**Types of Valves**  
(from Fluid Mechanics, by F. White, McGraw-Hill, 1999)

- (a) Gate valve
- (b) Globe valve
- (c) Angle valve
- (d) Swing-check valve
- (e) Disk-type gate valve

**Butterfly Valve**

- Used mainly for on-off
- Lots of torque needed for high flow rates

(from Chemical Process Control, by J. B. Riggs, Ferret Publ., 2001)

**Cutaway View of Globe Valve**

(from Chemical Process Control, by J. B. Riggs, Ferret Publ., 2001)

- Typical globe valve
- Larger View of Cage

**Close-up of Actuator**

-from Chemical Process Control, by J. B. Riggs, Ferret Publ., 2001-

**Valve Designs**

- Globe Spli-Body Angle
Valve Design Logic Diagram

Goal: Control \( q \) by changing \( l \)

1. SAFETY
   - Fail-open or Fail-closed

2. Calculate \( \Delta p_{rv} \), required
   - may be a function of \( q \)

3. Specify design flow rate (\( q \))

4. Does \( \Delta p_{rv} \), change much
   - With changes in \( q \)?

   Equal percentage valve
   \( f(l) = R l^{-1} \), \( R \approx 25 \) to \( 50 \)

5. Calculate \( C_v \)
   \( q = C_v f(l)/\Delta p_{rv} \), \( S.G. \times 0.5 \)
   - \( \Delta p_{rv} \) may change with \( q \)
   - Hopefully \( \Delta p_{rv}/\Delta p_{ps} \approx 1/4 \) to \( 1/3 \)

6. Plot \( q \) vs. \( l \) to check linearity of combined system

C\(_v\)'s for an Equal Percentage Valve

<table>
<thead>
<tr>
<th>Body Size (in)</th>
<th>Stem Position as a Percentage of Total Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.79, 1.25, 1.80, 2.53, 3.63</td>
</tr>
<tr>
<td>1.5</td>
<td>0.80, 1.23, 1.91, 2.95</td>
</tr>
<tr>
<td>2</td>
<td>1.65, 2.61, 4.30, 6.62</td>
</tr>
<tr>
<td>3</td>
<td>3.11, 5.77, 9.12, 13.7</td>
</tr>
<tr>
<td>4</td>
<td>4.90, 8.19, 13.5, 20.1</td>
</tr>
<tr>
<td>C(_v)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>12.7, 15.2, 17.0, 19.0</td>
</tr>
<tr>
<td>20</td>
<td>14.6, 17.0, 19.0, 21.7</td>
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<tr>
<td>30</td>
<td>16.4, 18.0, 20.0, 22.7</td>
</tr>
<tr>
<td>40</td>
<td>18.0, 20.0, 22.0, 24.7</td>
</tr>
</tbody>
</table>

(From Chemical Process Control, by J. B. Rigg, Ferret Publ., 2001)
Answers to Problem 9.4

b. Del_pv = 30 (Cv = 77)

c. Del_pv = 90 (Cv = 44)

a. Del_pv = 5 (Cv = 188)