Associazione Italiana Strumentisti

ISA Italy Section

ATI Associazione Termotecnica Italiana Sezione Lombardia

VALVOLE DI CONTROLLO E INTERCETTAZIONE, SISTEMI DI AZIONAMENTO, DISCHI DI ROTTURA E DISPOSITIVI DI SICUREZZA UTILIZZATI NELL'INDUSTRIA DI PROCESSO

Milano, 18 Aprile 2018

Auditorio TECNIMONT

Rising Stem Globe Control Valves vs Ball Control Valves.

A comparison in terms of mass, fluid dynamic performance, fields of application.

VSI CONTROLS
A PETROLVALVES COMPANY

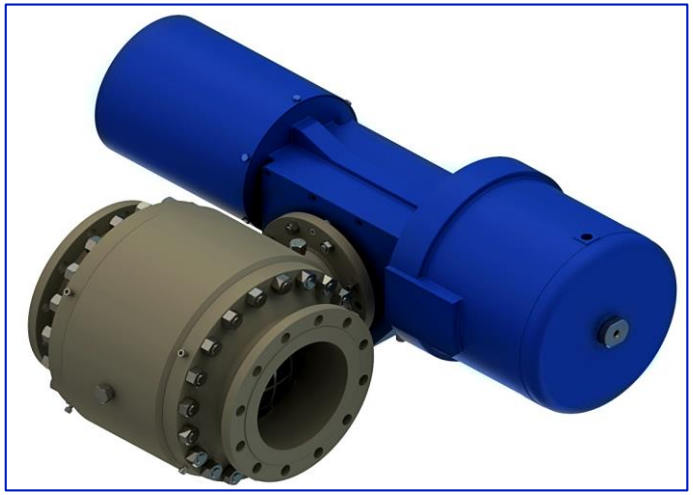
Michele Ferrante
VSI Controls

When a Ball Valve can be used as a Control Valve?
Can it replace a Globe Valve?

A Ball Valve is typically a quarter-turn valve with a perforated ball in the middle to control flow. These valves are known for being durable with excellent shutoff, but do not always offer very precise control.

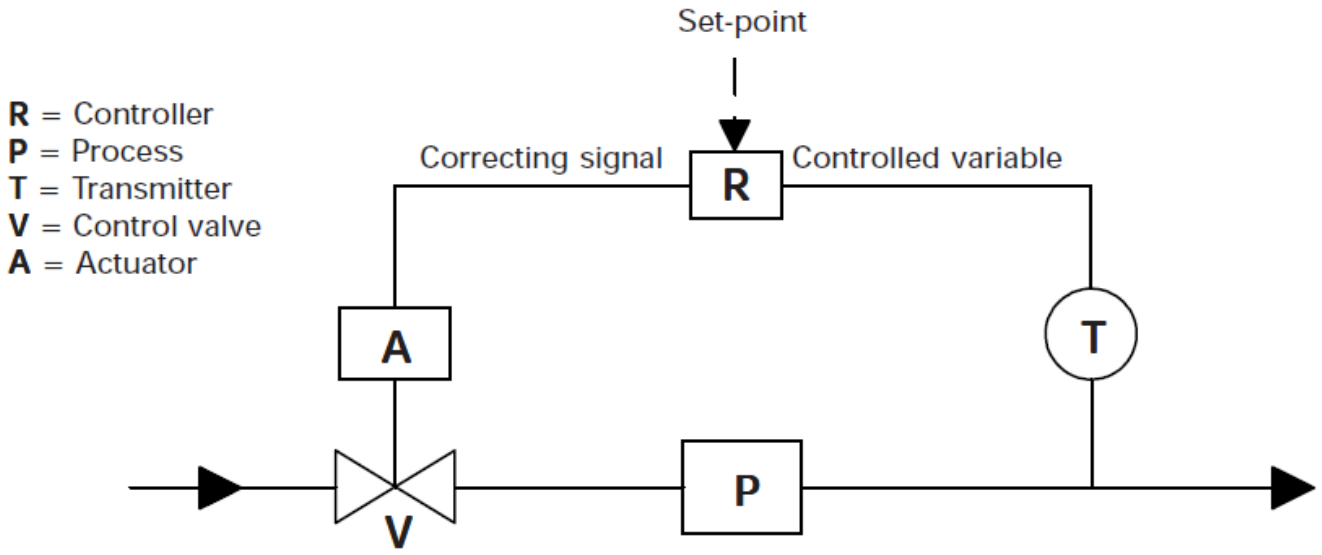
In recent years the use of Ball Valves for regulating service has increased, moving also in the field of severe applications, where the use of multi-stage trims is required.

For some control applications there is nowadays the possibility to install a Ball Valve or a Globe Valve, and the choice of the best model for the application is not always clear to the EPCs or to the End Users.



Scope of this work is to highlight the main features of Control Globe and Ball Valves, and to suggest guidelines in choosing one or the other.

Control Valves Working Principle



Process Control System (or Control Loop) usually consists of:

- ✓ a Sensor that measure a Process Variable
- ✓ a Transmitter
- ✓ a Controller that compares the Process Variable received from the Transmitter with the Set Point.
- ✓ a final control element, composed by an actuated Control Valve, that receives the Correcting Signal by the Controller

Main Features

Globe Control Valve

Linear motion of the closure member (Plug)

In-line or angle body design

Body and bonnet (flanged, welded or screwed)

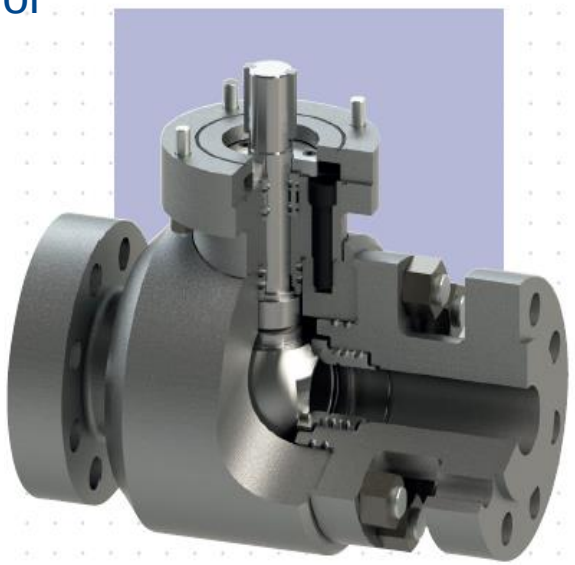
Regulating (contoured) Plug or Cage trim

Unbalanced or P/B trim

Manually or Power actuated

Pneumatic, Electric, Hydraulic actuators

Ball Control Valve



Rotary motion of the closure member (Ball)

In-line design

Top Entry or Side Entry

Trunnion or Floating trim

Unbalanced trim

Manually or Power actuated

Pneumatic, Electric, Hydraulic actuators

Main Features

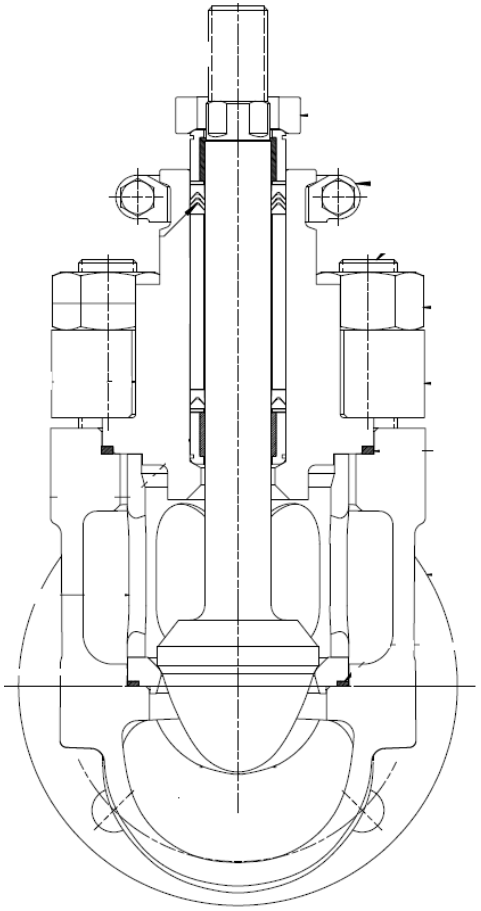
	Globe Control Valve	Ball Control Valve
ND	0,5 to 36'' (24'' more reasonable limit)	2 to 60'' (and more)
Pressure Class	Up to: ANSI 4500 (775 bar/11240 PSI) API 20000 (1380 bar/20000 PSI)	Up to: ANSI 900 (150 bar/2175 PSI) (up to ANSI 2500 for special applications)
Temperature Limits	From -196°C to 600°C and more	From -196°C to 250°C (extreme applications up to 450°C on small valves)
End connections	Flanged, BW, SW	
Fluid	Gas, Liquid, Mixtures, Flashing, Slurry	
Allowable Pressure drops	300 bar on gas and liquid Up to 700 bar on choke applications	Up to 100 bar
Seat Leakage Class (ANSI/FCI 70-2)	UP to: Class V metal Class VI soft Bidirectional (depending on trim type)	UP to: Class V metal Class VI soft Bidirectional
Reduced Port Option	Available	
Packing options	Single, double, leak off, low emission…	

The characteristics listed here are indicative and refer to the most common applications.

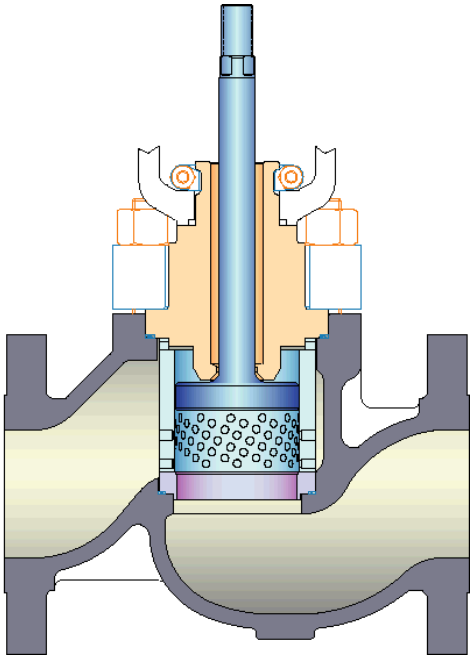
Special projects can exceed these limits

Typical Trim Types

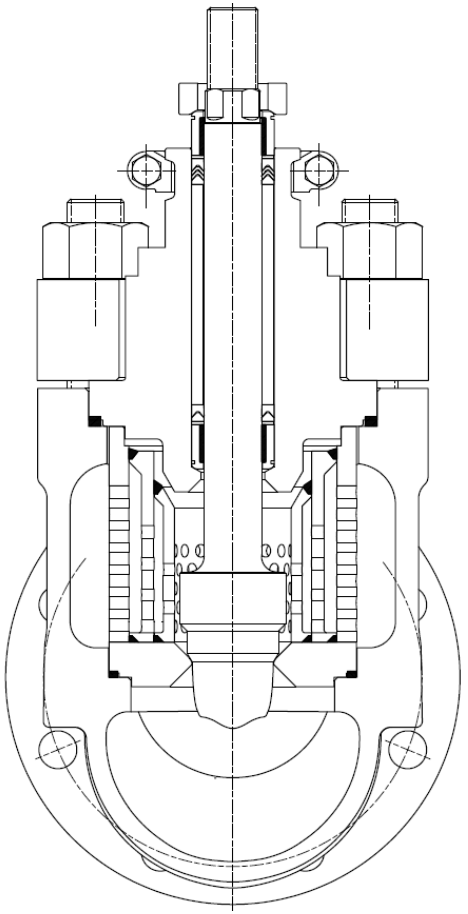
Globe Valves



Contoured Plug



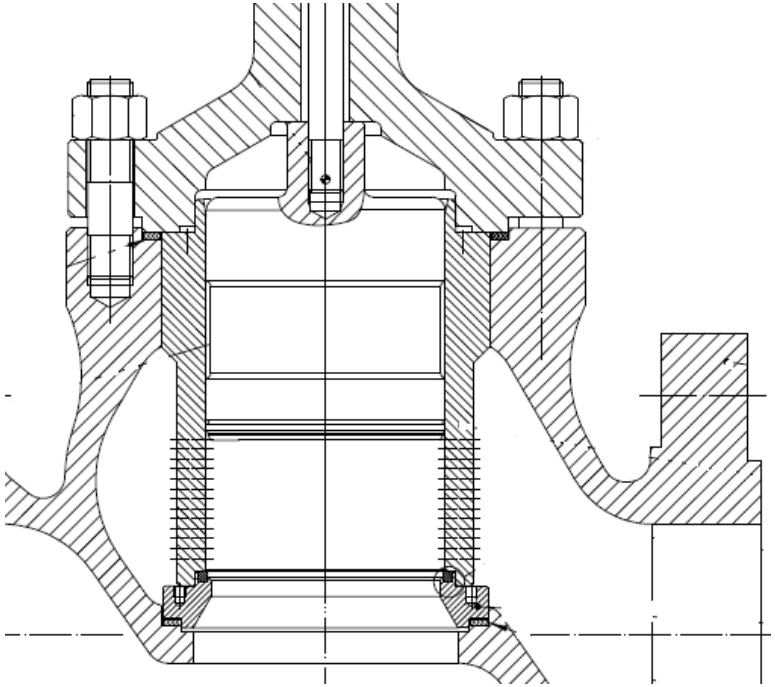
Cage Trim



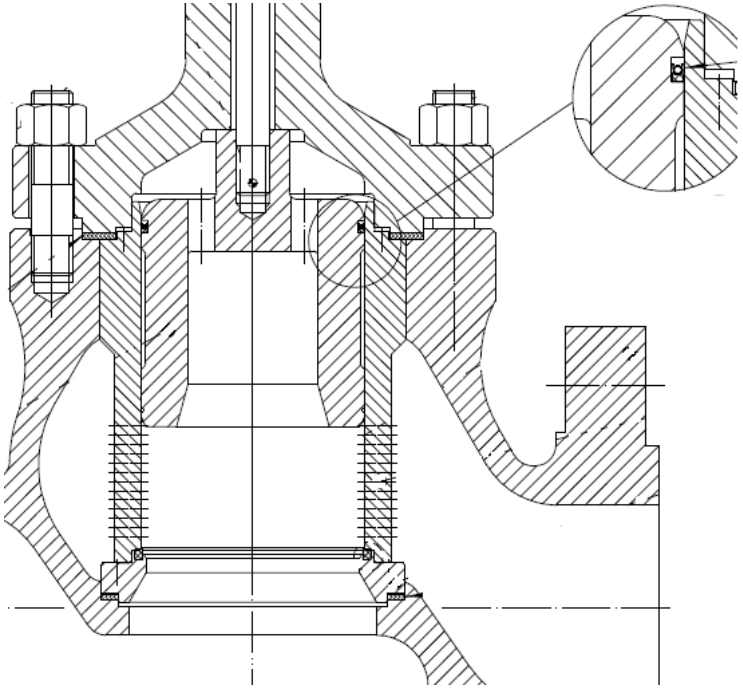
Multicage and
Special Trim

Typical Trim Types

Globe Valves



Unbalanced Trim



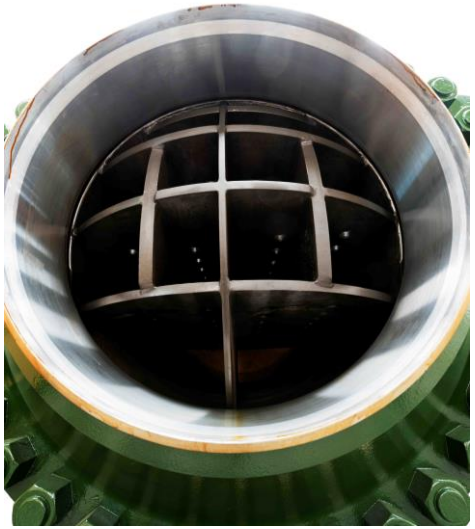
Pressure Balanced trim

Tipical Trim Types

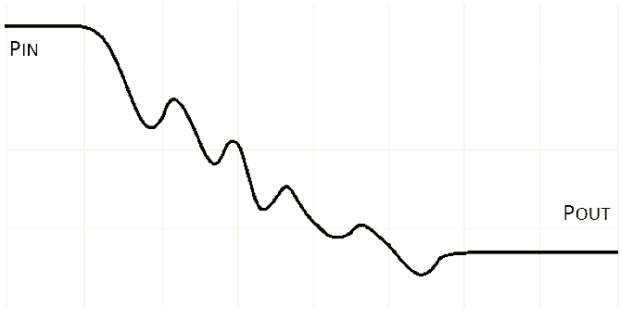
Ball Valves

Full bore

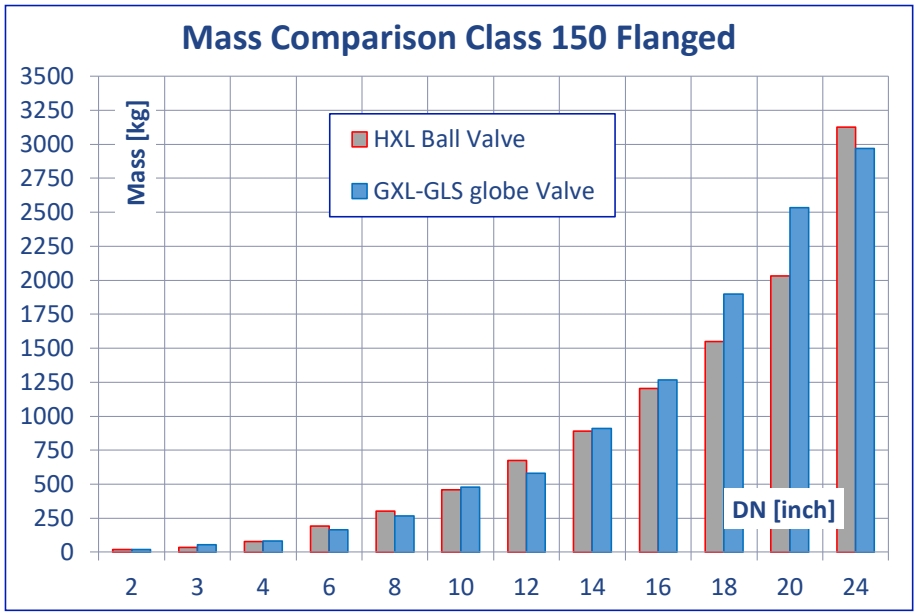
Drilled Disk Trim

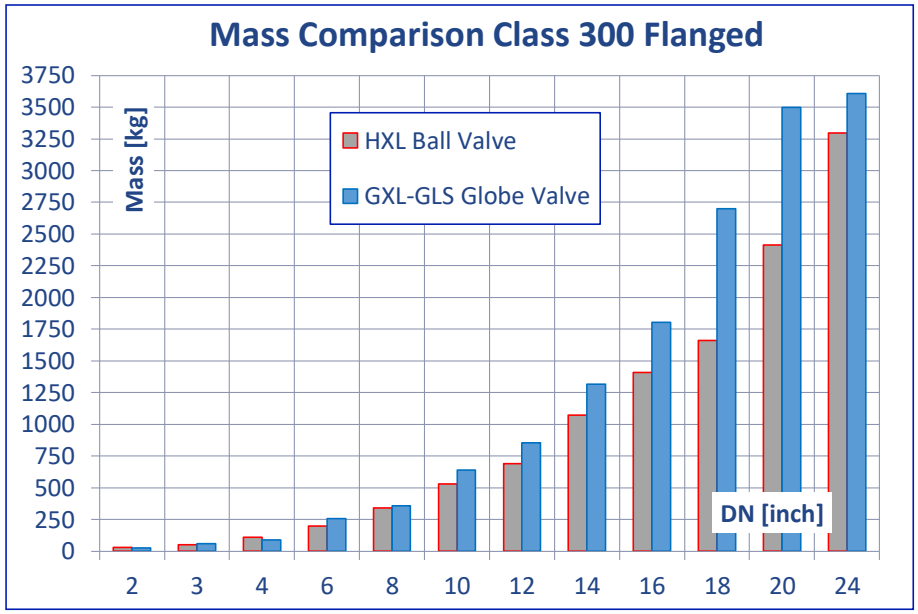


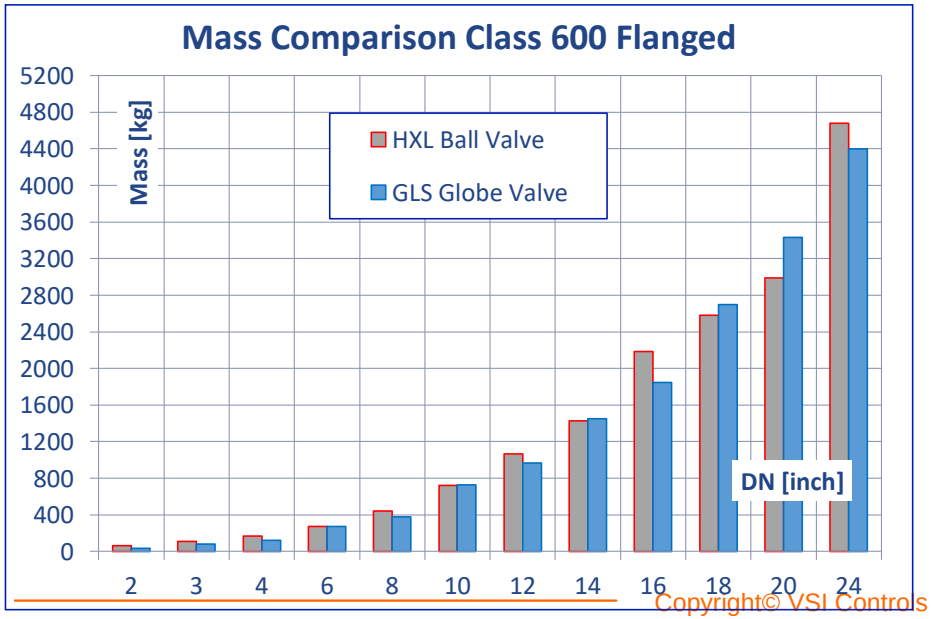
Multicage and Special Trim

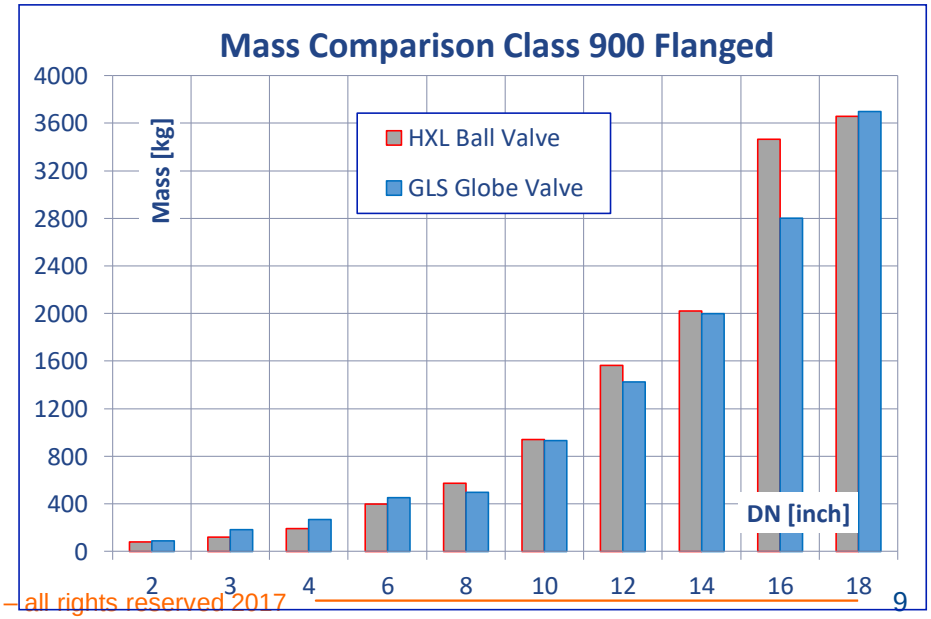


Mass Comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

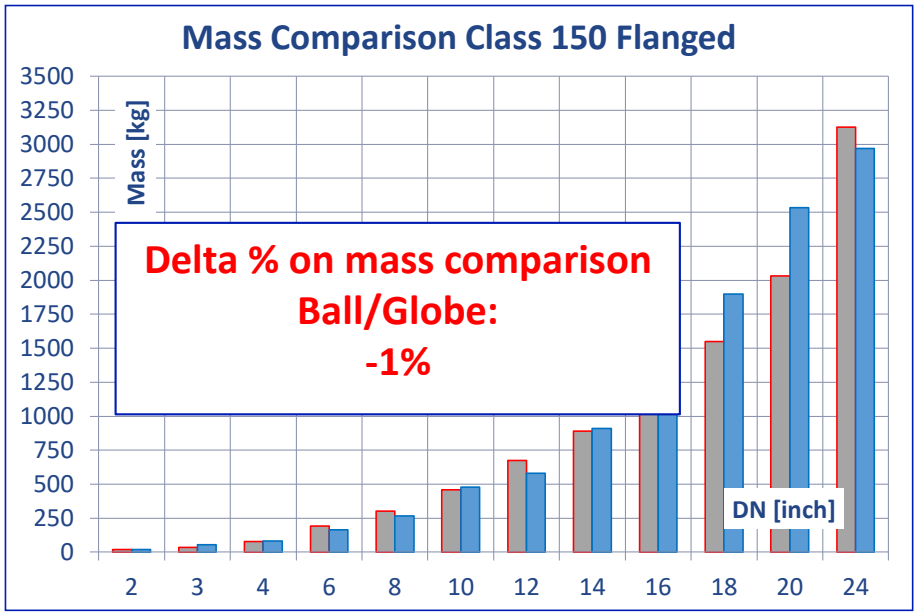


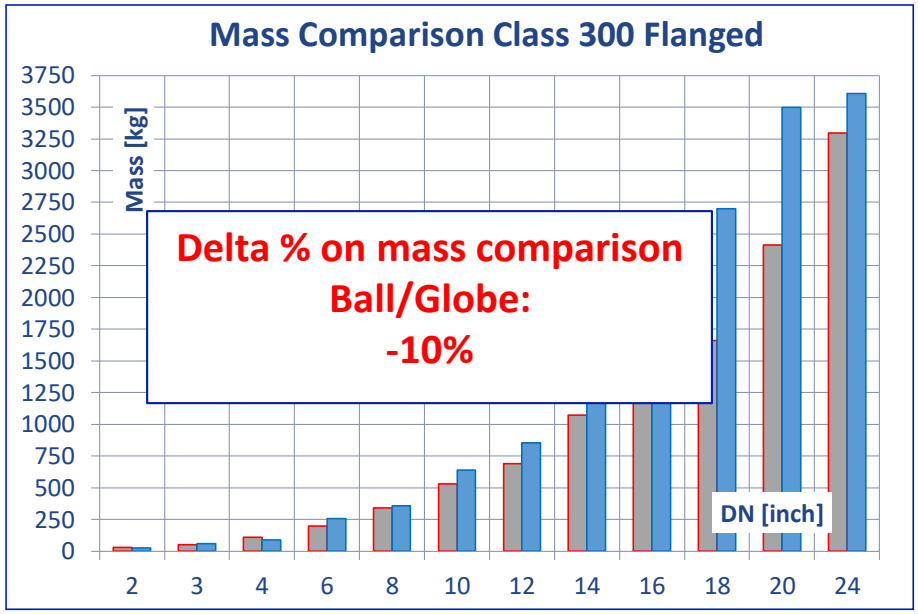


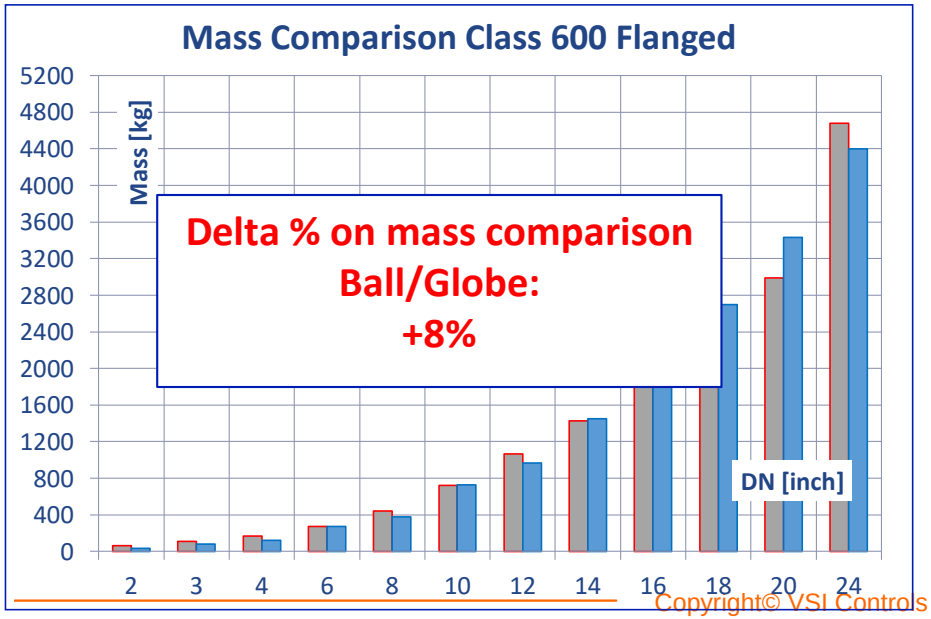


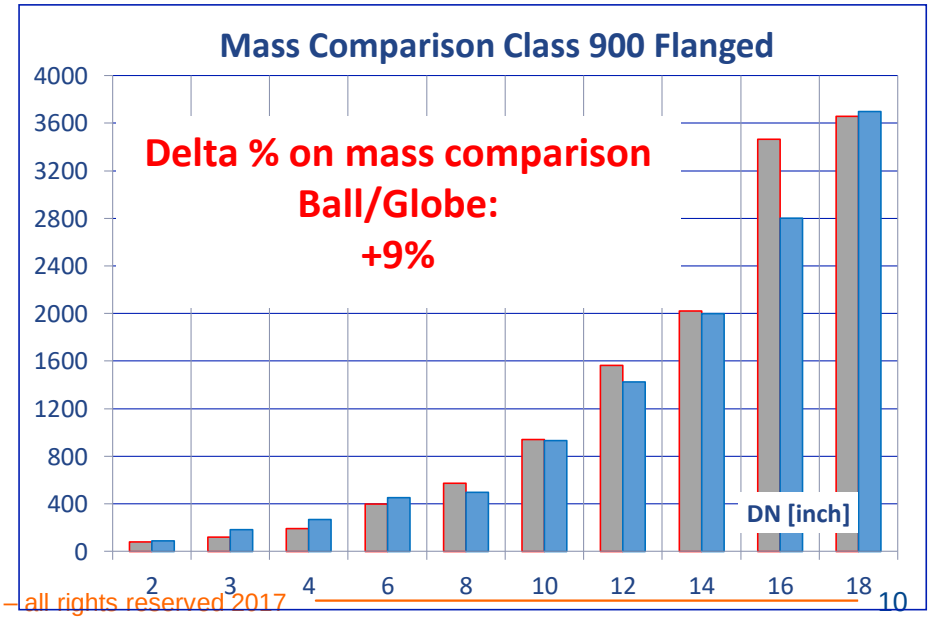


Mass Comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

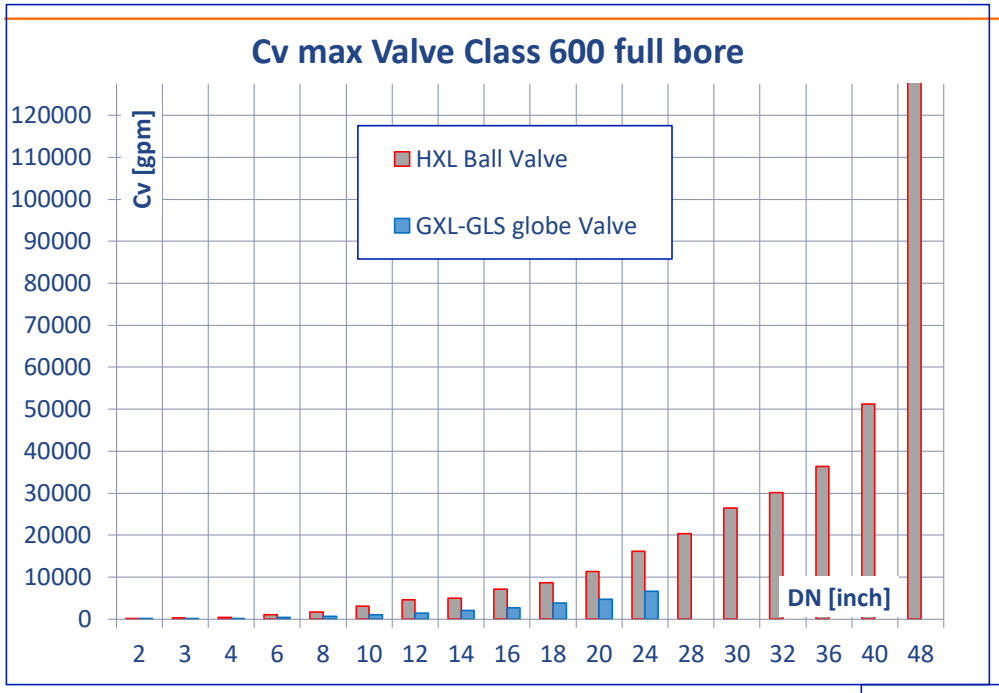




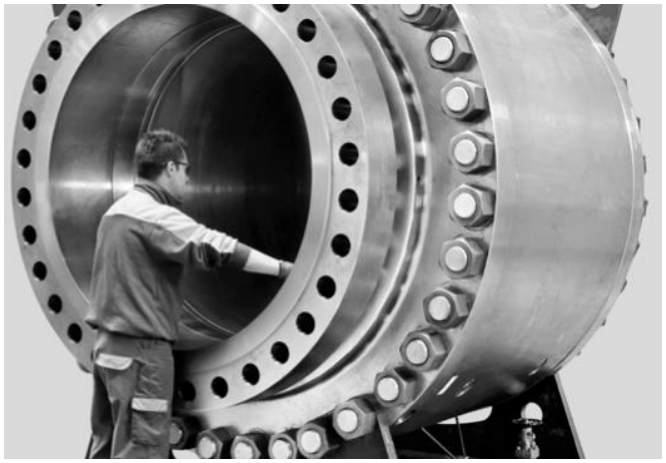


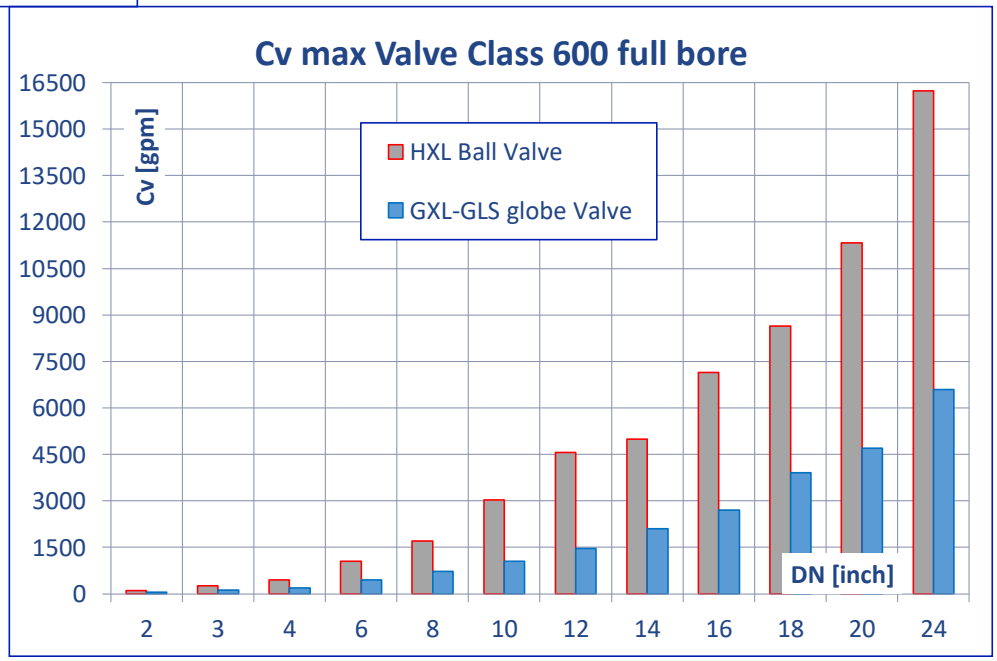


Cv Comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

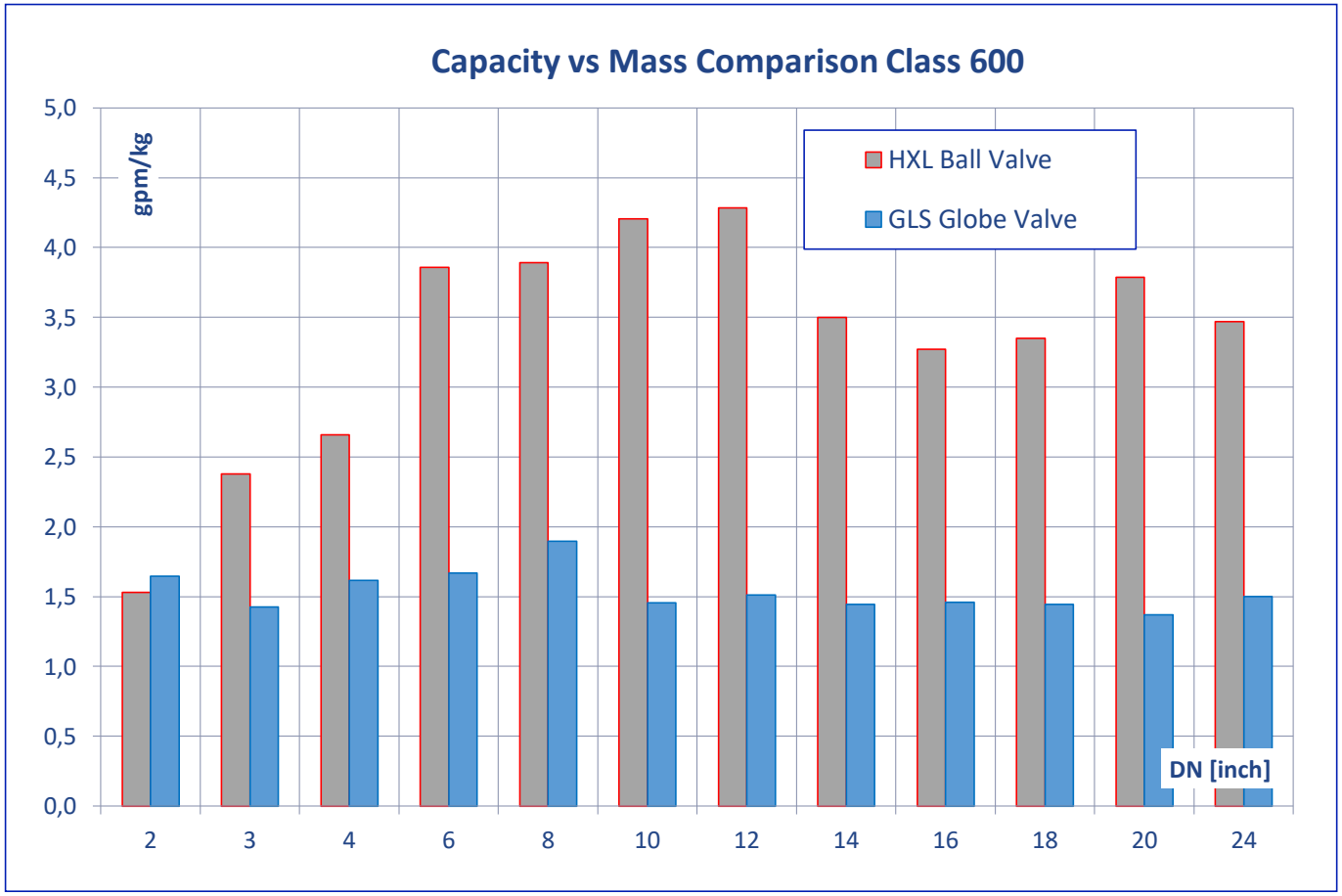


- ✓ HXL full bore.
- ✓ GLS full port, contoured plug.





Capacity vs Mass Comparison:
VSI Controls GLS Globe Valve vs HXL Ball Valve



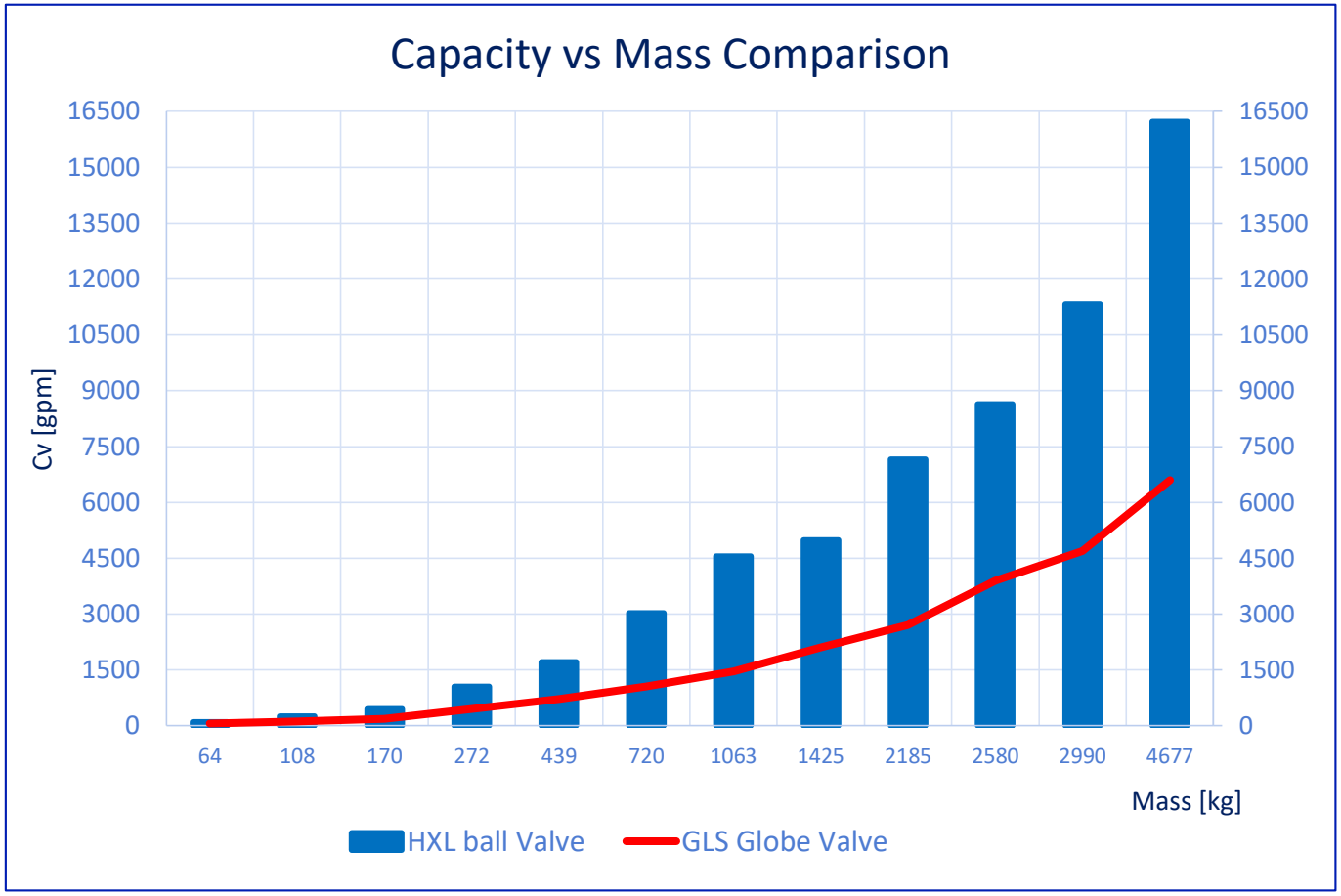
- ✓ HXL full bore.
- ✓ GLS full port, contoured plug.

Delta %

Ball/Globe:

+218%

Capacity vs Mass Comparison:
VSI Controls GLS Globe Valve vs HXL Ball Valve



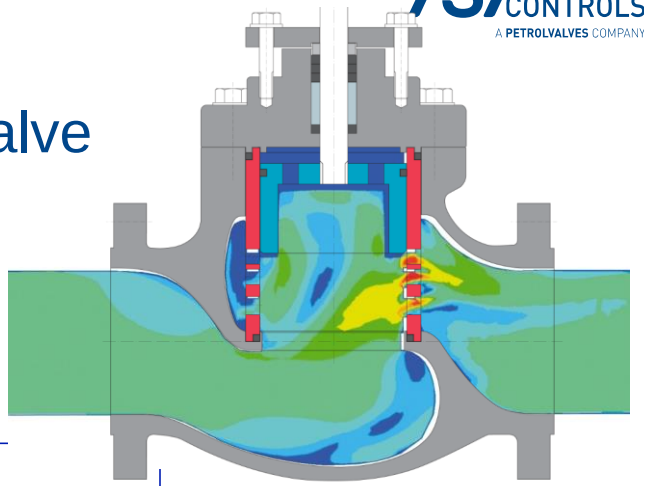
- ✓ HXL full bore.
- ✓ GLS full port, contoured plug.

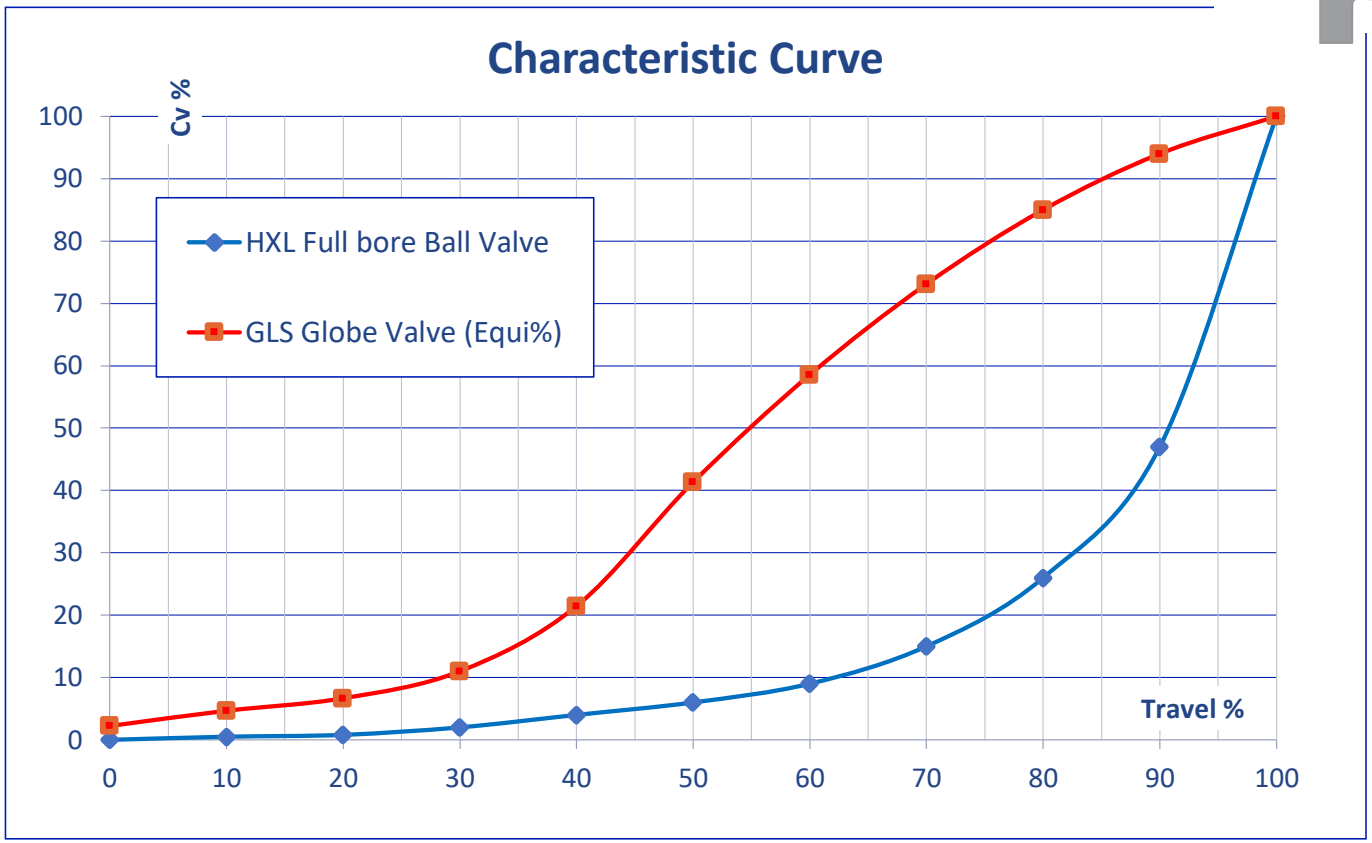
Delta %

Ball/Globe:

+218%

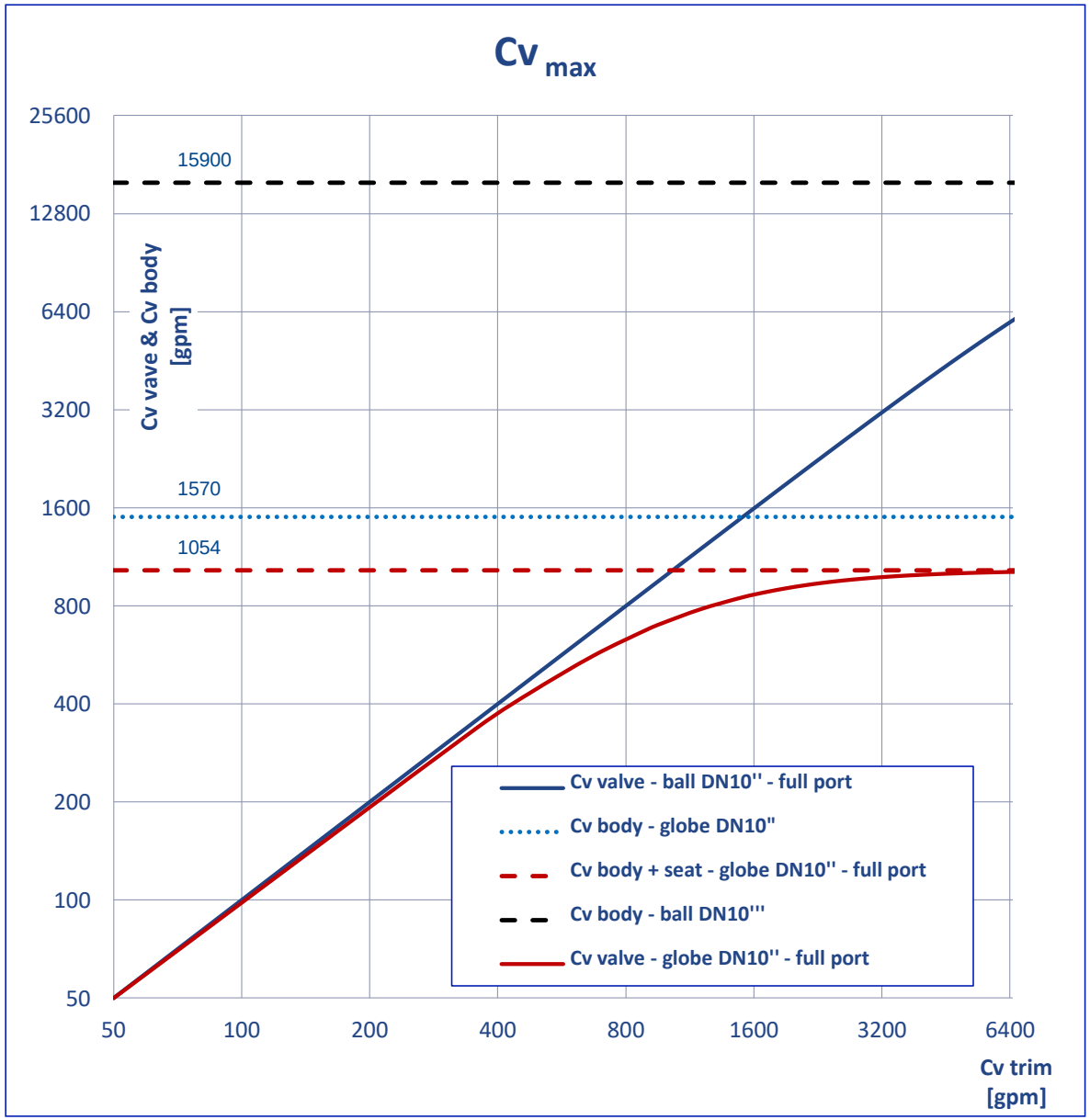
Characteristic Curve Comparison :
VSI Controls GLS Globe Valve vs HXL Ball Valve





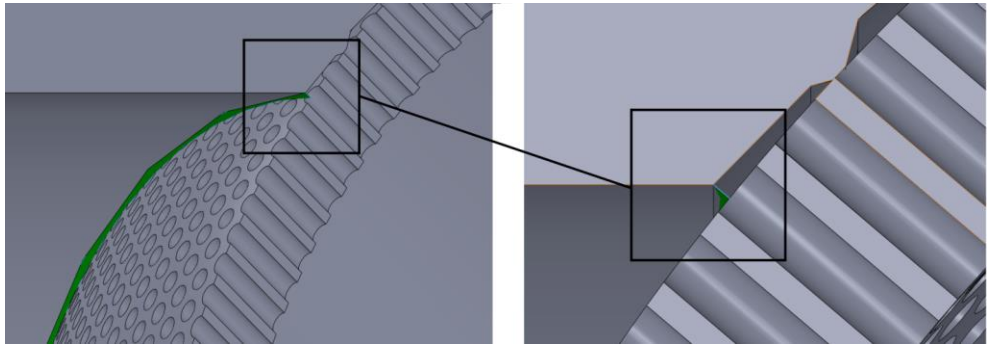
- ✓ HXL full bore.
- ✓ GLS full port, contoured plug, equi% char.

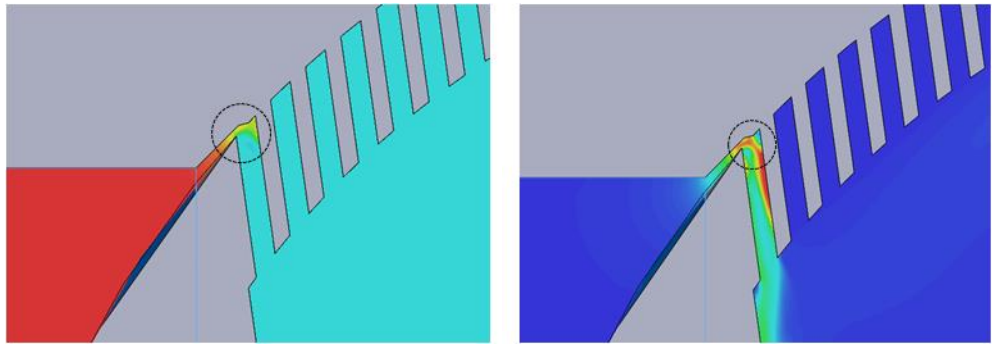
Cv Comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

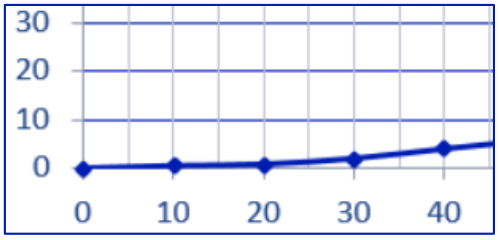


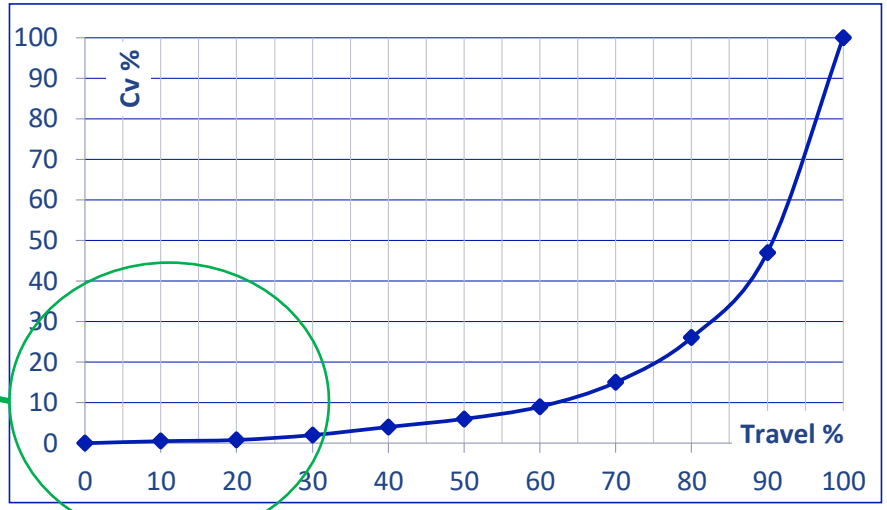
- ✓ HXL full bore.
- ✓ GLS full port, contoured plug

Rangeability comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

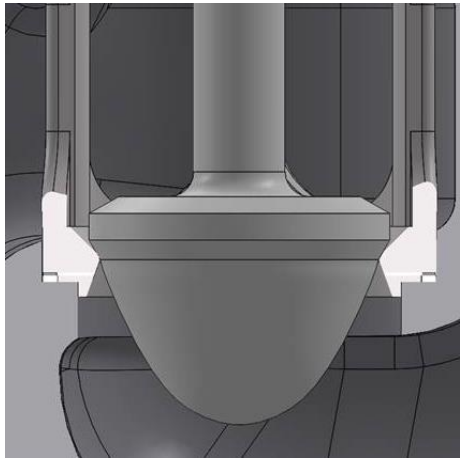


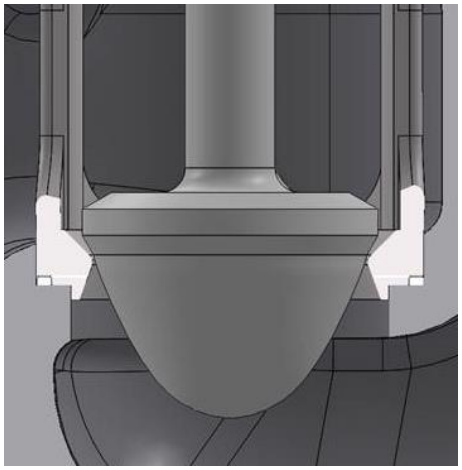


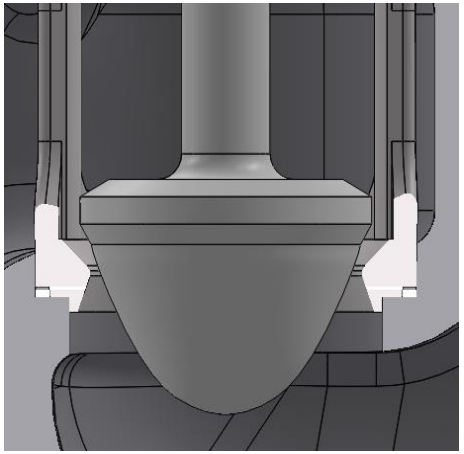


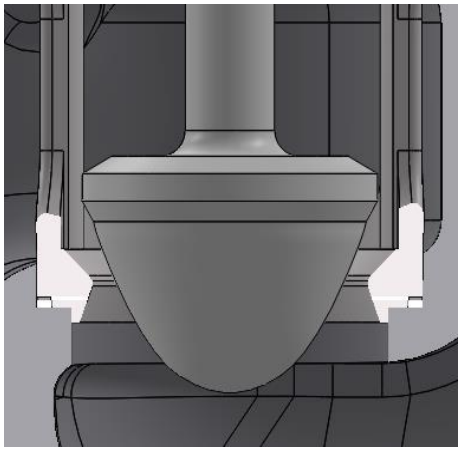


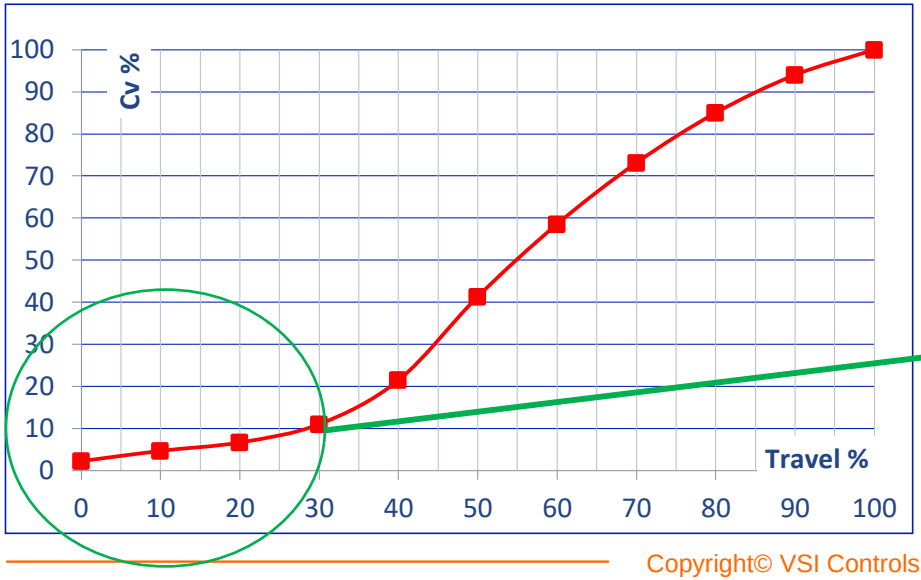
Rangeability comparison: VSI Controls GLS Globe Valve vs HXL Ball Valve

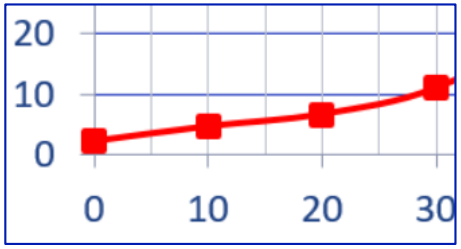






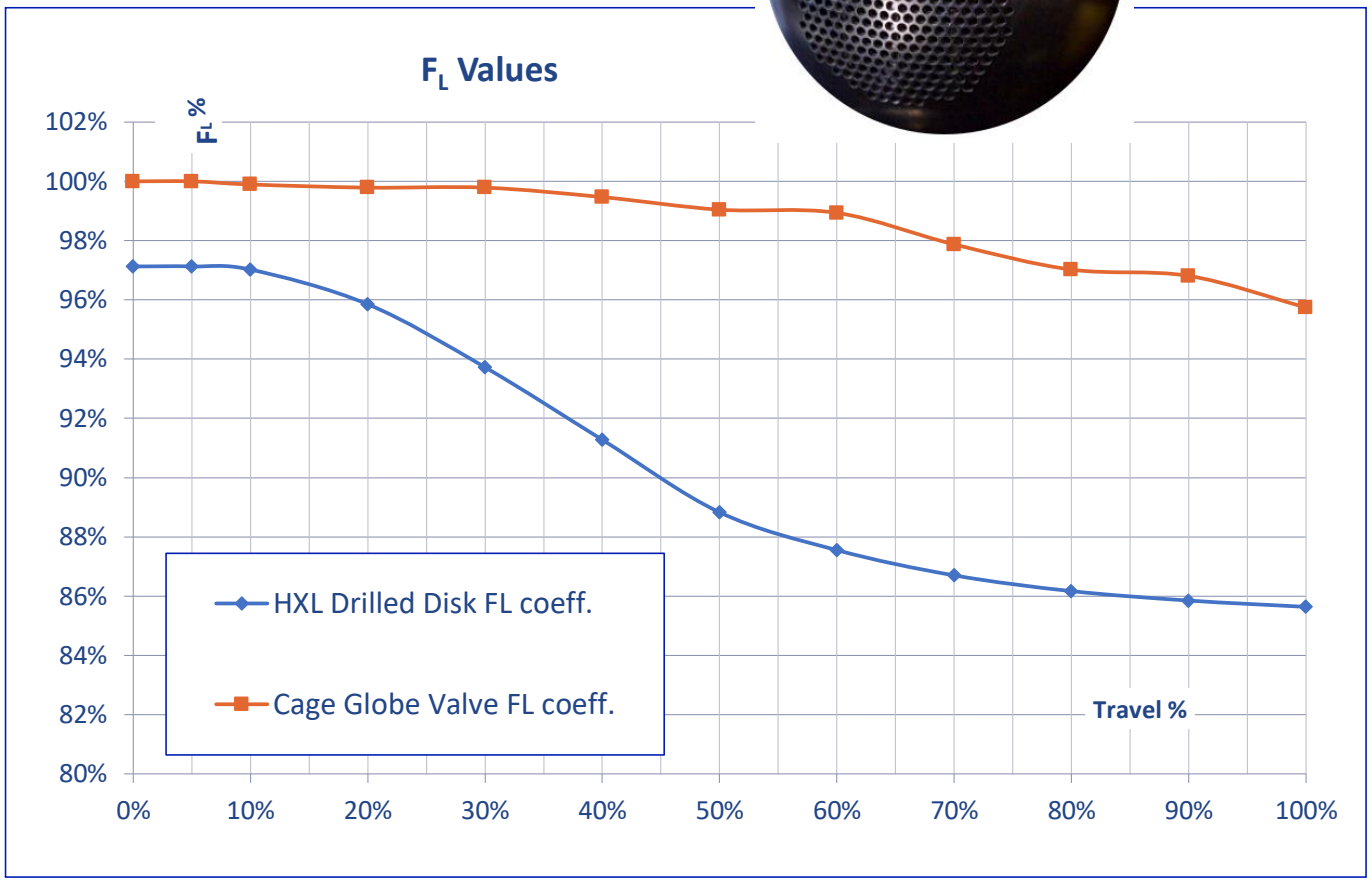






Fluid Dynamic Comparison:
Cage trim Globe Valve vs Drilled Disk Ball
F_L Coefficient

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

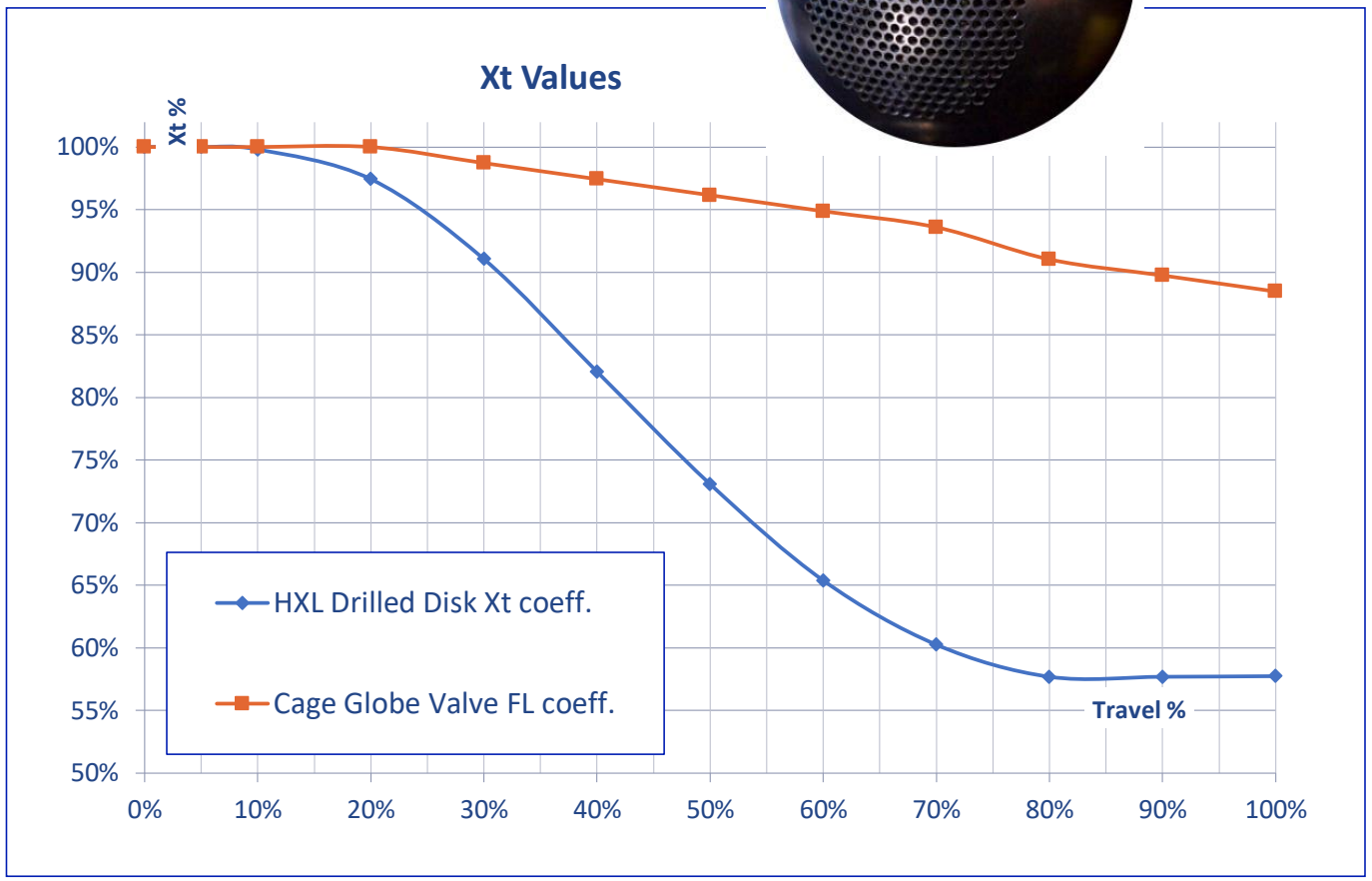


Curves related to:

- ✓ single cage globe valve trim
- ✓ single drilled disk on full bore for ball valve

Fluid Dynamic Comparison:
Cage trim Globe Valve vs Drilled Disk Ball
Xt Coefficient

$$Xt = \frac{\Delta P}{P_1}\ limit$$

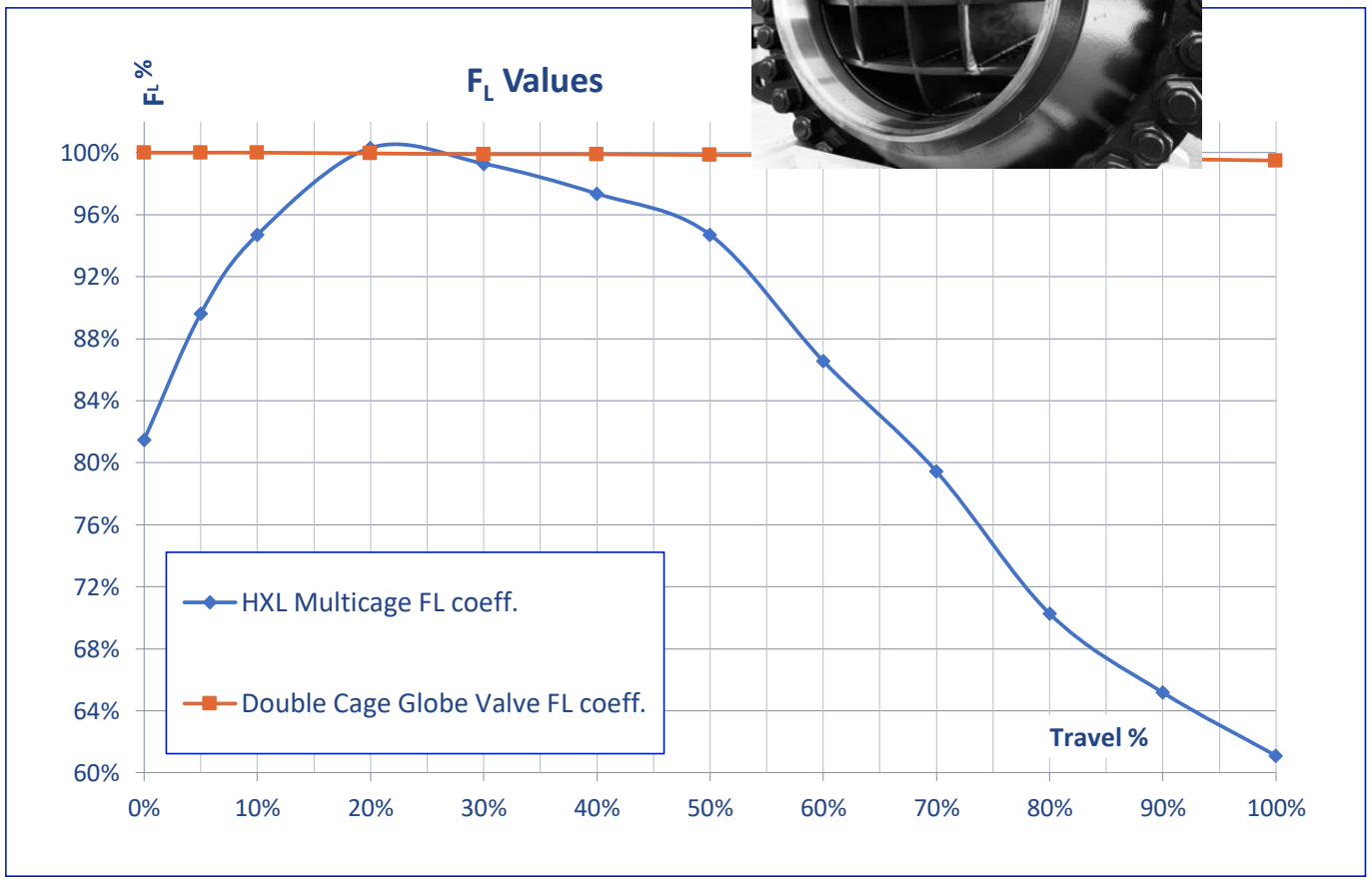


Curves related to:

- ✓ single cage globe valve trim
- ✓ single drilled disk on full bore for ball valve

Fluid Dynamic Comparison:
Multicage trim Globe Valve
vs Multicage Ball Valve F_L Coefficient

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

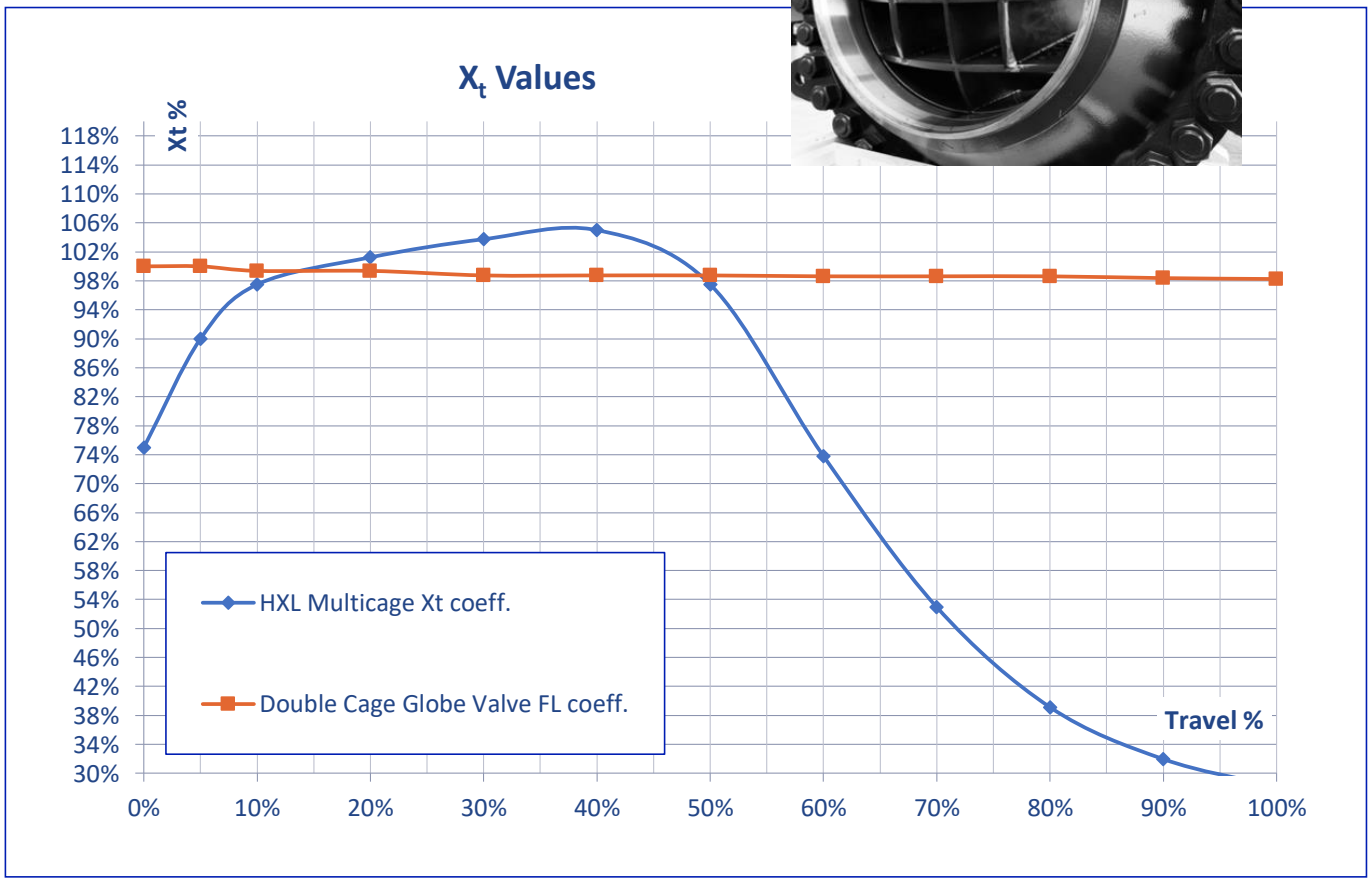


Curves related to:

- ✓ double cage globe valve trim
- ✓ multicage 3 stages ball valve trim

Fluid Dynamic Comparison:
Double Cage trim Globe Valve
vs Multicage Ball Valve Xt Coefficient

$$Xt = \frac{\Delta P}{P_1}\ limit$$

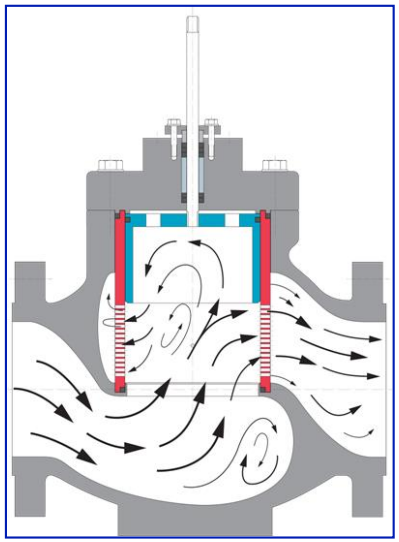


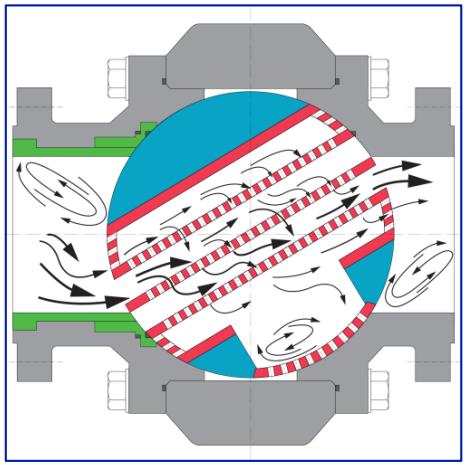
Curves related to:

- ✓ double cage globe valve trim
- ✓ multicage 3 stages ball valve trim

Conclusions

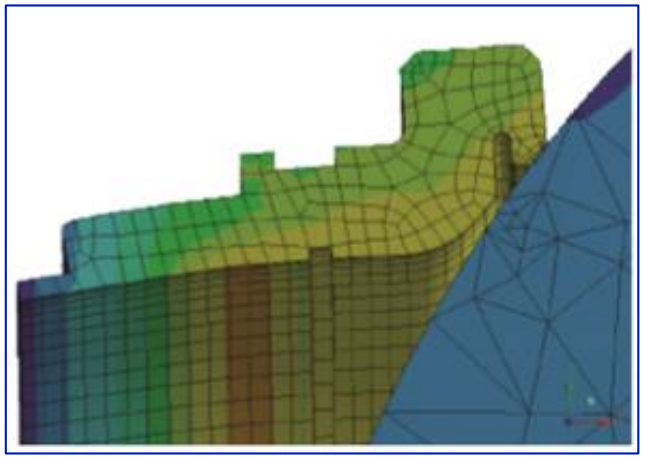
- ✓ Both Globe Valves and Ball Valves are used for Control applications. Both could be equipped with several kind of trims, to fit with several industrial applications.
- ✓ Some geometrical features make the Ball Valve less suitable when an accurate control is required: over a certain opening, especially on full bore trims, a large amount of flow rate change with a minimum variation in opening degrees. There is also some ‘play’ between the stem and ball that hinders precise control. Lastly, the amount of torque required to adjust Ball Valves do not allow for fine adjustment near the “closed” and “open” position.
- ✓ The use of trunnion mounted ball design, as well as precise coupling between ball and stem, and the possibility to equip Control Ball Valves with disk or cage trim partially limit this disadvantages.
- ✓ When a precise control at any flow rate is mandatory, the Globe Valve still have a significant margin of advantage.





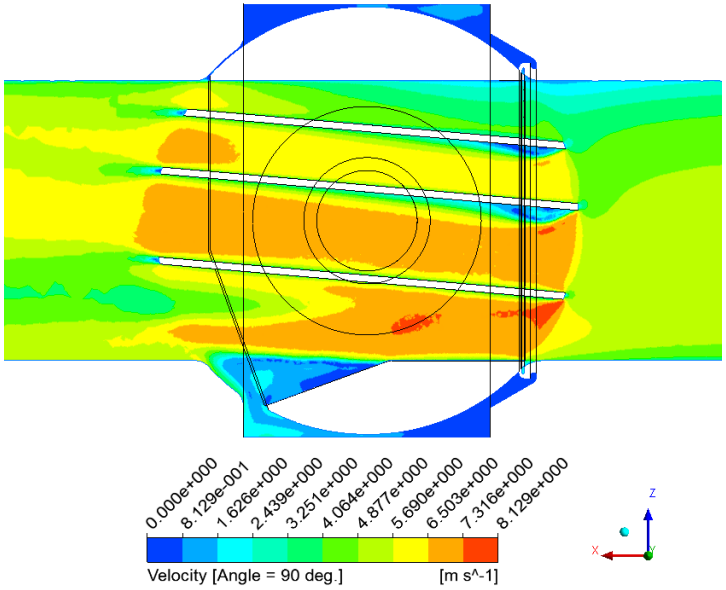
Conclusions

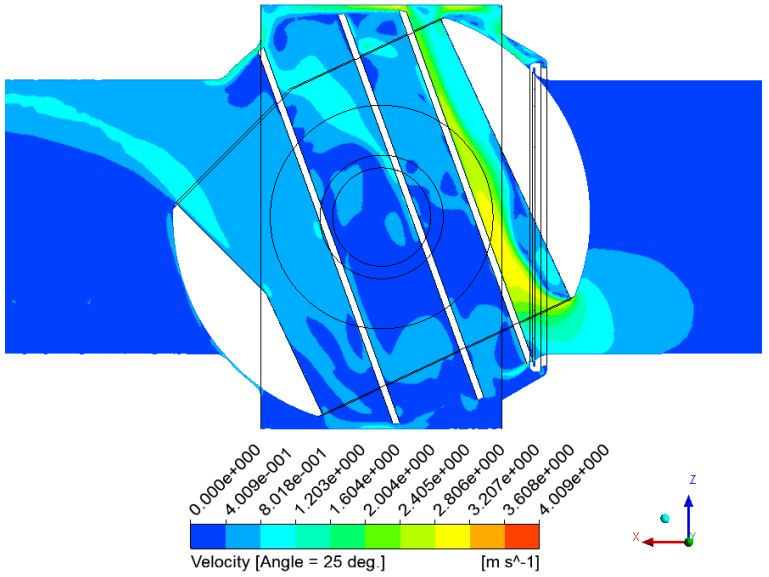
- ✓ The possibility to install P/B trims in Globe Valves, for high size valves and/or with high pressure drop, allows the reduction of actuating thrusts. This possibility is not available for Control Ball valves, which are therefore often equipped with large size actuators.
- ✓ An additional advantage of Globe Valves is related to the possibility of being used for high temperature applications, where the complex tolerance chain and the criticality of differential thermal expansion limit the use of a Ball Valve.
- ✓ The high and reliable sealing performance of the Ball Valve place it in advantage when the shutoff class is the fundamental requirement.
- ✓ Comparing the Control Globe Valve with the Control Ball Valve from the point of view of valve weight for same ND/Class a clear advantage of one over the other can not be identified.
- ✓ A comparison in terms of Capacity shows instead a huge advantage for the Ball Valves. This advantage is evident both in terms of capacity for a given ND and Class, than in terms of net capacity for mass unit.



Conclusions

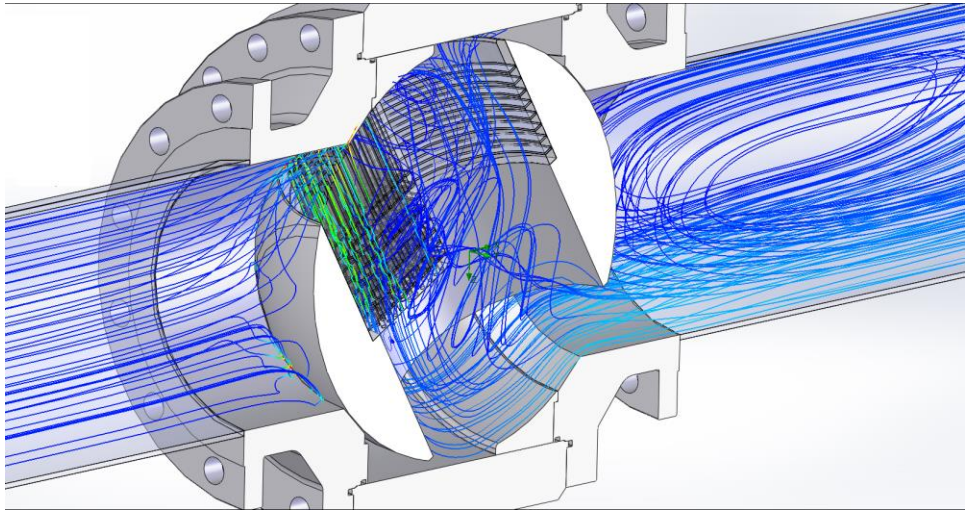
- ✓ From the point of view of the Characteristic Curve the Ball Control Valve is not affected in any way to valve body Cv, and the resulting curve is determined solely by the trim Cv.
- ✓ The possibility to regulate small clearance flow rate at first openings, combined with the possibility to discharge huge flow rates at valve completely open allows the Control Ball Valve to reach rangeability values theoretically infinite.

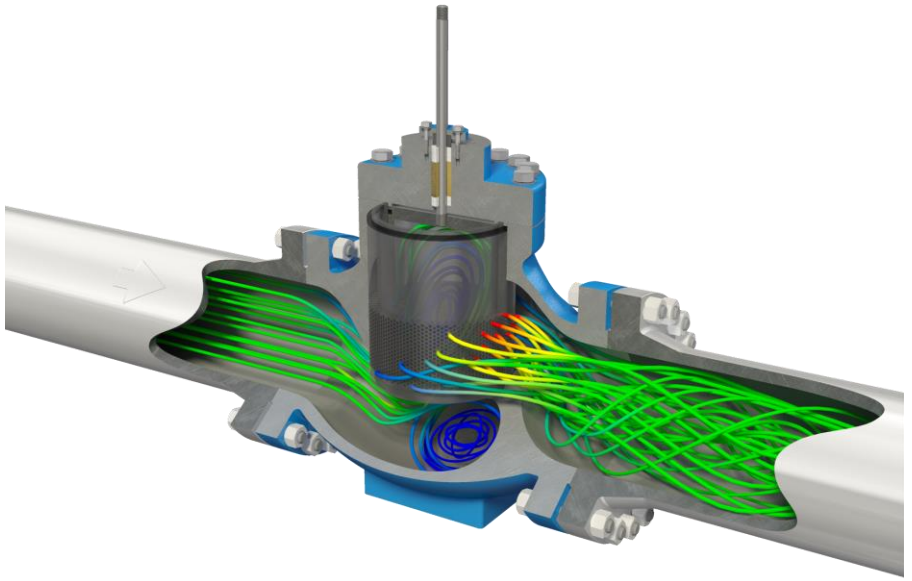




Conclusions

- ✓ Fluyd Dynamics coefficents are higher for Control Globe Valves, both regarding anti cavitation performances on liquid flows, and regarding velocity control and noise reduction on gas flows. The advantage of Globe Valves is significant both in case of full bore valves, and in case of application of cage or multicage trims.
- ✓ Control Ball Valve can reach F_L and Xt values comparable to those of a Globe Valves only in correspondence of some range of openings, while the globe valve assure a more constant value of coefficient over the entire stroke of the valve.





Thanks for Your Attention

M.Ferrante

michele.ferrante@vsicontrols.com