Actuator Sizing Calculation for Gate & Globe Valves

Information required		Examples		
1	Bore diameter at seat (use actual diameter if known)	12 inch	3 inch	3 inch
2	Differential pressure, using 30psi minimum, and line psi if higher	200 psi	2250 psi	2250 psi
3	Type of valve and service	Wedge gate, oil	Globe, steam	Globe, steam
4	Stem diameter and lead of screw thread (pitch x number of starts)	1 ¾" x 1/3" rising stem	1 ½" x ¼" rising rotating	1 ½" x ¼" rising stem
5	Travel time/speed in inches per minute (if critical)	About 1 minute		

Method Having obtained the above information proceed as follows

A	Obtain bore area (full bore assumed) (1)	113 sq in	7.06 sq in	7.06 sq in
B	Differential psi	200 psi	2250 psi	2250 psi
C	Obtain valve factor **Table 1**	0.35	1.15	1.15
D	Multiply A x B x C to obtain seating thrust For rising stem valves:	7950 lbf Yes	18200 lbf No	18200 lbf Yes
E	Add packing friction thrust = 2000 x stem diameter (2) For gate valves:	3500 lbf Yes	---- No	3000 lbf No
F	Add piston effect = 0.785 x diam. of stem^2 x diff. Pressure (For globe valves, the stem area is included with the disc area, so piston effect can be ignored)	481 lbf	----	----
G	D+ E+F gives total thrust	11931 lbf	18200 lbf	21200 lbf
H	Obtain Stem Factor **K Table 2**	0.014	0.012	0.012
J	G x H gives torque For rotating stem valves:	**167 lbf-ft** No	218 lbf-ft Yes	**254 lbf-ft** No
K	Add gland friction torque = (1000 x stem diameter^2) ÷12 (2)	----	188 lbf-ft	----
L	J+K gives total thrust (rotating stem)		**406 lbf-ft**	
M	Actuator RPM = Speed in inches per min ÷ Lead of stem	12 ÷ 1/3 = 36 RPM		

Table 1 Valve Factors (3)

Valve type	Liquids Below 750ºF	Liquids Above 750ºF	Gases/ Steam below 1000ºF	Gases/ Steam above or close 1000ºF
Parallel slide and Flexible or double disc	0.28	0.3	0.35	0.45
Solid wedge gate	0.35	0.4	0.45	0.5
Globe above 2"	1.15	1.15	1.15	1.15
Globe below 2"	1.5	1.5	1.5	1.5

Notes

(1) API-600 and API-603 Gate Valves must have full ports according to Annex A form ASME B16.34. Valves conforming to API-602 have reduced ports indicated in this standard. Other valves may differ according to manufacturing standard or published CV factor. Consult plant for an specific valve port diameter.

(2) Factors based on Flexible Graphite Packing. For PTFE Packing, the results can be divided by 2.

(3) Valve factors are based on metallic seats, when valve is new. If you foresee seats oxidation or aging during the service, multiply this factors by 1.25 to 1.5 depending the severity of seats oxidation or aging. Stroking the valve frequently, maintain the seats cleaner and the thrust and torque lower.

(4) For inside screw threads multiply factors by 1.5 for exposed sluice gates (penstocks) multiply factors by 1.25 and insure that thrust estimate is a minimum of three times the weight of the gate. This factors assume a proper lubrication on stem threads, if a poor maintenance is predicted multiply this factors by 1.15 to 1.3. Depending on the specified speed, the stems can have single, double or triple start. Consult plant for actual stem diameter, pitch and lead.

Table 2 Stem Factors (4)

Factor is lbf-ft per lbf of thrust, for ACME thread, using a coefficient of friction equal to 0.14

Lead Ins	Stem 3/4	Dia 1	In 1 ¼	1 ½	1 ¾	2	2 ¼	2 ½	2 ¾	3	3 ¾	3 ½	3 ¾	4	4 ¼	4 ½	4 ¾	5	5 ¼	5 ½	6	6 ½
1/8	.006	.007																				
1/5	.007	.008	.010	.011																		
1/4	.007	.009	.010	.012	.013	.015	.016	.018	.019	.021	.022											
2/7	.008	.009	.011	.012	.014	.015	.017	.018	.020	.021	.023											
1/3	.008	.010	.011	.013	.014	.016	.017	.019	.020	.022	.023											
2/5	.009	.010	.012	.013	.015	.016	.018	.019	.021	.022	.024	.025	.027	.028	.030	.031	.033	.034	.036	.037	.040	
1/2		.012	.013	.014	.016	.017	.019	.020	.022	.023	.025	.026	.028	.029	.031	.032	.034	.035	.037	.038	.041	
2/3				.016	.019	.020	.022	.023	.025	.026	.028	.030	.031	.032	.034	.035	.037	.038	.040	.041	.044	.047
1				.020	.023	.024	.026	.027	.029	.030	.032	.032	.035	.036	.038	.039	.041	.042	.044	.045	.048	.051
1 1/2												.040	.042	.043	.045	.046	.048	.049	.051	.052	.055	.058
2													.048	.050	.051	.053	.054	.056	.057	.059	.062	.065

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