Actuator Sizing Calculation for Gate & Globe Valves

Information required

1. Bore diameter at seat (use actual diameter if known)
   Examples: 12 inch, 3 inch, 3 inch

2. Differential pressure, using 30psi minimum, and line psi if higher
   Examples: 200 psi, 2250 psi, 2250 psi

3. Type of valve and service
   Examples: Wedge gate, oil globe, steam globe, steam

4. Stem diameter and lead of screw thread
   (pitch x number of starts)
   Examples: 1 ¾” x ½”, rising stem
             1 ½” x ¼”, rising rotating

5. Travel time/speed in inches per minute (if critical)
   Examples: About 1 minute

Method

Having obtained the above information proceed as follows

A. Obtain bore area (full bore assumed) (1)
   Examples: 113 sq in, 7.06 sq in, 7.06 sq in

B. Differential psi
   Examples: 200 psi, 2250 psi, 2250 psi

C. Obtain valve factor
   Table 1
   Examples: 0.35, 1.15, 1.15

D. Multiply A x B x C to obtain seating thrust
   Examples: 7950 lbf, Yes, 18200 lbf

E. Add packing friction thrust = 2000 x stem diameter (2)
   Examples: 3500 lbf, Yes, 3000 lbf

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)
   Examples: 481 lbf

G. D+E+F gives total thrust
   Examples: 11931 lbf, 18200 lbf, 21200 lbf

H. Obtain Stem Factor
   Table 2
   Examples: 0.014, 0.012, 0.012

J. G x H gives torque
   For rotating stem valves:
   Examples: 167 lbf-ft, No, 218 lbf-ft

K. Add gland friction torque = (1000 x stem diameter^2) ÷ 12
   (2) Factors based on Flexible Graphite Packing. For PTFE Packing, the results
can be divided by 2
   Examples: ----, 188 lbf-ft

L. J+K gives total thrust (rotating stem)
   Examples: 406 lbf-ft

M. Actuator RPM = Speed in inches per min ÷ Lead of stem
   Examples: 12 + 1/3 = 36 RPM

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 1 Valve Factors

<table>
<thead>
<tr>
<th>Valve type</th>
<th>Liquids Below 750°F</th>
<th>Liquids Above 750°F</th>
<th>Gases/Steam below 1000°F</th>
<th>Gases/Steam above or close 1000°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parallel slide and Flexible or double disc</td>
<td>0.28</td>
<td>0.3</td>
<td>0.35</td>
<td>0.45</td>
</tr>
<tr>
<td>Solid wedge gate</td>
<td>0.35</td>
<td>0.4</td>
<td>0.45</td>
<td>0.5</td>
</tr>
<tr>
<td>Globe above 2”</td>
<td>1.15</td>
<td>1.15</td>
<td>1.15</td>
<td>1.15</td>
</tr>
<tr>
<td>Globe below 2”</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 2 Stem Factors

| Factor is lbf-ft per lbf of thrust, for ACME thread, using a coefficient of friction equal to 0.14 |
|--------------------------------------------------|--------------------------------------------------|
| Length in 3/8                                 | Stem Dia in 1/8                                 |
| 1/8                                             | .006                                            |
| 1/6                                             | .007                                            |
| 1/4                                             | .007                                            |
| 3/16                                            | .007                                            |
| 1/2                                             | .008                                            |
| 3/16                                            | .008                                            |
| 3/8                                             | .009                                            |
| 5/16                                            | .010                                            |
| 7/32                                            | .010                                            |
| 1/8                                             | .012                                            |
| 3/16                                            | .012                                            |
| 5/32                                            | .012                                            |
| 7/32                                            | .012                                            |
| 1/4                                             | .016                                            |
| 9/64                                            | .016                                            |
| 1/8                                             | .020                                            |
| 1/4                                             | .040                                            |
| 5/32                                            | .040                                            |
| 1/8                                             | .080                                            |
| 1/4                                             | .160                                            |
| 5/32                                            | .160                                            |

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