Globe type control valve

Basically a globe type of control valve consists of two parts as follows:

- Main (globe) valve body
- Diaphragm type of pneumatic actuator

This two valve’s part is coupled by a special coupling → when the air pressure coming into the diaphragm pneumatic actuator → the rubber diaphragm inside the actuator will push or pull the main (globe) valve stem/shaft downward or upward.
Globe type control valve

- The main design of this control valve is globe type → a valve with a linear up-down type of movement to open/close the fluid flow & the body shape is globular with a plug disc as the main part inside it.
- The traveling linear up-down distances of the valve is called valve’s stroke.
- Since the globe type control valve is not designed as an on-off type of valve → but a proportional or modulating type of valve → the % opening of the control valve is always proportional or modulating to comply to the instruction received from the main controller.
- Since the main valve will always open with a certain % of opening → It will create a differential pressure (Δ P = Delta P = P1 – P2) between the inlet & outlet of the valve.
- Delta P (Δ P) shut-off is the increasing fluid pressure above the normal pressure at the inlet side of the control valve → when the control valve is closed 100 %!
Globe type control valve

- Bonnet (20) is the upper part of the main valve → when we dismantle the bonnet → the valve’s plug disc & stem are located at this valve’s bonnet too
- Stem packing (21) are used to prevent fluid leakage at the valve’s stem area → PTFE or teflon is commonly used as stem packing → for high temperature we can choose graphite packing (but graphite packing creates high friction on the stem area)
- Packing box is the stem packing housing → there is a mechanism to tighten the steam packings here
- Trim is the main valve’s parts that will contact the fluid directly (wetted parts) as follows: Disc plug, Seat ring, Stem, Guide, Bushing or Cage.
Globe type control valve

- Valve stem (26)
- Actuator stem (4)
- Coupling (16) is used to couple the main valve’s shaft with the diaphragm pneumatic actuator stem → coupling construction is very important → if the coupling construction is no good → the accuracy of the control valve will be affected → there will be error that we call valve’s hysteresis (the % opening of the valve will be deviated and it will not comply to the main controller instruction)

- Stem guide (18) = A guide bush that located at the valve’s bonnet is very important → it is installed to make sure the valve’s stem & plug disc will always be aligned when it move up & down
Globe type control valve

- Seat ring (24) is the valve’s part where the plug disc can be seated on top of it when the valve is closed → for steam application: The surface of the seat ring can be hardened by adding stellite on it.
- Plug disc (17)
- Unbalanced trim → The total fluid pressure is coming only from the bottom of the valve’s plug disc (one direction only)
Globe type control valve

- **Balanced trim** → This type of control valve is using a **CAGE** type of plug disc’s housing → where there are a few holes on the valve’s plug disc → so when the control valve position is totally closed → the fluid can go through the holes on the plug disc of the valve → then the fluid can occupy the upper space above the valve’s plug disc → it will create a balanced fluid pressure below & above the plug disc.
Globe type control valve

• The rubber diaphragm (12) inside the diaphragm pneumatic actuator needs compressed air pressure to pull or push the actuator’s stem (4) upward or downward
• There are a few springs inside the diaphragm actuator’s housing → The spring’s force have to be sized properly to accommodate the fluid pressure flowing through the control valve body → Springs will be on top of the diaphragm for normally close control valve → Springs are positioned below the diaphragm for normally open control valve
• Reversed acting = fail closed → air pressure to close the valve → springs to open the valve
• Direct acting – fail open → air pressure to open the valve → air pressure to close the valve
Globe type control valve

The opening or closing movement characteristic of a control valve will follow a certain pattern/characteristic as follows:
- Quick opening
- Linear
- Equal %

It can be achieved by modifying the trim of the control valve:
- By modifying the plug disc
- By modifying the cage
Globe type control valve

There are reasons why the engineers will choose a certain pattern of the control valve’s trim characteristic.

It depends on a certain process design.

We can see the attached recommended flow characteristic table.

---

### Table 10-1

**Recommended Flow Characteristics**

<table>
<thead>
<tr>
<th>Control System</th>
<th>Application</th>
<th>Recommended Flow Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Level</td>
<td>Constant ( \cdot P ).</td>
<td>Linear</td>
</tr>
<tr>
<td>Liquid Level</td>
<td>Decreasing ( \cdot P ) with increasing flow; ( P_{\text{min}} &gt; 20% \cdot P_{\text{max}} ).</td>
<td>Linear</td>
</tr>
<tr>
<td>Liquid Level</td>
<td>Decreasing ( \cdot P ) with increasing flow; ( P_{\text{min}} &lt; 20% \cdot P_{\text{max}} ).</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Liquid Level</td>
<td>Increasing ( \cdot P ) with increasing flow; ( P_{\text{max}} &gt; 200% \cdot P_{\text{max}} ).</td>
<td>Quick Opening</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow; valve in series with measurement device; wide range of flow required.</td>
<td>Linear</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow; valve in series with measurement device; small range of flow required with large ( \cdot P ) change for increasing flow.</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow; valve in parallel (bypass) with measurement device; wide range of flow required.</td>
<td>Linear</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow; valve in parallel (bypass) with measurement device; small range of flow required with large ( \cdot P ) change for increasing flow.</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow squared; valve in series with measurement device; wide range of flow required.</td>
<td>Linear</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow squared; valve in series with measurement device; small range of flow required with large ( \cdot P ) change for increasing flow.</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow squared; valve in parallel (bypass) with measurement device; wide range of flow required.</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Flow</td>
<td>Measurement signal proportional to flow squared; valve in parallel (bypass) with measurement device; small range of flow required with large ( \cdot P ) change for increasing flow.</td>
<td>Equal Percentage</td>
</tr>
<tr>
<td>Pressure</td>
<td>All.</td>
<td>Equal Percentage</td>
</tr>
</tbody>
</table>

POSITIONER is needed to let the control valve functioned well

• Before the control valve factory sends the product away to the distributors → Factory will perform a test to the control valve on a TEST BENCH
• On a TEST BENCH → There is no fluid is passing (flowing) through the control valve main body (it is empty during testing)
• But at the customer site → There will be fluid passing (flowing) through the control valve main body with a certain pressure → the factory TEST BENCH’s result is not valid anymore → The control valve’s movement will be deviated → It can bee seen at the next slide!
• Control valve is not a smart product → It need an extra smart product to perform well!
Deviation on globe type control valve

- At control valve factory → A normally closed globe control valve is tested (without fluid passing the main valve body) → We can see at the above chart the blue line (bench testing)
- At customer site → There is fluid passing through the globe control valve main body with a certain pressure → We can see at the above chart the red line representing the service condition
- Here we can see the deviation between the bench testing result & the service condition result → Below 0.2 bar air pressure coming into the diaphragm pneumatic actuator → the control valve is already open!
Deviation on globe type control valve

- At control valve factory → A normally open globe control valve is tested (without fluid passing the main valve body) → We can see at the above chart the blue line (bench testing)
- At customer site → There is fluid passing through the globe control valve main body with a certain pressure → We can see at the above chart the red line representing the service condition
- Here we can see the deviation between the bench testing result & the service condition result → At 1 bar air pressure coming into the diaphragm pneumatic actuator → the control valve has not yet move to close!
A globe type control valve needs a positioner
To make the control valve performs well
A positioner translates the input signal received from the main controller, process it & send the correct signal to the control valve’s diaphragm pneumatic actuator to allow the control valve open *at a correct opening %* that is complied to the instruction received from the main controller by add-in or relieving the compressed air coming into the diaphragm pneumatic actuator.

**HOW IT WORK:**

- When receive signal from the main controller → the positioner will check the existing opening % of the control valve first
- Then the positioner will do a correcting of the control valve’s position to comply to the instruction received from the main controller (by add-in or relieving the air pressure going to the diaphragm pneumatic actuator)