Key Considerations for Specifying Rotary vs. Globe Control Valves

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Key Considerations for Specifying Rotary vs. Globe Control Valves

It is not uncommon for engineers in the process industry to ask about selection criteria for specifying a linear (globe or sliding stem) control valve as opposed to a rotary (ex: eccentric plug, segmented ball, butterfly) control valve solution in a given application.

Admittedly, engineering specification decisions are sometimes based upon past convention simply because selecting what has been used previously may be the least risky approach. No one wants to be the person asked why there was a deviation from past practice should something possibly go wrong. *Ideally, all specifications should be based upon process requirements derived from process needs.*

ZX Rotary Globe Control Valve
Courtesy of © Valmet

Needs > Requirements > Specifications. If this is completed, the engineering design basis should be traceable, and there should never be a question of why in a properly designed system.

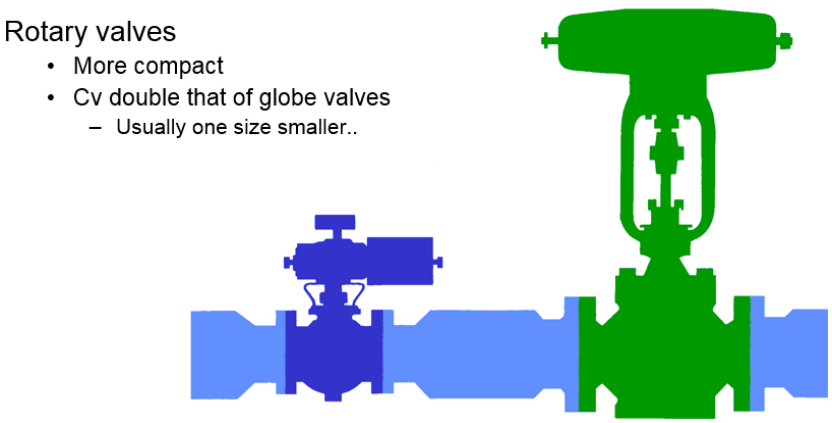
While technological obsolescence can cause a relatively short service life for process automation hardware, the properly specified control valve, in comparison, can have a much longer term of service, especially if the life cycle is managed optimally. This can mean that control valve engineering selection decisions aren't as frequently analyzed for improvement. Control valve manufacturer/suppliers may also have financial disincentives to point clients to less expensive options.

G Series Globe Control Valve
Courtesy of © Valmet

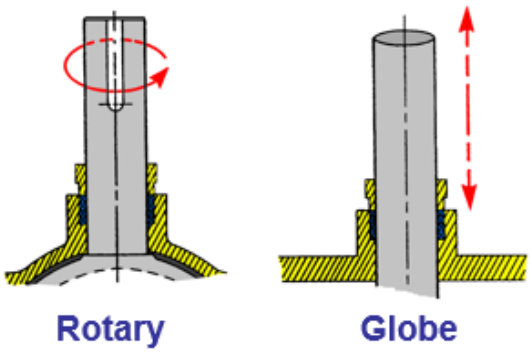
The growth of modularization in process industry capital construction is leading to greater analysis of installed equipment weight and envelope dimensions. Concerns with fugitive emissions can also be a factor when evaluating rotary versus sliding stem options.

Rotary control valves have gained in popularity because of the following reasons:

1. <u>PHYSICAL SIZE:</u> The envelope dimensions of the rotary control valve installation are usually smaller than that of a globe valve with comparable flow capacity, thus saving space and weight.



2. Stem Sealing Life: The process, sometimes hazardous or just sticky, can coat a valve stem and if pulled through the packing of the valve, as is the case with a sliding stem valve, packing damage can occur. Rotary valves will therefore have longer stem sealing life and less resulting fugitive emissions. *This would not be the case if bellows sealing were used in a linear globe control valve.*

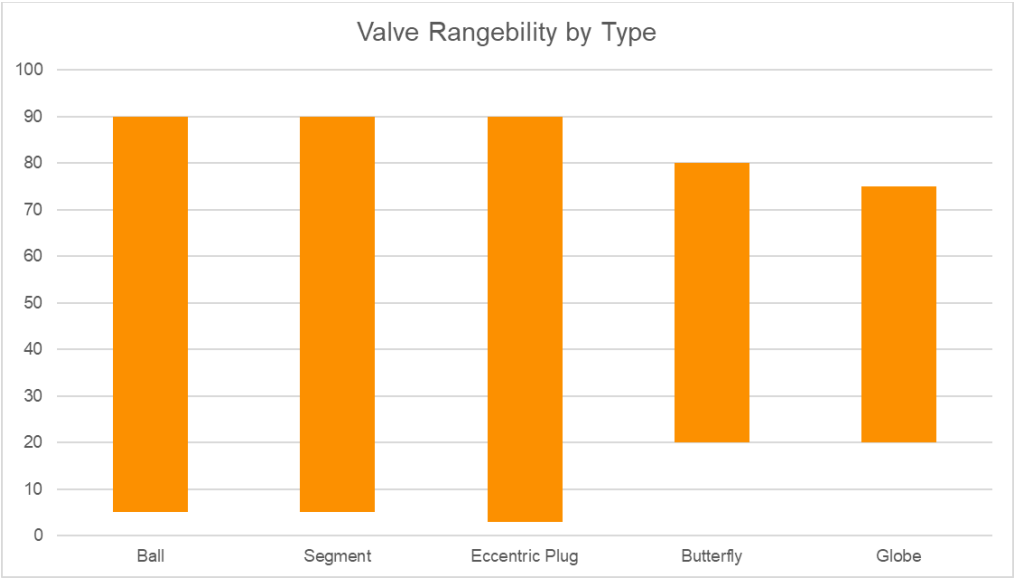


A real world comparison is shown in the picture below. Both valves were installed at the same time, with these pictures taken about 1 year into service for both valves. The valves were installed in the same process media and at the same time. Note the obvious process leak at the packing on the globe valve - right picture.

Neles Rotary Globe

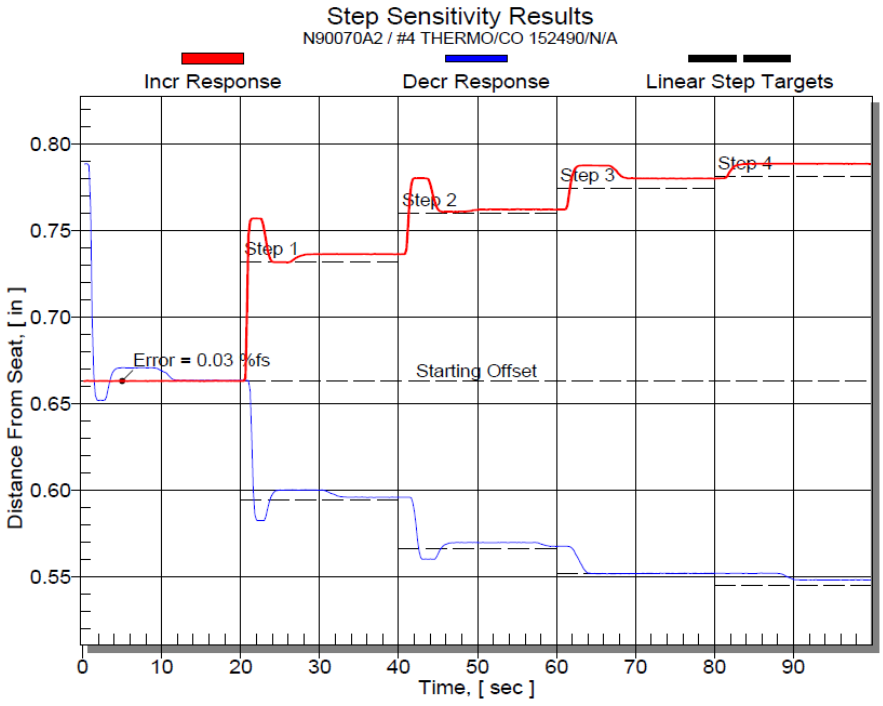
Competitor Linear Globe

3. Rangeability of control is typically greater with a rotary solution so a wider flow range can be covered with a single valve. While no control valve should operate below 20% opening for extended periods of time, it's possible on some valve types to achieve good control



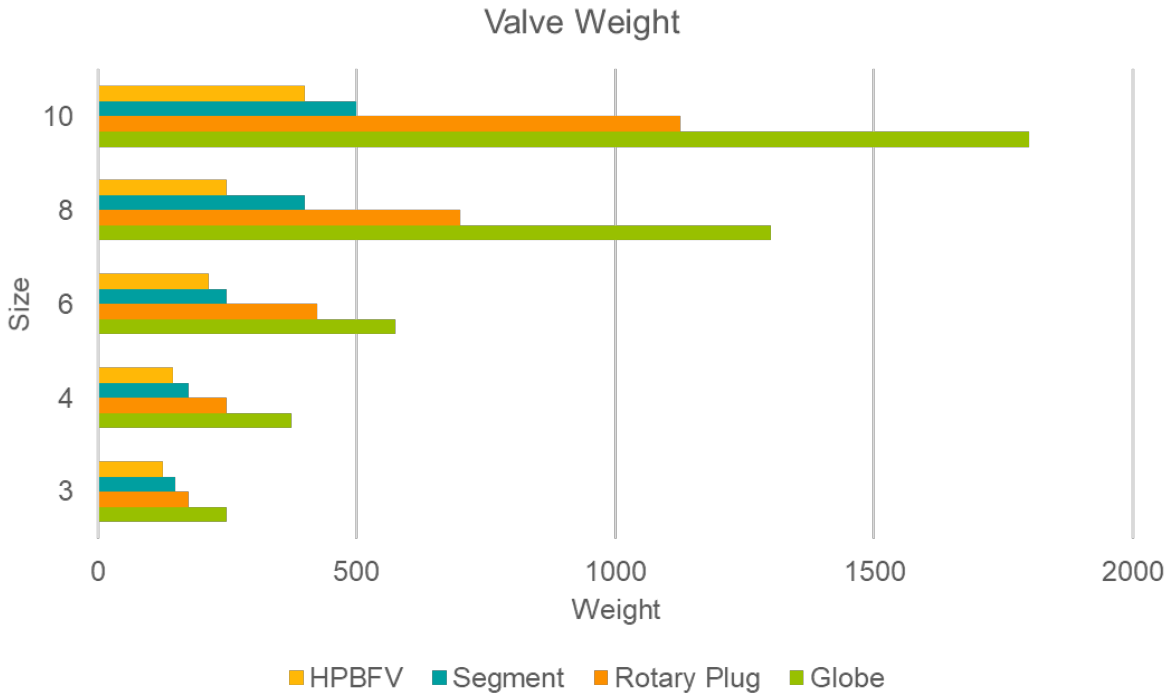
during startup cases. The chart to the right shows rangeability by valve type.

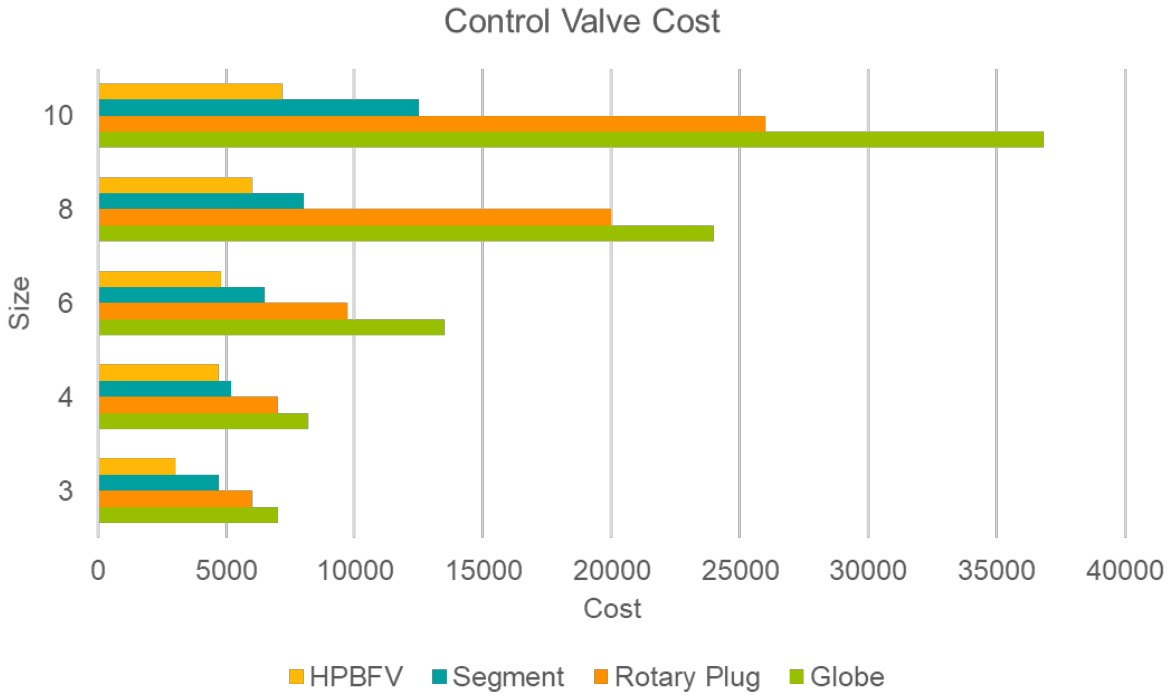
4. Permanent pressure loss is lower through rotary valves as compared to globes. The reason is both the valve body shape, and the trim. Globe style valves have a torturous path through the body, which will inherently absorb some of the pressure drop across the valve. Also, the trim of globe valves is always in the flow path and does not swing out of the way like a segment or ball valve, again absorbing more pressure drop across the valve. Greater permanent pressure loss can lead to higher energy costs.
5. Actuation Options: Rotary valves are more readily actuated with double acting pistons when a "fail last upon air failure" specification is needed. While there are some exceptions, most globe valve manufacturers will typically orient their product offerings around spring diaphragm actuation, necessitating a fail open or fail close choice. Of course, double acting piston solutions for globe valves are available through several manufacturers and via third party suppliers, but for most manufacturers, spring diaphragm is the norm, leading to greater availability in supply. The volume of quarter turn actuation out on the market provides a variety of choices, whereas linear globe users typically provide their own brand actuator.
6. Slurry Services: Rotary control valves are chosen for dirty or slurry services due to a less tortuous flow path and in some situations, can provide benefits in flashing applications.
7. Control Performance: When higher friction, graphite packing is necessarily specified, sliding stem valves can demonstrate difficult stick-slip action that may not be as acute when compared to a similar size rotary solution also specified with graphite packing.



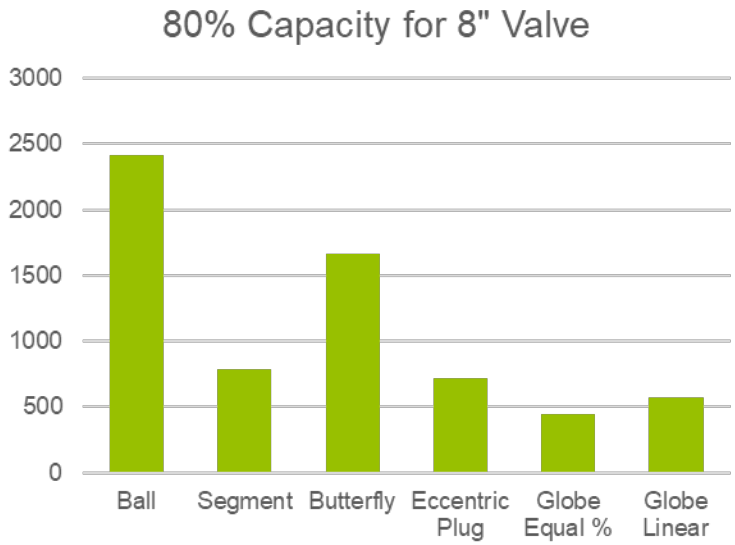
8. Shutoff: While tight shutoff may not be a primary consideration for throttling control valve specification, rotary valves will typically provide for lower allowable leakage rates when fully closed.
9. Cost: Rotary valves are less expensive than globe valves – globe valves can be prohibitively expensive on larger sized applications as compared to rotary. In applications in steam power plants where larger control valves (8" and above) are common, such as typically seen in low pressure steam let down stations or turbine by-pass, a rotary solution (high performance butterfly) can be a superior choice, even if necessarily coupled with a downstream diffuser. The price and weight of the combined package are reduced, and manufacturing lead times much shorter when compared to a sliding stem option.

10. Weight: Rotary control valve assemblies will usually weigh less than a similar linear globe option. Consider the chart below. As with the cost comparison, larger line size and heavier valves will justify moving away from a globe solution. Not only is the valve weight indicative of it's cost, there can be a significant difference in ease of installation with a lighter valve.





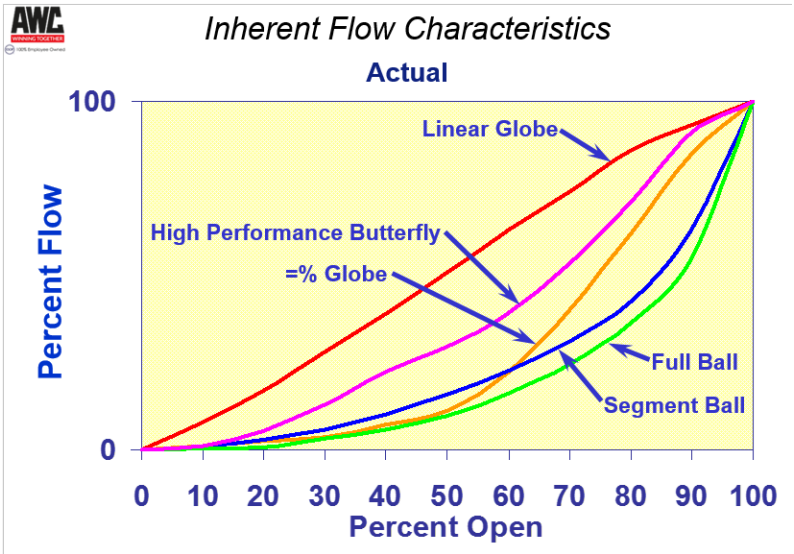
11. Capacity: Rotary valves have more capacity (Cv). This can lead to smaller sized valves / actuators being installed into a similar application as a linear valve. As a rule of thumb, the rotary valve should not be less than ½ the pipe size to ensure flanges will handle the piping stresses.



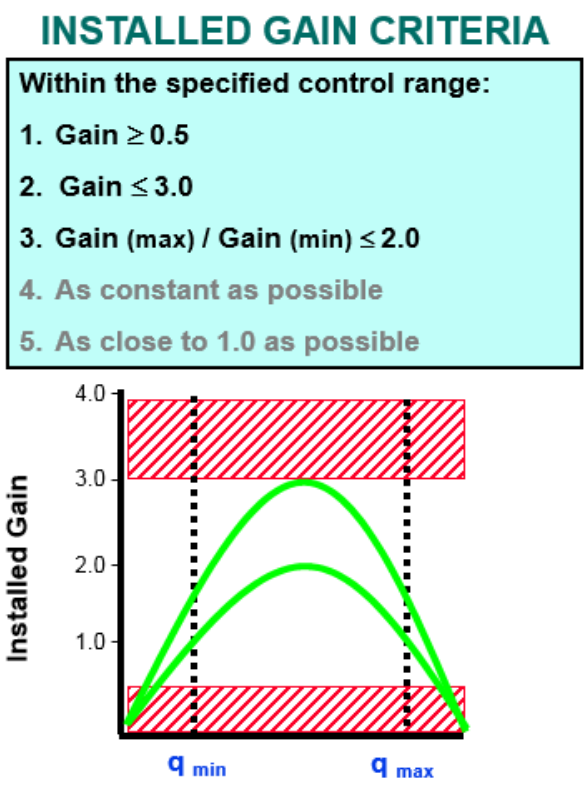
However, Globe (Linear, Sliding Steam) control valves can have demonstrable advantages over a rotary solution as detailed below:

1. Versatility: Globe valve trim can be altered with multiple options available within the same body size for changes in flow control sizing, performance and inherent characteristic, whereas rotary valves typically cannot be altered. The control characteristic of a rotary valve is fixed – typically as modified equal percentage characteristic.

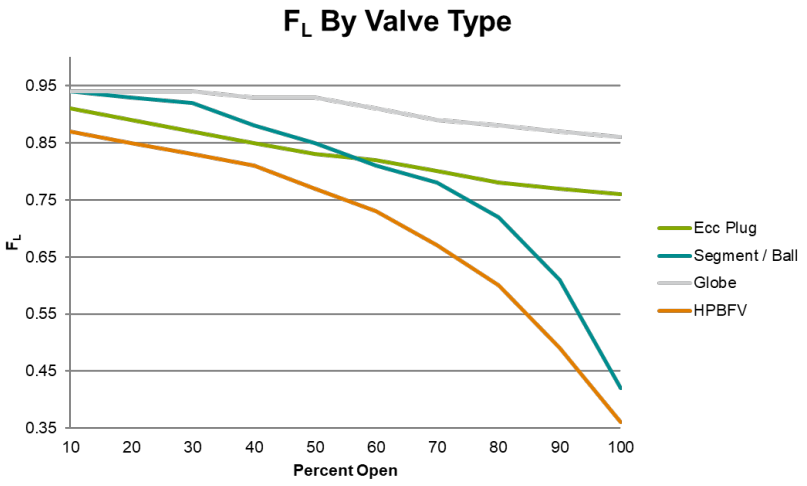
2. Low Q Trim: While several manufacturers offer low flow trim options in a ball valve platform, globe control valves will have more low flow (Cv) options than rotary control solutions.



3. Installed Gain: While globe valves have lower rangeability, they can have the advantage of lower installed gain. From a pragmatic standpoint, it is more likely that a globe valve will be sized so that a greater amount of the valve travel covers an expected flow range. This simply means that a small change in closure member movement results in less flow change providing less inherent gain and potentially tighter control. A further explanation of this point is beyond the scope of this publication, but there are exceptions to this depending upon application, process gain and controller tuning. Some control valve sizing software packages provide for iterative comparison of various types and sizes of control valves in order for these factors to be analyzed in detail.

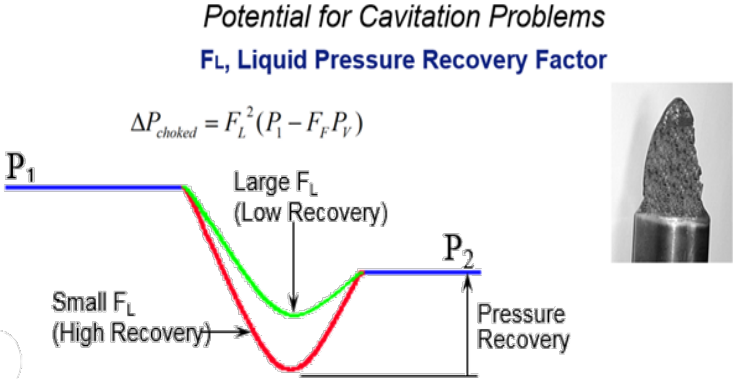


4. Pressure Recovery: Globe valves generate more permanent pressure loss but with lower pressure recovery downstream and are subsequently less likely to create problems with cavitation and noise. Again, this may not be a concern in many applications but valve sizing software can predict potential challenges with noise, flashing or cavitating conditions.



5. Trim Options for Noise and Cavitation: A few manufacturers (Valmet being one) offer attenuation trim options for rotary control valves when considering noise and cavitation conditions, but there are more source treatment trim options in the sliding stem (globe) platform. Globe control valve designs from various manufacturers allow for throttling of higher pressure drop gas or liquids, especially when these severe process conditions exist.

6. In-Line Repair: Globe control valves are inherently top entry designs which allow for repair work in-line without removing the valve from the process piping. This is obviously an advantage when considering welded-in valves.



Valves	Globe Top Guided	Globe Cage Guided	Ball Full/Segment	Eccentric Rotary Plug	 High Perf Butterfly
Cost	High	High	Medium	Medium	Low
Weight	High	High	Medium	Medium	Low
Flow Capacity	1 X	1X	2 X	1 X	2X
compared to globe					
Cavitation Potential	Low	Low	Medium	Medium	High
In-line repairable	Yes	Yes	No	No	No
Cav./Noise Reduction Options	No	Yes	Some	Some	No
Suitable for High Pressure Drop	Limited	Yes	Limited	Yes	Limited
Suitable for Dirty Service	Yes	No	Yes	Yes	Yes
Suitable for Slurries	Limited	No	Yes	Yes	Limited
Inherent Flow Characteristic	=%, Linear, Quick Opening	=%, Linear, Quick Opening	=%	Modified Linear	=%, Mod =%

References

Monsen, J. (2014). Control Valve Application Technology