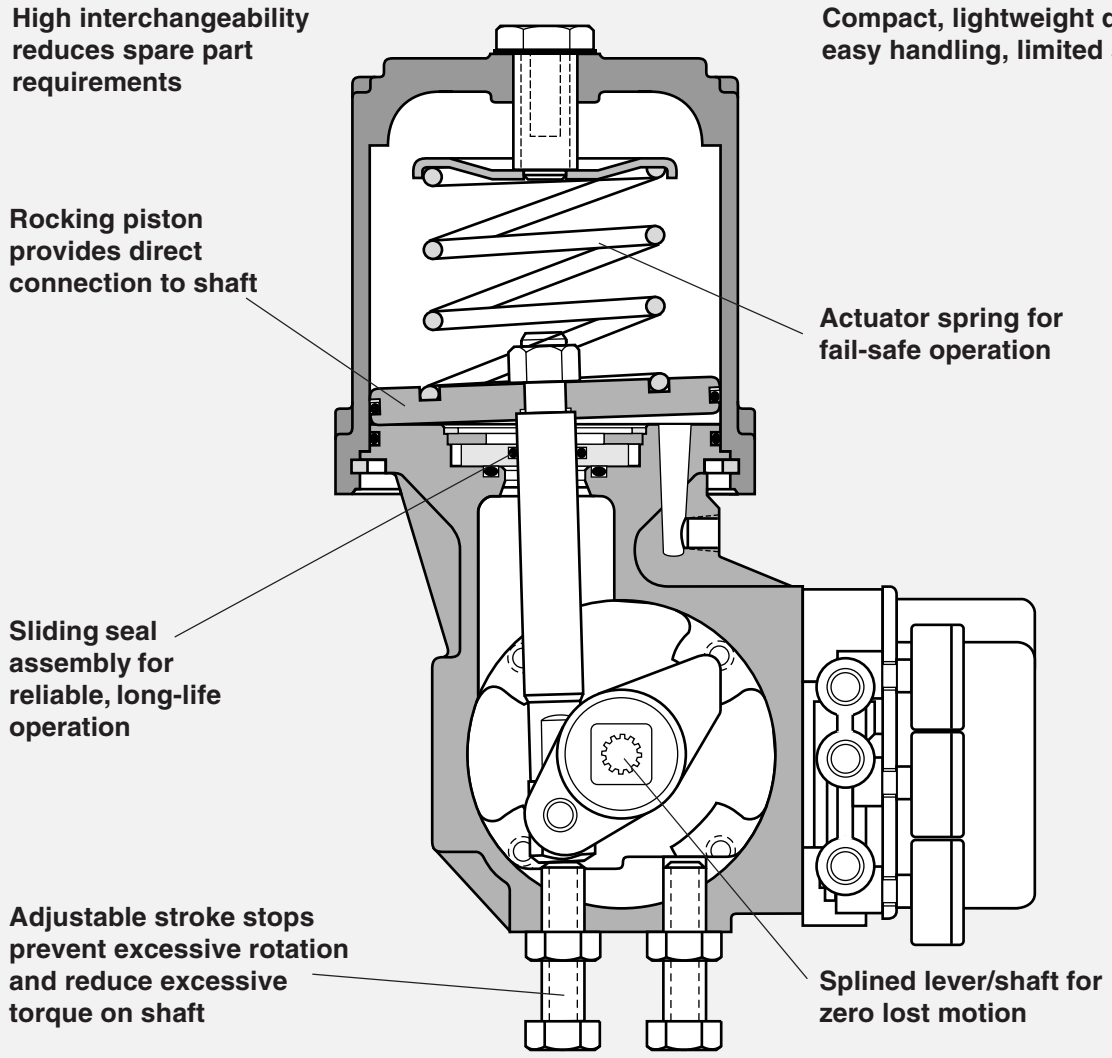

Figure 1: Spring Cylinder Rotary Actuator Features

The Valtek® spring cylinder rotary actuator combines high torque and pneumatic stiffness with excellent throttling capabilities. These characteristics are designed into a lightweight, rugged and compact assembly, making the Valtek rotary actuator the foremost choice for quarter-turn applications. The Valtek rotary actuator is designed to operate the Valdisk high-performance butterfly valve, the ShearStream V-notch ball valve, or other applications requiring precise rotary motion. Valtek pneumatic and electro-pneumatic positioners are available for throttling applications.

The Valtek actuator, cylinder and positioner are designed for supply pressures up to 150 psi* (10.3 bar), making very high torques attainable. The actuator uses a rocking piston for direct conversion of linear motion to rotary motion. The rocking piston assembly combined with a splined shaft and lever eliminates lost motion.

*(*See Tables I and II for limitations on certain sizes.)*

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Valtek Spring Cylinder Rotary Actuators
Features and Advantages

The Valtek spring cylinder rotary actuator features high torques, positioning stiffness and easy maintenance to produce a high-performance rotary actuator that excels in maintenance-free throttling and on/off control applications.

Features	**Advantages**
Accepts up to 150 psi (10.3 bar) air supply	Achieves higher torques Obtains stiff piston positioning Permits higher ΔP limits on valve
Rocking piston	Provides direct connection to shaft Assures zero lost motion between actuator and valve Utilizes fewer parts
Splined shaft and lever	Allows zero lost motion
Compact, lightweight, rugged	Permits easy maintenance Installs in limited space applications Easily meets seismic requirements
Low-friction bearings	Provide millions of cycles with minimal wear Combined with direct linkage, provides very low hysteresis
Field-reversible	Requires no extra parts Permits fast, easy field reversing of air action Requires no change of spring action
Fail-safe spring	Moves actuator to failure position without pressure assistance
Air-purged, fully enclosed transfer case	Prevents corrosion of linkage Ensures safe operation Contains external position indicator Allows four mounting positions without retubing, changing or adding parts
Stroke stops	Allow both ends of stroke to be adjusted
Interchangeability	Minimizes requirements for stocking spare parts Reduces inventory costs Uses identical parts in differing rotary actuator sizes Utilizes many Valtek linear actuator parts
Spool-type four-way positioner	Provides high-performance modulating positioner control Ensures ease of calibration and maintenance due to fewer parts

Valtek Spring Cylinder Rotary Actuators
Stiffness and Performance

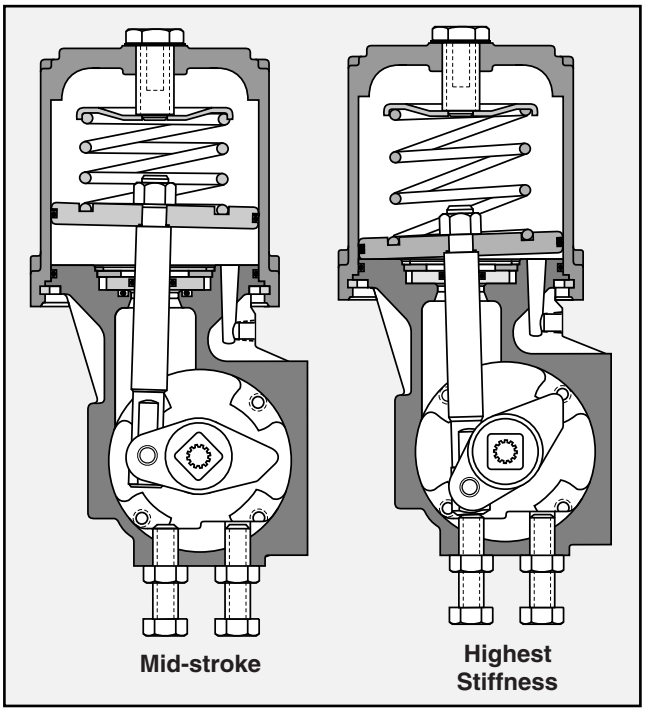

Figure 2: Actuator Position

Control valves generally are used by the process control industry to regulate constantly fluctuating flows. As the dynamic forces of a flow increase or decrease, the control valve must remain in the same position as dictated by the controller. To do this, the valve is dependent upon the actuator stiffness to minimize these position fluctuations.

Actuator stiffness is defined as the ability of the actuator to withstand suddenly changing dynamic fluid forces acting on the valve trim.

Since supply air pressure is delivered to both sides of the piston in the cylinder, the stiffness of the Valtek spring cylinder rotary actuator is significantly greater than that of a diaphragm actuator.

The stiffness (spring rate) is equal to the expression:

$$K = \frac{kPA^2}{v}$$

Where: K = spring rate
k = ratio of specific heat
P = supply pressure
A^2 = piston area (in^2)
v = cylinder volume under piston

For a size 25 cylinder actuator (typical for a 2-inch DN25 valve) with a supply air pressure of 100 psi (6.9 bar), the spring rate would be nearly 10,000 pounds per inch (11,500 kg/cm) near the seat. As the volume under the piston becomes smaller, the stiffness factor becomes larger in the Valtek spring cylinder rotary actuator. The result of the higher actuator stiffness in cylinder actuators is that rotary valves can be operated in the flow-to-close orientation without position fluctuations caused by dynamic forces (flow fluctuations).

The spring rate for a diaphragm actuator remains the same, regardless of diaphragm position. The equivalent diaphragm actuator (46 in^2 / 298 cm^2) on the same valve with a 3-15 psi (0.2-1 bar) signal has a spring rate of less than 1000 pounds per inch (11.50 kg/cm). When a rotary valve with a diaphragm actuator is operated near its closed position, sudden changes in dynamic force can cause the valve to slam shut.

In contrast, the stiffness of the Valtek spring cylinder rotary actuators actually increases as the closing member approaches the seating surface (Figure 2). Thus, the Valtek rotary actuators and rotary valves may be operated with the valve shaft upstream or downstream.

Torque Producing Capability

The Valtek spring cylinder rotary actuator produces substantially higher torque than a comparable diaphragm actuator because the cylinder operates with supply pressures up to 150 psi (10.3 bar). Throttling diaphragm actuators are limited to 40-60 psi (2.8-4.1 bar) thus, decreasing their torque-producing capability. Higher actuator air supply, coupled with high-pressure air on both sides of the actuator piston, provide exceptional stiffness for precise throttling control. The Valtek rotary actuator stiffness is sufficient to control high pressure drops and to permit the valve to throttle near the seat.

Cam Characterizable Operation

The Valtek standard Beta positioner is provided with a reversible cam that characterizes Valdisk's C_V to either modified equal percent or linear performance. The same cam enhances the ShearStream control valve's inherent equal percent characteristic.

A second rotary cam is also available. This optional cam provides ShearStream valves a linear relationship of rotation with respect to the controller signal. It is reversible for use in air-to-close or air-to-open, fail-open applications and is also linear in this mode.

Valtek Spring Cylinder Rotary Actuators
Performance and Options

Speed and Sensitivity

The high air-handling capacity of the positioner, combined with relatively low cylinder volumes, produces fast stroking speeds. High operating speed is achieved with virtually no overshoot when approaching the final disc or ball position. At the same time, static sensitivity of the unit is excellent. For example, as little as 0.017 psi (0.0017 bar) is required to rotate the shaft 0.01 degrees (the minimum detectable movement in the tests conducted) on a size 25 actuator. A signal change of only 0.02 psi (0.0014 bar) is required to reverse shaft motion.

Frequency Response

The frequency response of Valtek cylinder actuators is extremely high – generally an order of magnitude better than comparable diaphragm actuator units. Such response is achieved through a double-acting configuration that uses pressure on both sides of the piston.

Size 25 Actuator, 9 psi ± 2 psi (0.6 bar ± 0.13 bar)

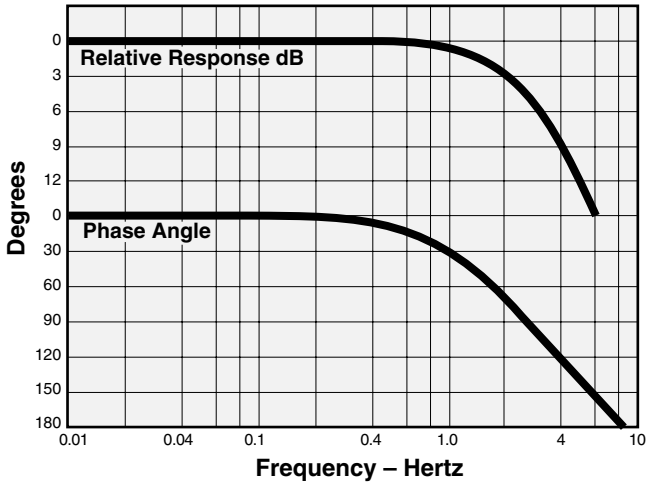

Figure 3: Frequency Response

Hysteresis and Repeatability

An important characteristic of any actuator is its ability to respond to signal changes from the controller and to give uniform response unaffected by decreasing or increasing pressures. Tests have shown that both the hysteresis and repeatability of the spring cylinder rotary actuator, (with Beta positioner) are less than 0.7 percent of full scale. (See *Table VII: Beta Positioner Performance* on page 10.)

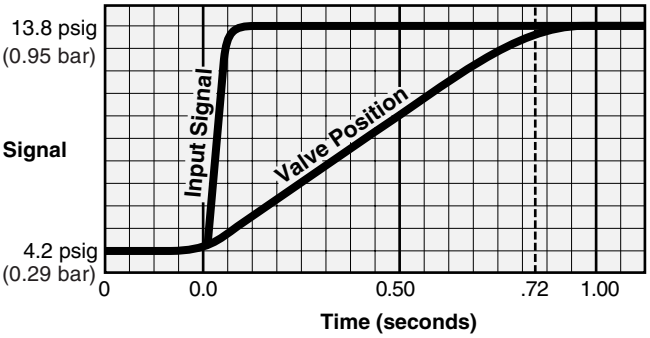

Figure 4: Step Test, Size 25 Actuator

Declutchable Handwheel Actuator

The declutchable handwheel is designed to override the actuator in case of air failure or if manual operation is desired. This unit has a special high-output worm gear that develops as much torque as the standard Valtek pneumatic rotary actuator.

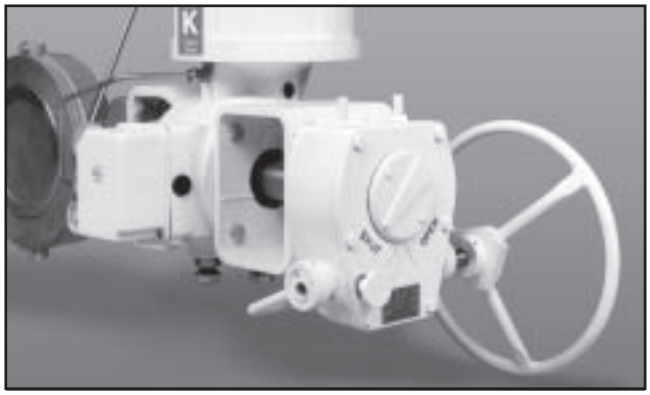

Figure 5: Declutchable Handwheel

Manual Handwheel Actuator

For applications requiring infrequent but reliable operation, a high-torque, manual handwheel actuator is available. Three sizes are available to match the torque requirements of any application. The sealed housing is made of cast iron and filled with grease for maintenance-free operation.

Heavy-duty Springs

For high shutoff pressure, heavy-duty springs are available. A spring cap installed in the cylinder is used for high pressure drop applications, requiring the installation of the longer heavy-duty spring. The same spring can be used for both fail-open and fail-closed applications. Dual springs are available with size 100 and 200 rotary actuators.

Valtek Spring Cylinder Rotary Actuators
Torque Output

Table I: Net Torque Output of Actuators at Various Supply Pressures, lbs/in (kg/cm)

Actuator Size	Supply Pressure		Degrees from Fail Position on Air Supply Loss																			
	psi	bar	0		10		20		30		40		50		60		70		80		90	
STD 25	150	10.3	3013	3471	3399	3916	3700	4262	3907	4501	4000	4608	3970	4573	3811	4390	3514	4048	3084	3553	2532	2917
with	140	9.7	3808	4387	3165	36467	3444	39677	3631	4183	3714	4279	3685	4245	3531	4068	3253	3747	2854	3288	2339	2695
STD	120	8.3	2397	2761	2695	3105	2928	3373	3080	3548	3145	3623	3110	3583	2972	3424	2731	3146	2390	2753	1962	2260
Spring	100	6.9	1986	2288	2228	2567	2412	2779	2530	2915	2573	2964	2535	2920	2414	2781	2211	2547	1928	2221	1577	1817
	80	5.5	1574	1813	1759	2026	1896	2184	1979	2280	2002	2306	1961	2259	1856	2138	1688	1945	1463	1685	1191	1372
	60	4.1	1163	1340	1290	1486	1381	1591	1428	1645	1430	1647	1386	1597	1298	1495	1167	1344	1001	1153	806	929
Spring Torque			72	83	115	132	167	192	225	259	284	327	338	389	379	437	399	460	391	450	349	402
STD 25	150	10.3	2647	3049	2973	3425	3223	3713	3386	3901	3448	3972	3403	3920	3246	3739	2976	3428	2600	2995	2124	2447
with	140	9.7	2441	2812	2738	3154	2964	3415	3110	3583	3162	3643	3115	3589	2966	3416	2716	3129	2368	2728	1931	2225
HD	120	8.3	2030	2339	2270	2615	2450	2822	2558	2947	2590	2984	2542	2928	2409	2775	2195	2529	1905	2195	1552	1788
Spring	100	6.9	1618	1864	1802	2076	1934	2228	2009	2314	2020	2327	1967	2266	1850	2131	1673	1927	1441	1660	1167	1344
	80	5.5	1206	1389	1333	1536	1418	1634	1457	1678	1448	1668	1392	1604	1292	1488	1151	1326	978	1127	781	900
	60	4.1	795	916	865	996	902	1039	907	1045	877	1010	818	942	733	844	630	726	515	593	396	456
Spring Torque			440	507	542	624	647	745	749	863	839	967	908	1046	945	1089	937	1079	878	1011	758	873
STD 50	150	10.3	10701	12328	1198	13802	13015	14993	13751	15841	14134	16282	14089	16231	13575	15638	12568	14478	11043	12722	9035	10408
with	140	9.7	9970	11485	11157	12853	12114	13955	12798	14743	13136	15133	13083	15072	12596	14511	11653	13424	10232	11787	8365	9636
STD	120	8.3	8516	9810	9513	10959	10318	11886	10874	12527	11141	12834	11075	12758	10649	12268	9826	11320	8615	9924	7053	8125
Spring	100	6.9	7059	8132	7873	9070	8515	9809	8953	10314	9153	10544	9073	10453	8693	10014	7999	9215	6995	8058	5712	6580
	80	5.5	5602	6454	6227	7174	6716	7737	7033	8102	7156	8244	7062	8135	6736	7760	6174	7112	5372	6189	4373	5038
	60	4.1	4147	4777	4586	5283	4913	5660	5114	5891	5166	5951	5058	5827	4784	5511	4347	5008	3755	4326	3034	3495
Spring Torque			222	256	343	395	489	563	651	750	816	940	966	1113	1081	1245	1134	1306	1107	1275	983	1132
STD 50	150	10.3	9774	11260	10898	12555	11781	13572	12380	14262	12651	14574	12533	14438	12000	13824	11036	12713	9648	11115	7850	9043
with	140	9.7	9044	10419	10074	11605	10880	12534	11425	13162	11652	13423	11527	13279	11021	12696	10122	11661	8837	10180	7183	8275
HD	120	8.3	7591	8745	8430	9711	9083	10464	9502	10946	9657	11125	9519	10966	9073	10452	8300	9562	7216	8313	5865	6756
Spring	100	6.9	6133	7065	6790	7822	7281	8388	7585	8738	7668	8834	7516	8658	7117	8199	6473	7457	5597	6448	4527	5215
	80	5.5	4678	5389	5148	5931	5481	6314	5660	6520	5671	6533	5508	6345	5163	5948	4646	5352	3974	4578	3186	3670
	60	4.1	3223	3713	3505	4038	3681	4241	3741	4310	3680	4239	3501	4033	3209	3697	2821	3250	2356	2714	1846	2127
Spring Torque			1148	1323	1428	1645	1726	1988	2026	2334	2304	2654	2529	2913	2662	3067	2667	3072	2511	2893	2167	2496
STD 100	150	10.3	26194	30175	29415	33886	32022	36889	33847	38992	34730	40009	34559	39812	33234	38286	30711	35379	26943	31038	22035	25384
with	140	9.7	24385	28092	27397	31561	29784	34311	31459	36241	32253	37155	32069	36943	30831	35517	28446	32770	26936	31030	20378	23475
STD	120	8.3	20805	23967	23329	26875	25330	29180	26685	30741	27303	31453	27104	31224	25983	29932	23921	27557	20932	24114	17119	19721
Spring	100	6.9	17226	19844	19271	22200	20859	24030	21914	25245	22368	25768	22119	25481	21134	24346	19394	22342	16920	19492	13808	15907
	80	5.5	13640	15713	15200	17510	16399	18892	17153	19760	17413	20060	17133	19737	16296	18773	14878	17139	12915	14878	10485	12079
	60	4.1	10055	11583	11139	12832	11929	13742	12391	14274	12472	14368	12159	14007	11447	13187	10350	11923	8901	10254	7167	8256
Spring Torque			704	811	1049	1208	1461	1683	1913	2204	2370	2730	2783	3206	3088	3557	3225	3715	3135	3612	2775	3197
STD 100	150	10.3	24678	28429	27231	31370	29008	33417	29925	34474	29917	34464	28969	33373	27058	31171	24266	27954	20699	23845	16483	18988
with	140	9.7	22881	26359	25195	29025	26771	30840	27539	31725	27459	31633	26475	30499	24632	28376	22001	25345	18691	21532	14832	17086
Dual	120	8.3	19304	22238	21127	24338	22317	25709	22784	26247	22507	25928	21490	24756	19782	22789	17472	20128	14680	16911	11563	13321
Springs	100	6.9	15713	18101	17070	19665	17847	20560	18012	20750	17567	20237	16518	19029	14946	17218	12956	14925	10674	12296	8245	9498
	80	5.5	12130	13974	12999	14975	13385	15420	13248	15262	12612	14529	11538	13292	10101	11636	8432	9714	6662	7675	4927	5676
	60	4.1	8545	9844	8939	10298	8921	10277	8483	9772	7673	8840	6558	7555	5257	6056	3910	4504	2662	3067	1611	1856
Spring Torque			2217	2554	3256	3751	4485	5167	5831	6718	7185	8277	8405	9683	9299	10712	9691	11165	9407	10837	8316	9580
STD 200	80	5.5	27695	31905	31132	35864	33903	39056	35838	41285	36820	42417	36663	42236	35280	40643	32620	37578	28633	32985	23416	26976
with	70	4.8	24156	27828	27119	31241	29480	33961	31134	35866	31916	36767	31730	36553	30501	35137	28139	32416	25670	29572	20206	23277
STD	60	4.1	20595	23725	23091	26601	25069	28879	26406	30420	27014	31120	26813	30889	25699	29605	24656	28404	20697	23843	16926	19499
Spring	50	3.5	17051	19643	19072	21971	20643	23781	21696	24994	22126	25489	21876	25201	20897	24073	19173	22087	16724	19266	13646	15720
Spring Torque			704	811	1049	1208	1461	1683	1913	2204	2370	2730	2783	3206	3088	3557	3225	3715	3135	3612	2775	3197
STD 200	80	5.5	26192	30173	28930	33327	30894	35590	31940	36795	32005	36870	31052	35772	29104	33528	26177	30156	22393	25797	17887	20606
with	70	4.8	22636	26077	24918	28706	26467	30490	27214	31351	27122	31245	26136	30109	24302	27996	21693	24990	18420	21220	14650	16877
Dual	60	4.1	19094	21996	20889	24064	22056	25409	22505	25926	22217	25594	21198	24420	19499	22463	17208	19824	14445	16641	11370	13098
Springs	50	3.5	15538	17900	16872	19437	17629	20309	17779	20481	17326	19960	16275	18749	14709	16945	12735	14671	10478	12071	8083	9312
Spring Torque			2217	2554	3256	3751	4485	5167	5831	6717	7185	8277	8405	9683	9299	10712	9691	11164	9407	10837	8316	9580

NOTE: *For air-to-open/fail-closed actuators the 0° position shown above corresponds to the disc or ball being seated.*
For air-to-close/fail-open actuators the 90° position shown above corresponds to the disc or ball being seated.
*Size 200 actuator limited to 80 psi (5.5 bar) air supply pressure

Valtek Spring Cylinder Rotary Actuators
Specifications

Table II: Rotary Actuator Data

Actuator Size	Stroke		*Actuator Moment Arm		Max Air Supply		Spring Design	Spring Rate		Upper Cylinder Area		Lower Cylinder Area		Shipping Weight**	
	in	cm	in	cm	psi	bar		lb/in	kg/cm	in²	cm²	in²	cm²	lbs	kg
25	1.88	4.8	0.94	2.4	150	10.3	STD HD (Cap)	180 222	207 256	23.76	153.3	23.07	148.8	30	14
50	3.25	8.3	1.63	4.1	150	10.3	STD HD (Cap)	164 235	189 271	47.17	304.3	46.07	297.2	60	27
100	4.00	10.2	2.00	5.1	150	10.3	STD DUAL	300 885	346 1020	95.03	613.1	93.26	601.7	160	73
200	4.00	10.2	2.00	5.1	80	5.5	STD DUAL	300 885	346 1020	188.69	1217.4	186.92	1206	265	120

* Valve in closed position
** Estimated, including Beta positioner

Table III: Actuator Specifications

Type	Cylinder with positive spring action
Sizes	25, 50, 100 and 200
Spring Designs	Single (std.), heavy-duty, dual
Action	Field-reversible: air-to-open, air-to-close
Operating Pressure	Up to 150 psi** (10.3 bar)
Temperature Range	-40° - 350°F* (-40° - 177°C)

* Ambient temperatures greater than 180° F (82° C) require flourocarbon O-rings. Ambient temperatures below -40° F (-40° C) require fluorosilicone O-rings.
** See Table II for limitations on certain actuators.

Table IV: Stroking Speeds with Positioner*

Actuator Size	Time in Seconds for 90° Rotation		Actuator Stroke	
	1/4-in. Tubing (standard)	3/8-in.Tubing (optional)	in	cm
25 (std.)	1.0	1.0	1.88	4.8
50 (std.)	3.5	3.5	3.25	8.3
100 (std.)	9.5	9.0	4.00	10.2

* Beta positioner stroking valve to fail position. Consult factory for speeds faster than those shown above.

Table V: Materials of Construction

Yoke	Ductile iron
Transfer Case	Anodized aluminum
Splined Lever Arm	Ductile iron
Stem	416 stainless steel
Bearings	Filament-wound fiberglass with PTFE liner
Sliding Seal	Delrin 100, aluminum
Retaining Ring	Cadmium-plated steel
Piston	Anodized aluminum
Cylinder	Anodized aluminum
O-ring	Nitrile (std.)
Actuator Spring	Coated steel (rust-proof)
Spring Button	Painted steel or cadmium-plated

Ordering Information

When ordering individual rotary actuators, the following information must be provided:

1. Operating conditions, throttling or on/off.
2. Maximum air supply pressure.
3. Valve rotation in degrees.
4. Actuator torque required at both ends of rotation.
5. Positioner and input signal range, if needed.
6. Stroking time requirements, if critical.

Valtek Spring Cylinder Rotary Actuators
Dimensions

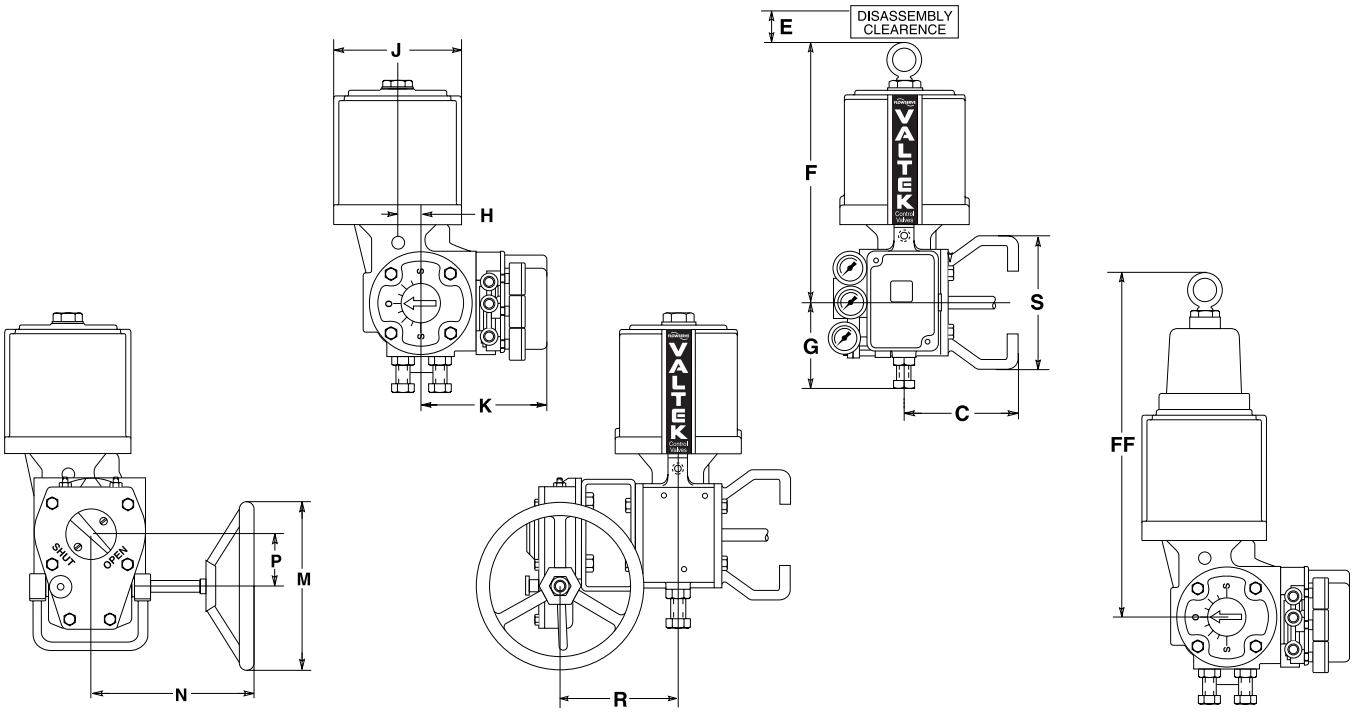

Table VIII: Rotary Actuator Dimensions (inches/mm)

Size	C* (act)		E		F (std. or dual spring)		FF (extended spring)		G		H		J		M		N		P		R		S**		Press. Conn.
25	6.7	171	6.0	152	13.1	332	16.5	420	5.6	142	1.1	29	6.5	165	10.0	254	9.8	248	2.6	67	6.9	176	6.8	171	1/4 NPT
50	6.7	171	8.0	203	17.2	437	23.5	598	6.7	170	2.0	50	9.1	232	12.0	305	10.3	260	3.4	86	9.1	230	6.8	171	1/4 NPT
100	6.7	171	11.0	279	22.9	583	N/A	N/A	9.1	230	2.4	61	12.5	318	18.0	457	12.8	324	5.4	137	10.4	263	6.8	171	3/4 NPT
200	6.7	171	11.0	279	23.6	599	N/A	N/A	9.1	230	2.4	61	17.5	445	18.0	457	12.8	324	5.4	137	10.4	263	6.8	171	3/4 NPT

*7.8/198 on size 100 and 200 actuators, 16-inch (DN 400) and larger valves.
**7.9/202 on size 50 actuators and 8, 10-inch (DN 200, 250) valves; 9.4/238 on size 100, 200 actuators and 8,10,12-inch (DN 200, 250, 300) valves; 11.3/286 on size 100, 200 actuators and 16-inch (DN 400) and larger valves.
NOTE: Disassembly clearance (E) includes lifting ring on sizes 25 and 50

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