SINGER VALVE

Result-Based Solutions. Globally.™

Anti-Cavitation Trim



- **Eliminates cavitation damage**
- **Reduces noise**
- **Preserves valve and surrounding pipe systems**

singervalve.com

Model 106-(*)-AC
Automatic Control Valve with Anti-Cavitation Trim

Say Goodbye to Cavitation Damage!

Cavitation, a common problem in pumps and control valves, causes wear and tear, and serious damage. Cavitation can dramatically reduce the lifetime of system components and repairs are extremely costly.

Singer Valve's Anti-Cavitation Trim is one of the most innovative products in the industry today. Our dual cage Anti-Cavitation Trim eliminates damage caused by cavitation and reduces noise that occurs during the cavitation process. As a result, the life of the valve, system components and nearby piping is greatly enhanced.



Dual Anti-Cavitation Cages

What is Cavitation?

Cavitation occurs when the local pressure in a fluid reaches a level below the vapor pressure of the liquid at the actual temperature. This may happen when the fluid accelerates in a control valve or around a pump impeller. The vaporization itself does not cause the damage. The damage happens when the vapor almost immediately collapses after evaporation when the velocity is decreased and static pressure is increased.

Cavitation consists of rapid vaporization and condensation within a liquid. When local pressure falls to vapor pressure (approximately 0.25 psi / 0.018 bar absolute for cold water), vapor bubbles are formed. When these bubbles travel to an area of higher pressure, the bubbles collapse with phenomenal force. The violent collapse of these vapor bubbles near valve components or downstream piping surfaces causes cavitation damage and degrades performance.

The pressure drop across a control valve creates high velocity in the seat area and corresponding low pressure because potential pressure is reduced to compensate for the increase in kinetic energy. In control valves, this process typically occurs at or near the seat area or just downstream. The shock waves and pressure fluctuations resulting from these high velocity bubble collapses can also cause noise, vibrations, accelerated corrosion as well as limited valve flow. Typically, the cavitation occurs in the valve throttling area and the pressure fluctuations radiate into the downstream pipe as noise. When cavitation increases, pressure fluctuations increase. System vibrations, pipe wall vibration, and component damage also increase.

To better predict when cavitation may occur, often manufacturers will use the cold water cavitation coefficient as a reference or approximation. In globe style valves, damage may occur when the cold water coefficient is less than the 0.7. This roughly translates to a 3:1 ratio indicator (for example: 300 psi / 20.7 bar to 100 psi / 6.9 bar). At Singer Valve, we use this ratio as a rule of thumb to flag applications for careful consideration.

Four Serious Side Effects of Cavitation

EROSION – The most dangerous effect of cavitation is erosion and corrosion damage of the control valve or the nearby downstream piping. Severe cavitation commonly erodes through a valve wall or the nearby piping in a mere matter of months resulting in the need for repair or replacement.

STRONG VIBRATIONS – The shock waves generated by collapsing vapor bubbles produce pressure fluctuations and related vibration. As cavitation increases, the magnitude of the vibrations increases. Even systems with large properly secured valves exhibit pipe and valve movement during cavitation. These vibrations loosen bolts, fatigue material, loosen or break restraining devices and ultimately lead to structural damage or failure.

LOUD NOISE – In its mildest form, cavitation produces a light crackling sound, similar to popcorn popping. At more advanced stages, cavitation in certain valves sounds like gravel rumbling through the pipeline. In a large valve, the noise can become violent, resembling exploding dynamite that exceeds 100 db. The result is noise pollution in the neighboring areas and a risk of hearing damage.

RESTRICTED CHOKED FLOW – Because of the presence of water vapor displacing liquid water, the capacity needed for the required flow rates can be seriously restricted.

THE EXTENT OF CAVITATION DAMAGE

As a result of persistent and recurring cavitation, the reliability of control valve accessories and other system components is compromised. The most dangerous outcome is erosion of the control valve or the nearby downstream piping.

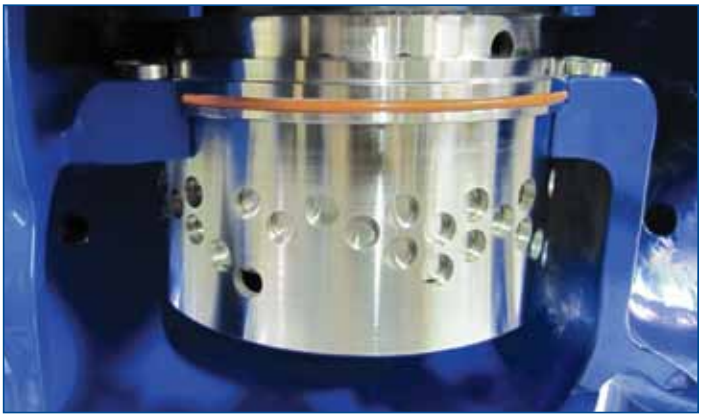
Singer's Solution to Cavitation

There is no way to eliminate cavitation in a control valve. But, there is a way to eliminate cavitation damage. More than 25 years ago, Singer Valve designed a solution to direct and contain the cavitation process. The Singer Valve Anti-Cavitation Trim is comprised of two stainless steel sliding cages that maximize full flow capacity. The first cage directs and contains the cavitation recovery, allowing it to dissipate harmlessly. The second cage allows further control to a level as low as atmospheric pressure downstream.

How does our custom designed Singer Valve Anti-Cavitation Trim differ from other anti-cavitation cages? Anti-cavitation products with pre-fabricated cages that have pre-fabricated slots disregard the pressure differential across the valve. As a result, they are designed neither for the particular system nor the specific application. Consequently, they are not equipped to handle the entire flow range and demand of a system and cannot control all cavitation at all flow rates. That becomes apparent when a back pressure orifice plate must be installed downstream to minimize the differential pressure across a valve. Orifice plates are sized only for a specific flow range and almost always to ensure high flow rates. During periods of lower demand, however, the differential across the orifice plate drops to the point that water flows through the plate without creating any of the needed backpressure, allowing cavitation to occur past the valve. As a result, valves with pre-fabricated anti-cavitation cages have serious limitations. The greater the pressure differential and the wider the flow range, the more limiting the valve becomes.

With Singer Valve's Anti-Cavitation Trim, each cage is engineered to meet the flow / pressure differential of each application, which makes orifice plates unnecessary. Our clients receive a custom solution that is engineered to meet the application's specific requirements…every time.

We guarantee that our valves work 24 hours a day, through all flow rates, even at very low flow such as off-peak times or night-time usage. That means no cavitation damage regardless of the flow rate. It's the ideal solution in one reliable valve.



Anti-Cavitation Cages in Valve Body

KEY FEATURES OF SINGER'S ANTI-CAVITATION TRIM

- Eliminates cavitation damage
- Single valve solution handles differential pressure of 300 psi / 20.7 bar, even to atmosphere
- Minimizes vibration
- Solves high pressure drop problems
- Controls continuous and/or variable flows
- Handles a wide range of flows without the use of orifice plates
- Reduces noise significantly

Sizing Considerations

A valve should never be sized according to existing pipeline sizes. Instead, the flow of the system should be considered. When Singer Valve engineers an anti-cavitation solution, we require that specific flow ranges, inlet pressure ranges and outlet pressure data is provided. The data is then entered into our proprietary engineering software which calculates the size and placement of each orifice on both the inlet and outlet cages.

The key advantage of using application specific data is that Singer Valve can engineer the orifices and provide you with a customized solution that will achieve optimal results.

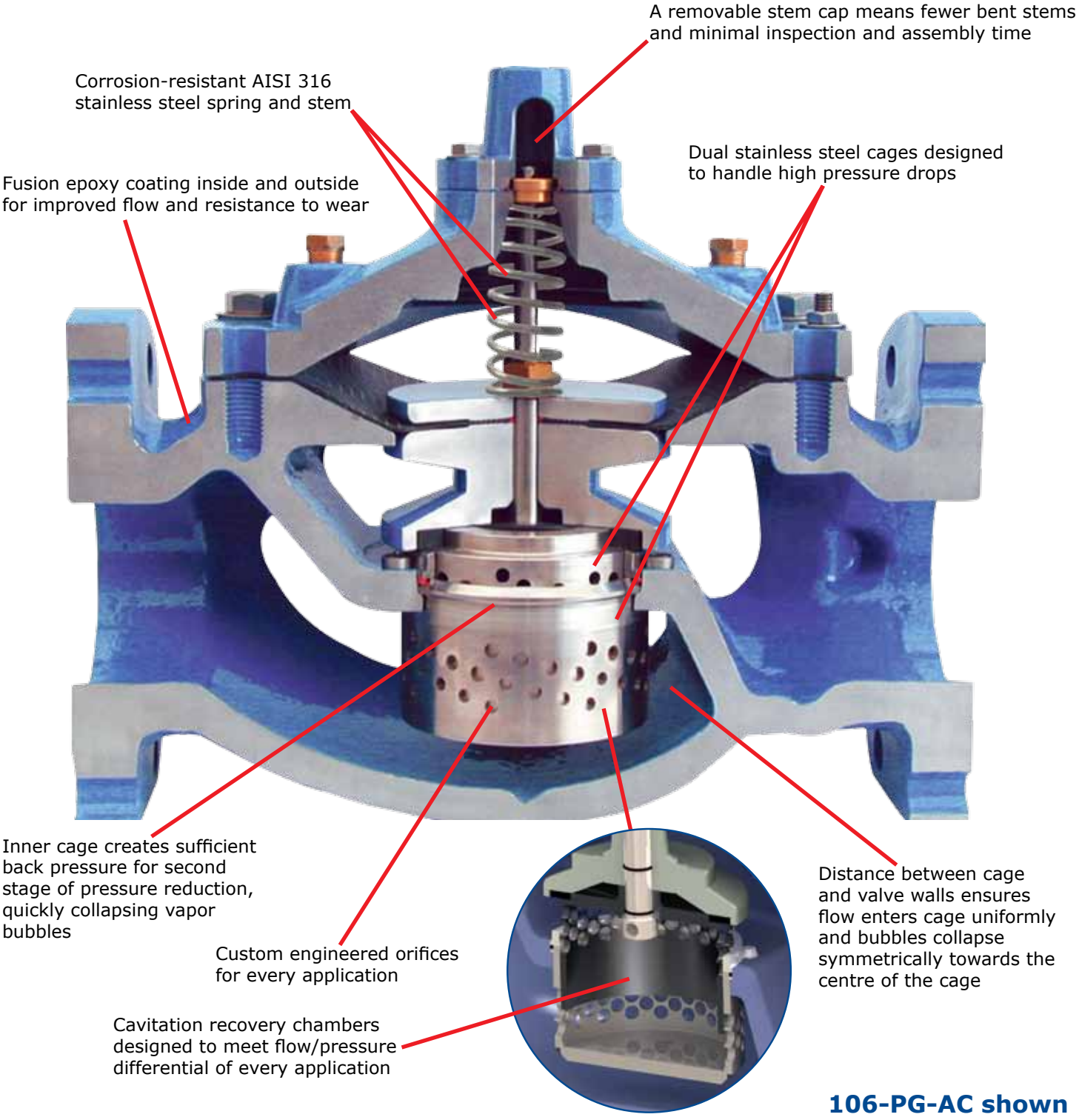
With Singer Valve, the engineered orifices are designed to fit a larger cage allowing higher C_v values (flow coefficient; K_v in metric units) while the body is designed to allow reasonable space between the Anti-Cavitation Trim and the body wall. This separation allows for uniform entry around the cage area ensuring the vapor bubbles collapse symmetrically towards the centre of the cage. Extreme pressure drops, even to atmosphere, can easily be handled with Singer's Anti-Cavitation Trim. Its dependability is limited only to the accuracy of the engineering data supplied.

WHY SINGER DOES IT BETTER!

Singer Valve takes your data and enters it into our proprietary software to custom engineer orifices for optimal performance. Singer guarantees our valves through all flow rates without the use of orifice plates.

The Singer Valve Advantage

At Singer Valve, we care about performance. That's why our Anti-Cavitation Trim has saved valves and the surrounding pipe systems from cavitation damage, reducing the need for maintenance. So, what's the difference between the Singer Anti-Cavitation Trim and others on the market? Take a look.



106-PG-AC shown

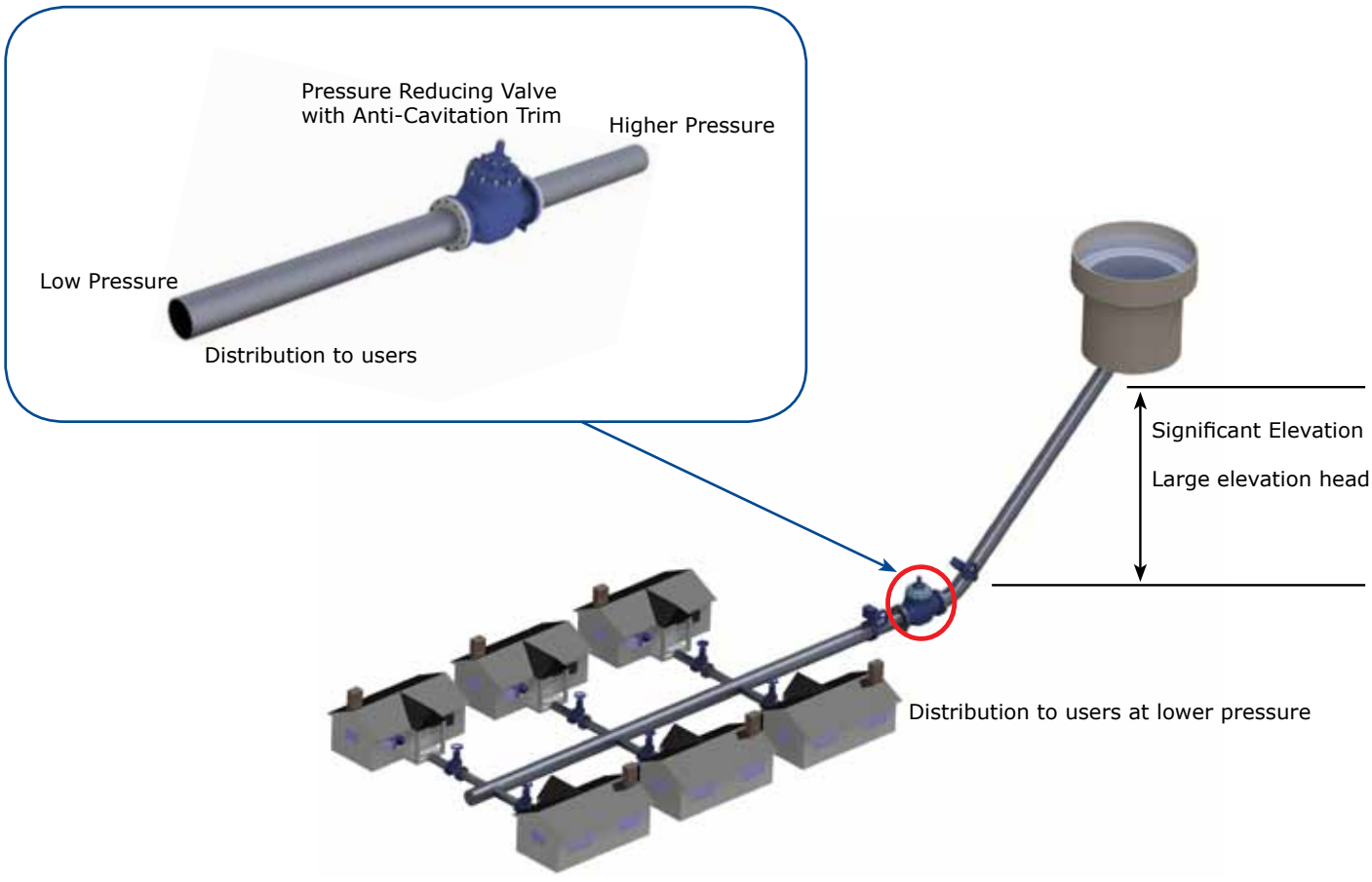
Typical Applications

The Singer Valve Anti-Cavitation Trim is typically used in applications that have outlet pressure near or less than 30 percent of inlet pressure, such as:

- Distribution Systems
- High Rise Buildings
- Reservoir Filling
- Reservoir Fill to Atmosphere
- Continuous Pressure Relief
- Sub-Atmospheric Considerations

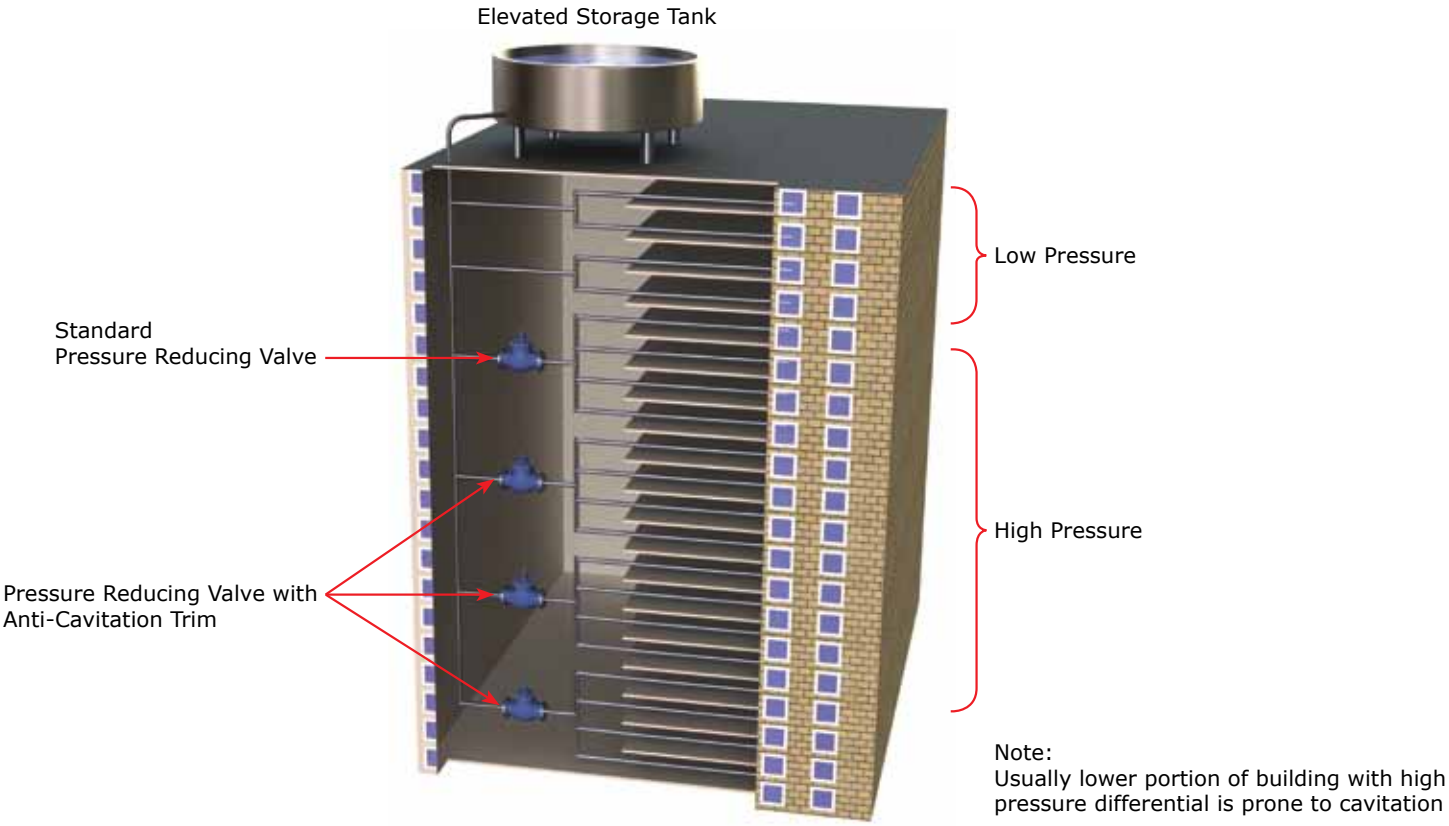
Distribution Systems

Often in water utility distribution systems, there can be significant pressure differential or drop which may necessitate the use of anti-cavitation cages / trim. The most common use for this type of technology can be where there is a need to reduce pressure significantly from high pressure transmission lines to a lower pressure distribution system. Another common application is where there are significant elevation changes within a transmission system or distribution system where lower elevations can be prone to significant pressures. Remember the 3:1 ratio rule applies but always verify the use of anti-cavitation with an engineering consultant versed in this field. The use of this technology requires that only one valve utilizing Anti-Cavitation Trim is required and therefore is ideal for space constraints.



High Rise Buildings

Often in high rise buildings standard pressure reducing valves are utilized to control pressures. While there are numerous approaches to water distribution and pressure management in high rise buildings, often water is pumped to the top of a building, stored in an elevated tank and then gravity fed to the floors below. It is typical for one pressure reducing valve to supply 4 – 5 floors which requires that several valves be installed to service the entire high rise. Often the highest floors rely purely on gravity and may require a small booster pump to supply sufficient pressure to the top 2 or 3 floors. The higher the building is the greater the pressure on the lower floors. Taking into consideration the 3:1 ratio rule, it makes sense that in the lower portions of the building Anti-Cavitation Trim could be very beneficial not only to protect the valves and downstream piping from the destructive forces of the vapor bubbles collapsing but also reducing the severe noise associated with cavitation. The noise issue becomes even more important if the high rise has a residential or hotel focus.

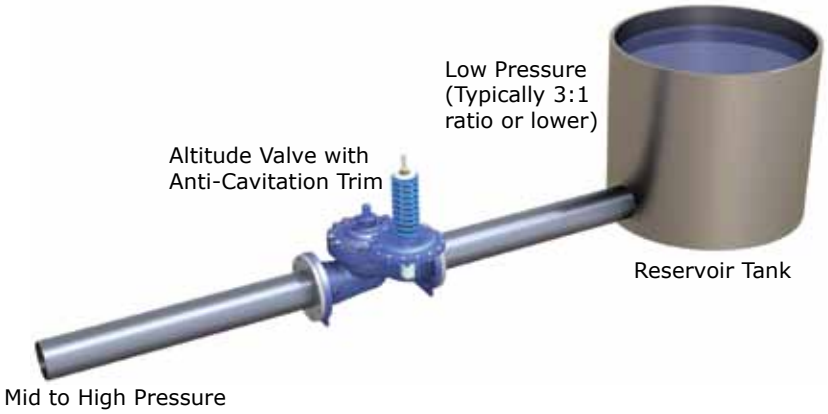


Reservoir Filling

At times elevated storage tanks may be supplied with high pressure with the downstream pressure being dictated by the static level of the tank, automatic control valves utilizing altitude pilots or solenoid valves reacting to level switches can often be used in these applications. If the high pressure on the upstream side of the control valve exceeds a 3:1 ratio when comparing the static head of the tank, then this would be another application where Anti-Cavitation Trim can reduce noise and eliminate damage downstream.

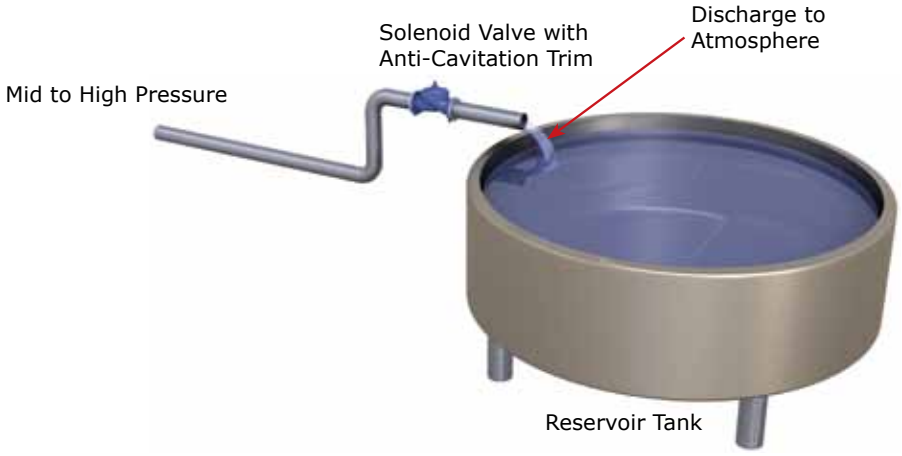
CHARACTERIZING OPENING

Employment of double cage design with engineered orifices provides an opportunity to characterize the C_v versus lift curve to limit maximum flow and / or to effect "soft" closing to reduce or eliminate closing surges in applications such as Solenoid Valves, Altitude Valves, and some Float Valves.



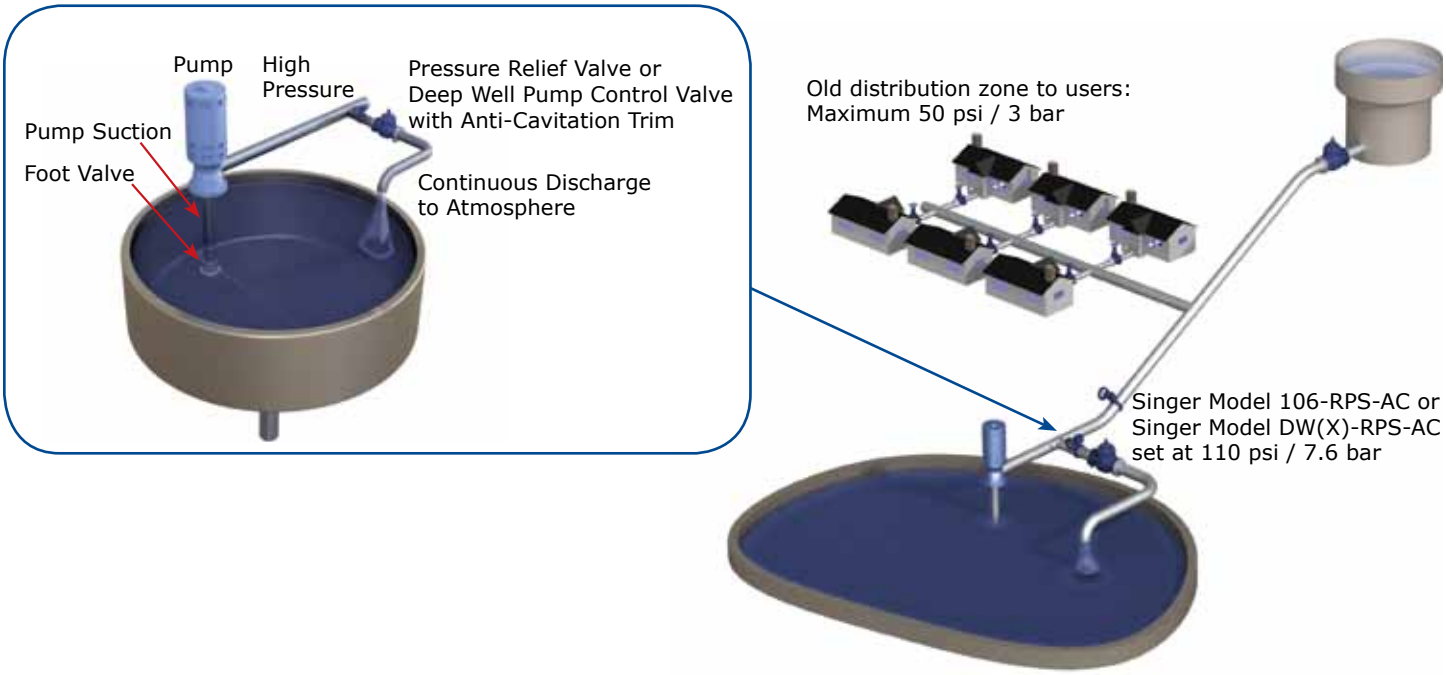
Reservoir Fill to Atmosphere

When automatic control valves are used to fill a reservoir and the water is being discharged to atmosphere there is a strong possibility that cavitation may occur depending on the upstream pressure. Often a float or solenoid style pilot system may be used in these applications. Another rule of thumb is if the upstream pressure is at or below 25 psi / 1.7 bar it should negate the requirements for Anti-Cavitation Trim and damage to the valve would be unlikely. For pressures exceeding the above stated figures it is strongly recommended that some form of protection against cavitation is considered.



Continuous Pressure Relief

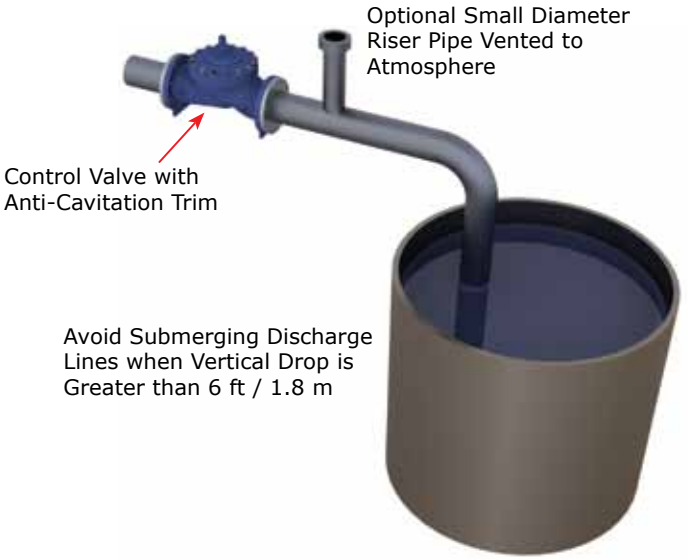
A very effective way of controlling outlet pressure of a pump is to relieve the excess flow back into the clear well. Obviously, this ends up being deep in the cavitation zone. Singer Valve's Anti-Cavitation Trim is ideal for applications like this where pressures are up to 250 psi / 17.2 bar and relieving to atmosphere.



Sub–Atmospheric Considerations

Regardless of the cavitation solution you select, caution should always be utilized when dealing with sub-atmospheric applications. If the discharge line is to be submerged it is recommended that the length of the vertical discharge line not exceed 6 ft / 1.8 m as this would render the anti-cavitation option useless, and cavitation would occur. If the vertical discharge line exceeds 6 ft / 1.8 m some consideration may be given to supplying an optional small diameter riser pipe vented to atmosphere off the horizontal pipe as shown on the drawing. It is suggested that if this application is considered, an engineering firm with experience in cavitation effects be consulted.

Note: It is always preferred to avoid submerging a discharge line if possible.



Anti-Cavitation Pressure Differential

The anti-cavitation pressure chart (page 10) will help you determine the valve size you require for your application. Select the smallest valve that has the flow capacity that meets or exceeds the flow required, at a pressure differential less than the minimum available in the application.

Ensure that all of the operating conditions (should they vary) for your application fall below the curve for the valve selected.

The solid lines show the maximum continuous flow capacity for a fully open valve, for a given size, at the chosen pressure differential.

If the inlet pressure varies widely, it may not be possible to obtain the maximum desired flow at times of low pressure differential. Be sure to consult with Singer Valve if:

- the pressure differential is over 300 psi / 20.7 bar
- the pressure differential drops below 50% of the maximum differential pressure
- the downstream pressure is sub-atmospheric
- the fluid is other than clean, cool water

Refer to chart on the page 10.

Valve Data

Valve Size	1”	2”	2½”	3”	4”	6”	8”	10”	12”	16”	20”	24”
C_V Factor	14.4	24.3	52	66	129	230	440	760	920	1500	2400	3100
K_V Factor	3.41	5.76	12.3	15.6	30.6	54.5	104	180	218	356	569	735

C_V & K_V factors for each are based on cages with maximum number and maximum size of orifices

How to Order

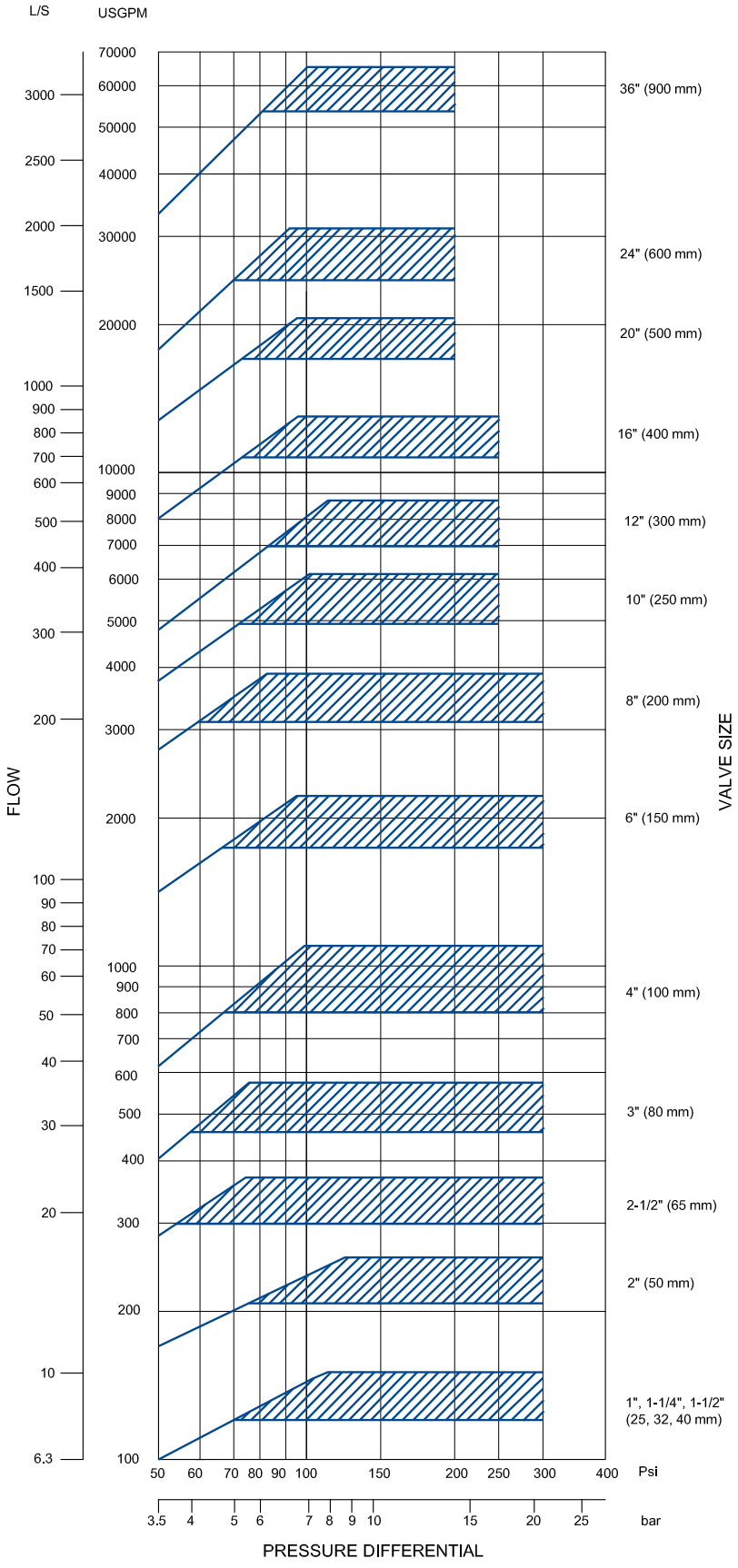
Please contact your local Singer Valve Sales Office with the following information ready:

1. Minimum & maximum inlet pressure
2. Minimum & maximum outlet pressure
3. Minimum & maximum flow rate

Anti-Cavitation Pressure Chart

Flow vs. Pressure Differential
Model 106 Series (PG, PGX, PT, PGM)

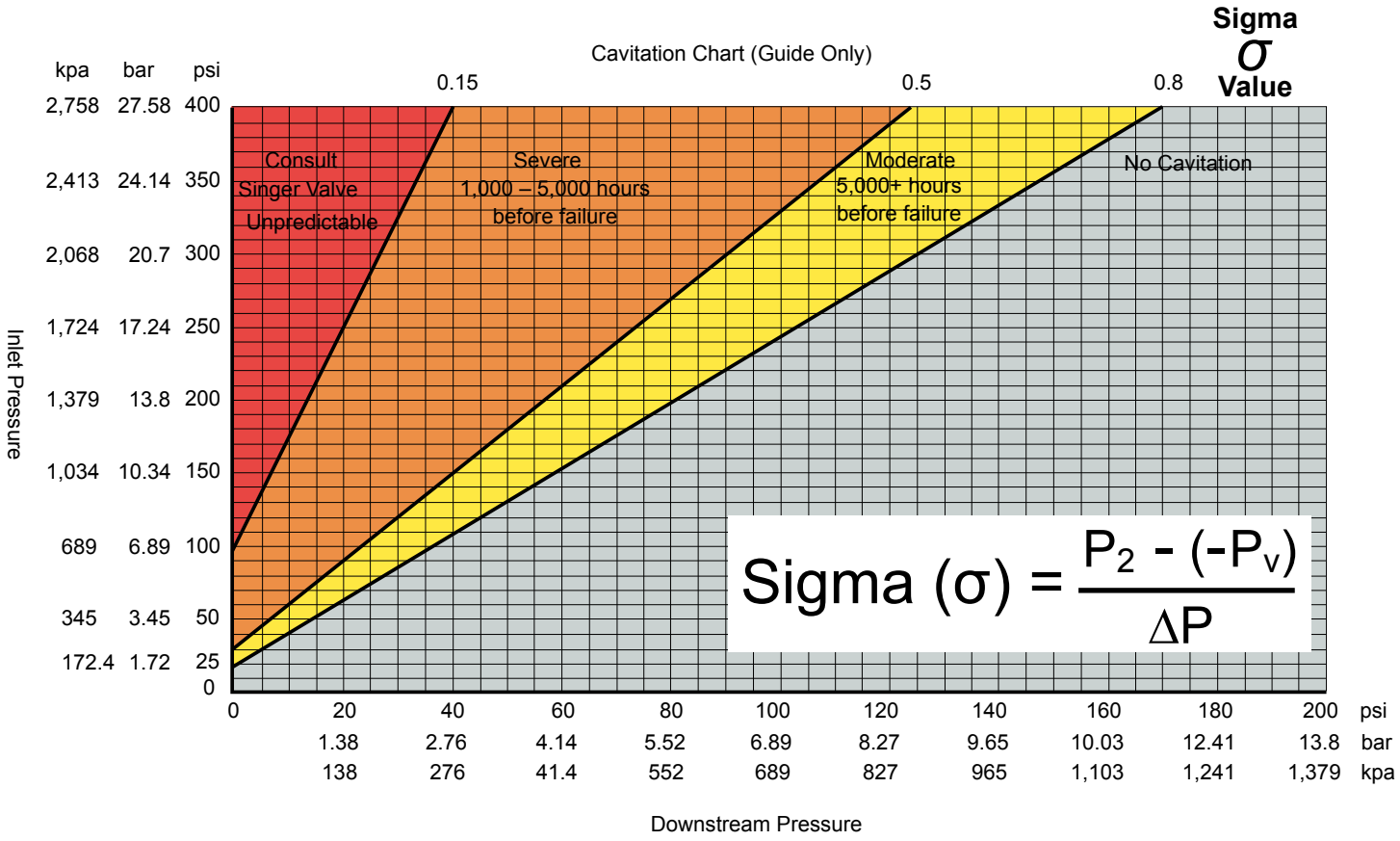
Full Port, Globe Body, Flat or Rolling Diaphragm
Anti-Cavitation Valve Curve 106-415
(1 in / 25 mm – 24 in / 600 mm)



- Area below the shaded boxes is suitable for continuous service.
- Shaded area is suitable for intermittent service.
- Differential Pressures over 300 psi / 20.7 bar, check with Singer Valve.

Cavitation Chart

This chart applies to cold water only.



Severity of cavitation increases with increasing flow.

Singer Valve will guarantee control of cavitation without the use of orifice plates.

Where P_2 = Downstream pressure
ΔP = Differential pressure
P_v = 14.4 Psi / 1 Bar / 103 KPa

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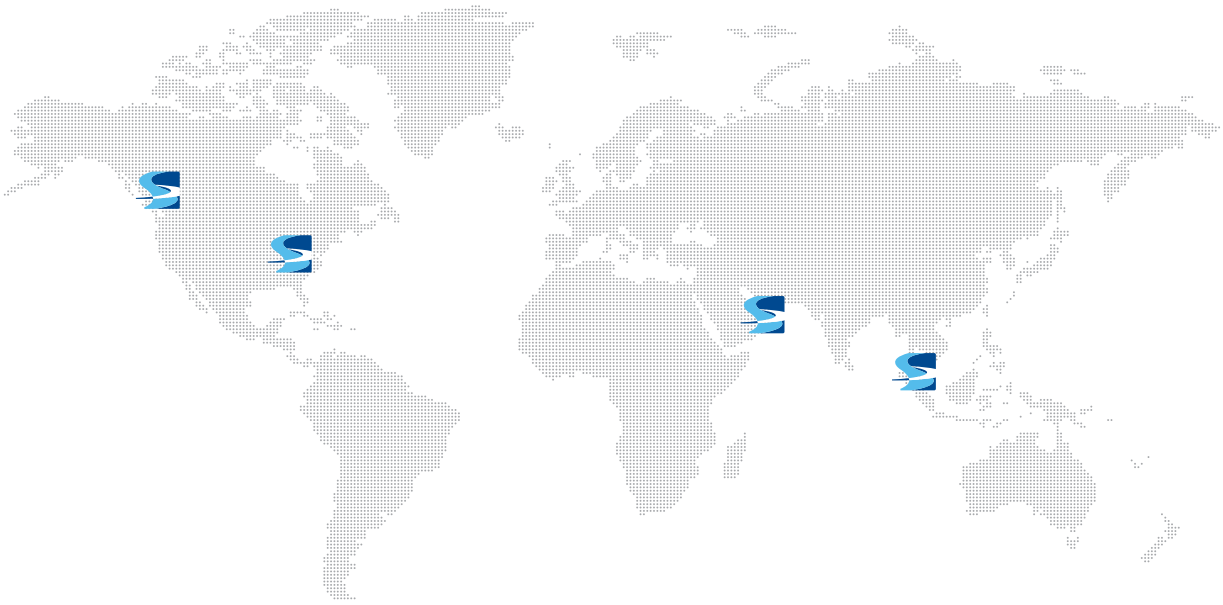

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