Live Control Valve Sizing Using Sizing Program

June 10, 2020

Serge Trudel & Ralph Forte

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ADVANTAGES OF QUARTER-TURN CONTROL VALVES

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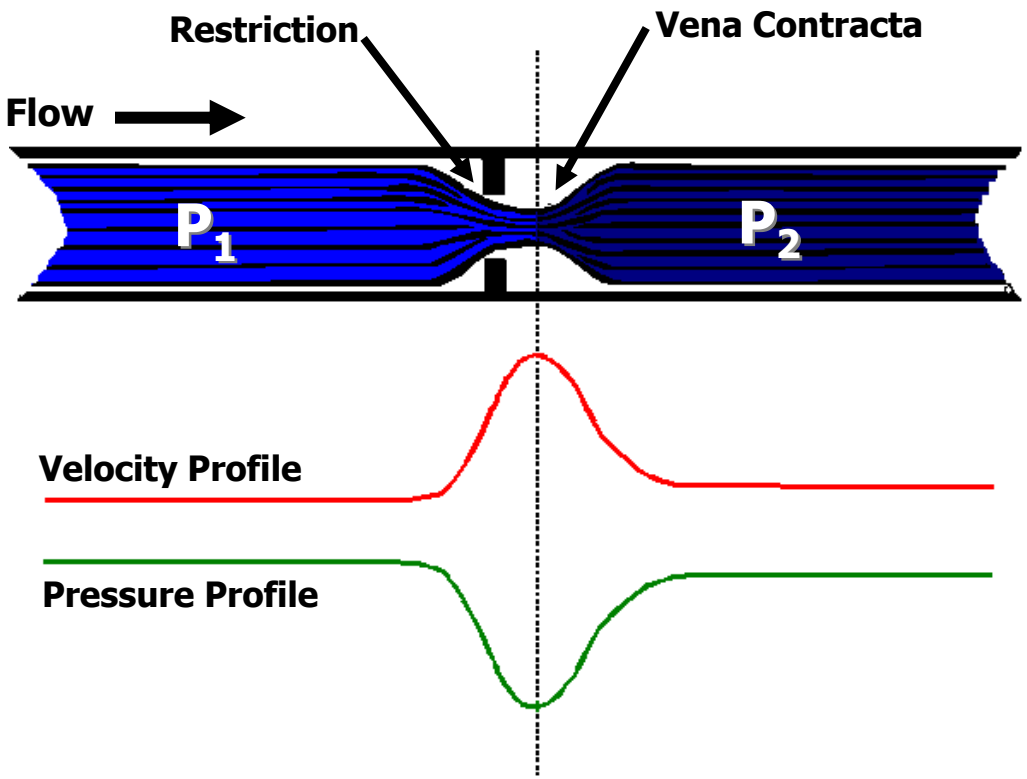
Flow Through a restriction

- As fluid flows through a *restriction*, the fluid's velocity increases.
- The *Bernoulli Principle* states that as the velocity of a fluid or gas *increases*, its pressure *decreases*.
- The *Vena Contracta* is the point of smallest flow area, highest velocity, and lowest pressure.



Terminology

Vapor Pressure Pv

The **vapor pressure of a fluid** is the pressure at which the fluid is in thermodynamic equilibrium with its condensed state. Vapor Pressure is sensitive to Temperature. When a fluid drops below it vapor pressure the fluid changes state and goes from liquid to gas.

Pressure at the Vena Contracta Pvc

This is the pressure at the Vena Contracta which occurs based upon the valve geometry and calculated by flow test conducted by the valve manufacturer.

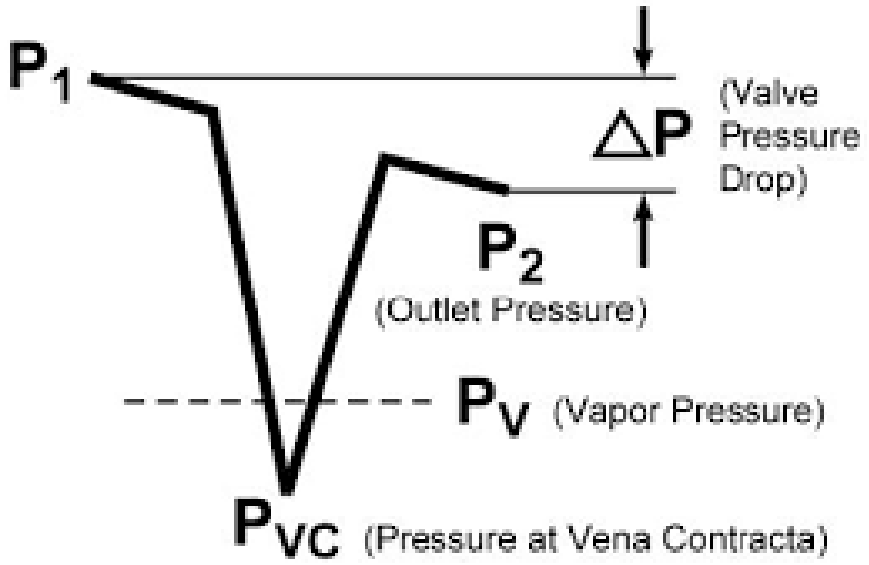
Differential Pressure (Pressure Drop through the valve)

$$\Delta P = P_1 - P_2$$

Valve Recovery Factor

$$F_L = \sqrt{\frac{p_1 - p_2}{p_1 - p_{vc}}}$$

Pressure Profile of flow through the valve

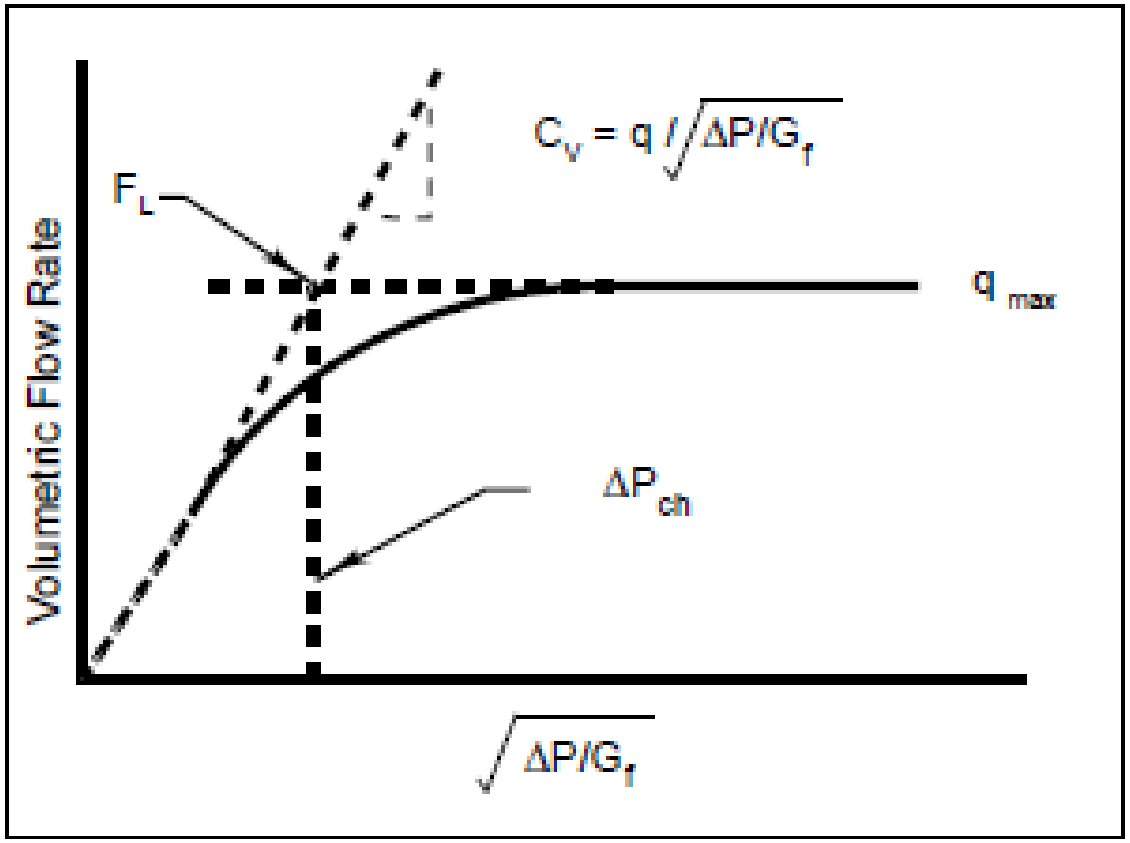


Choked Flow

Choked flow in liquids occurs when vapor is formed as the result of cavitation or flashing, this increases the specific volume of the fluid.

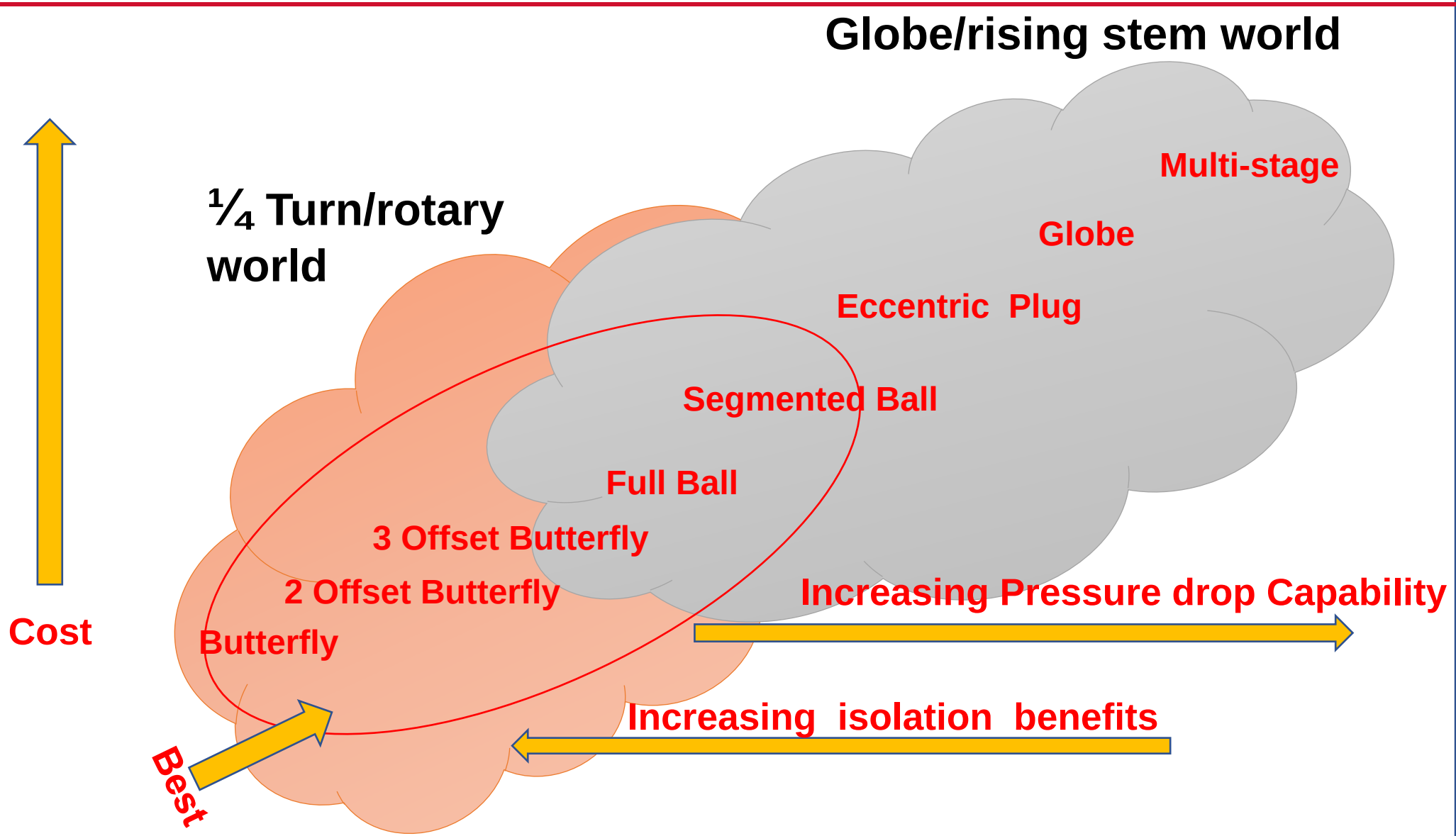
Flow no longer increases by increasing the differential pressure. In other words, the flow is choked and cannot be increased by lowering the downstream pressure increasing the differential pressure.

Choked Flow


Volumetric Flow Rate
$C_v = q / \sqrt{\Delta P/G_f}$
F_L
q_{max}
ΔP_{ch}
$\sqrt{\Delta P/G_f}$

Specifying Control Valves

Continuum of Modulating Valves



Exercise #1

Fluid:	Water		
Service Conditions:	Maximum	Normal	Minimum
Flow Rate:	900 gpm	600 gpm	100 gpm
Upstream Pressure:	125 psig	125 psig	70 psig
Downstream Pressure:	95 psig	95 psig	55 psig
Temperature:	75 F	75 F	75 F
Pipe Size	6” Schedule 40		

Exercise #2

Fluid:	Water		
Service Conditions:	Maximum	Normal	Minimum
Flow Rate:	1000 gpm	800 gpm	200 gpm
Upstream Pressure:	180 psig	180 psig	180 psig
Downstream Pressure:	120 psig	140 psig	65 psig
Temperature:	75 F	75 F	75 F
Pipe Size	4” Schedule 40		

Thanks for your time.
Questions/feedback please.