Globe Valves Severe Services Trim

VALTEK™ SULAMERICANA

Severe Services Trim
Introduction

Automatic valves in modern industrial processes are equipments known as: final control element or, simply, control valves. These valves required for either continuous or intermittent operations are used to regulate the inherent process parameters, such as flow rate, level, pressure, temperature and so on.
This bulletin aims to aid the selection procedure of control valves that operate in severe or critic conditions.

Selection of control valves operating in incompressible fluids - liquids

Incompressible fluids are the ones that during their movement the density coefficient remains unchanged; in which the shear stress and strain rate are constantly proportional (newtonian fluids). In practice, liquids are considered incompressible fluids.

The selection of a control valve operating with incompressible fluids require a series of parameters that should be complied and followed in logical sequence.
These parameters include the Cv calculation, fluid speed and level of operational noise.
The named Cv (flow coefficient) calculation includes the consideration of the fluid regime variables in addition to the effects caused by the process, such as the cavitation and/or flashing.
Also the effects arising from fluid viscosity should be considered, along with the pipe configuration where the valve will operate.
When the fluid enters the valve through the restriction created by the seat ring, it suffers a contraction, generating a decrease in the static pressure and consequent increase in fluid speed.
Figure 1 illustrates this phenomenon.

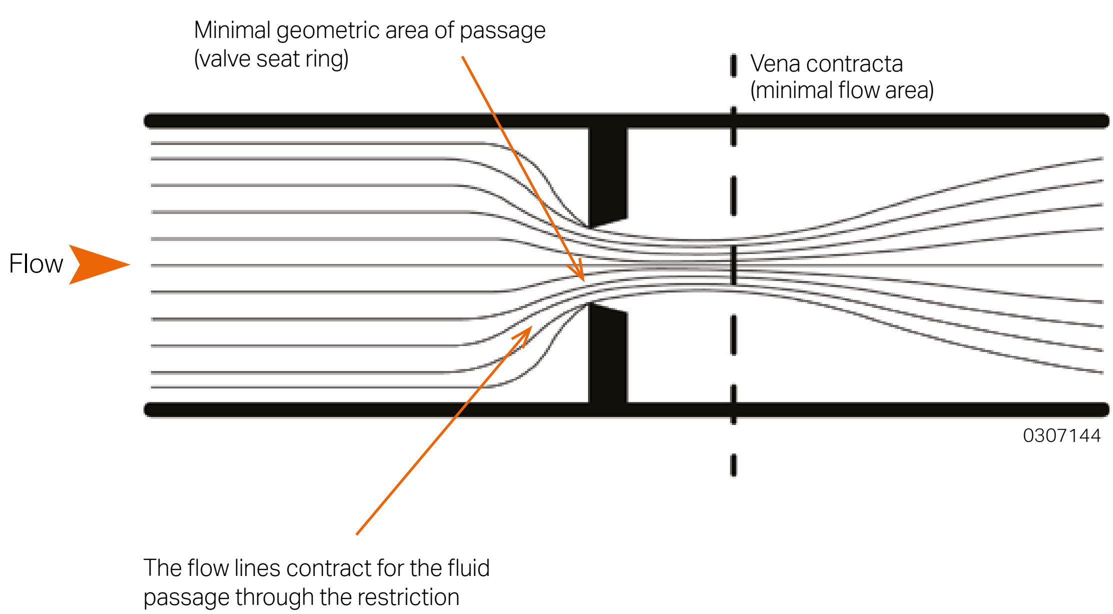

Fig. 1 - Fluid Lines Contraction

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Subsequently to the fluid passage, through the minimal geometric area restriction, the flow lines remain contracted until they become parallel again at a point just downstream of the valve exit. This minimal area of fluid lines is known as "vena contract". At this point, the fluid reaches a regime of minimum static pressure and maximum velocity (Fig. 2).
The fluid pressure at the "vena contracta" point in relation to the inbound pressure and the fluid vapor pressure is important to determine the flow coefficient through the valve.
After the fluid passage, at the "vena contracta" point, the fluid expands causing velocity decrease and static pressure increase.

The extent of pressure recovery is related to the configuration of the valve trims set and it is assessed using the liquid pressure recovery factor (F_L), where:

$$F_L = \frac{\sqrt{\Delta P}}{\sqrt{\Delta P_{VC}}}$$ being:

F_L = Liquid pressure recovery factor in the valve
ΔP = Pressure drop throughout the valve (Bar A) or (p.s.i.)
ΔP_{VC} = Pressure drop at vena contracta (Bar A) or (p.s.i. a)

This factor is extremely important for determining the valve size, notably when in regime of critical flow due to the possible occurrence of phenomena such as cavitation or flashing.

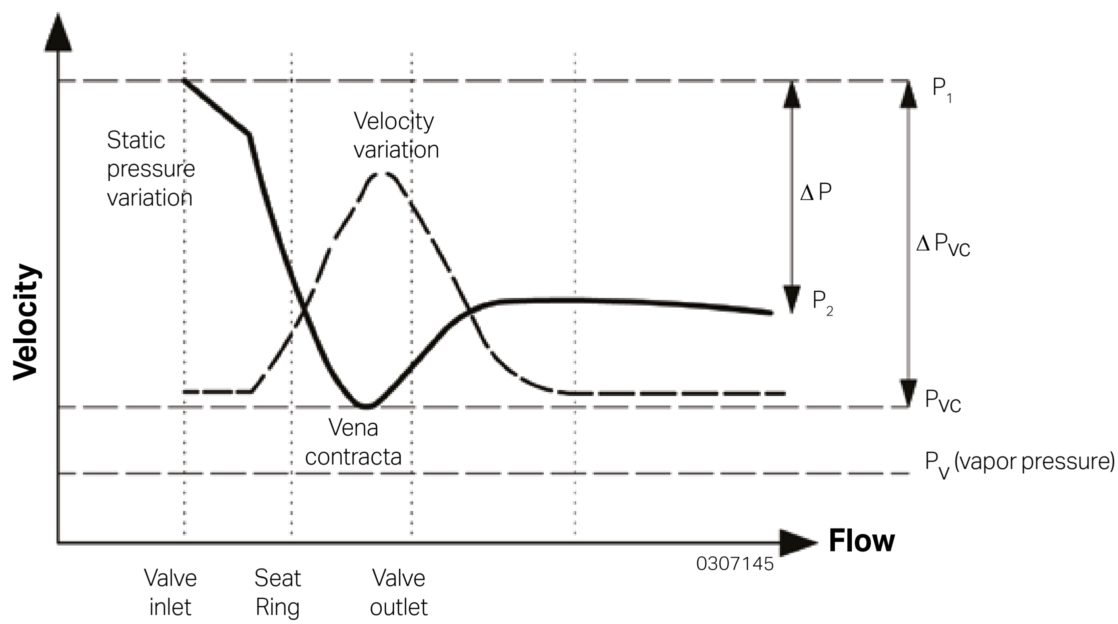

Fig. 2 - Static Pressure Variation versus Velocity

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Flow Regime

Liquids are usually considered as incompressible fluids and free of vapor formation. However the formation of bubbles is possible when the static pressure is lower than the fluid vapor pressure.
This incident is not uncommon in control valves and it is related to the various levels of fluid regime. Diverse flow regimes, according to the vaporization level, are used to describe fluid behaviour when it passes through a control valve.

Normal flow regime

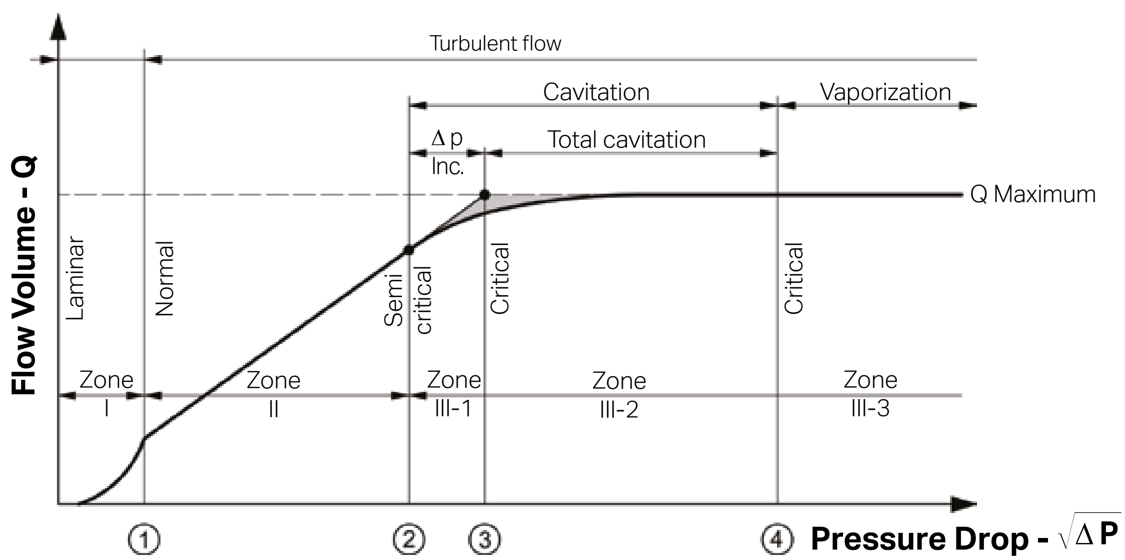
This condition describes the fluid as totally incompressible (with no bubbles production). On this condition, the flow rate is proportional to the square root of the fluid pressure drop throughout the valve. (Zone II; Fig.3).

Semi-critical flow regime

When the static pressure at vena contracta (minimal geometric area of flow) drops just under the fluid vapor pressure, occurs the formation of bubbles and the fluid can not be considered incompressible any more. In these circumstances, the occurrence of incipient cavitation is real, once the static pressure at vena contracta is lower than the fluid vapor pressure.
This case known as semi-critical flow regime corresponds to the drop in the ratio between the flow volume and the pressure drop (zone III-1 in Fig. 3).
At the semi-critical flow, any subsequent reduction in the downstream pressure causes higher levels of cavitation and reduced rate of flow increase.
To determine the point where cavitation starts to manifest, the following equation can be used:

$\Delta P_{inc} \geq F_I^2 (P_1 - P_V)$ Where:

F_I = Incipient cavitation coefficient of liquid
P_1 = Upstream pressure (Bar A) / (p.s.i. a)
P_v = Fluid vapor pressure, at flow temperature (Bar A) / (p.s.i. a)



Zone I : Laminar or almost laminar flow
Zone II : Normal turbulent flow
Zone III-1: Turbulent flow with beginning of cavitation and no choked flow
Zone III-2 : Turbulent flow with total cavitation and choked flow
Zone III-3 : Turbulent flow with vaporization and choked flow

Fig. 3 - Diverse Flow Regimes Depending on the Pressure Drop

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Critical flow regime

The critical flow happens when the pressure drop increases beyond the semi-critical zone of the fluid (Zone III-2; Fig. 3). At this stage, the pressure at vena contracta reaches its lower value and is referred to as critical pressure point (P_C). After this point, when the outbound pressure is reduced, there is no more changes in flow volume (choked flow), but a significant increase in the rate of cavitation and/or vaporization (flashing) formation.

Many calculation methods for control valves ignore the semicritical flow regime and consider the calculation of a normal regime until point 3 (Fig. 3) and of a critical one after this point. This omission, which is very common in flow coefficient (C_V) calculations, simplifies the calculation procedure and usually results in error of about 2% in the determination of a valve C_V.

The appearance of bubbles in the fluid, caused by the drop of static pressure below the vapor pressure, causes the phenomena known as cavitation and flashing, which cause destructive effects to the valve and adjacent equipments, as well as mistakes in the correct dimension and selection of the control valve.

Vaporization (Flashing)

When the fluid static pressure, at the point of maximum throttling of the valve, is below the nominated vapor pressure (P_v - Fig. 4), occurs the formation of a mixture of liquid and bubbles called flashing, which causes an increase in fluid volume and consequently in its velocity, causing higher erosion as well as excessive level of noise. To completely eliminate the flashing phenomenum, it would be necessary to increase the valve dimension at the exit, thus lowering the fluid static pressure in the process.

However, pratical experience shows that in the case of fluids in flashing stage the best solution is the use of trim designed with materials and characteristics that eliminate the effects of this physical penomenom.

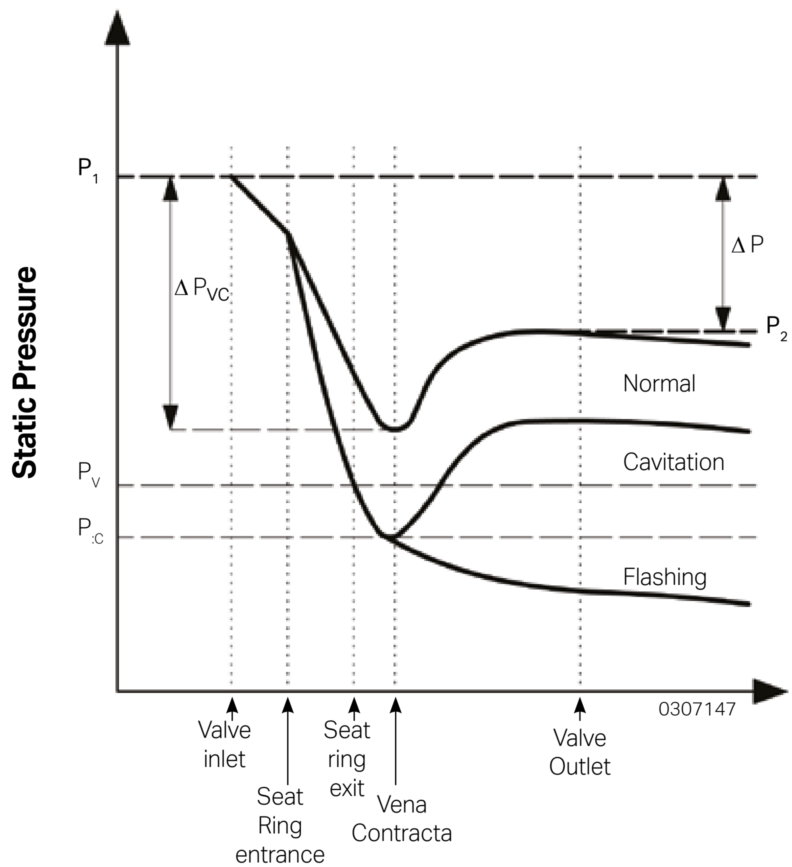

Fig. 4 - Static Pressure Variation in Relation to Diverse Flow Regimes

Severe Services Trim Introduction - Liquids

An incorrect selection of valve trim and materials causes serious erosion damages to the trim set, plug/ seat ring, with possible damages to the valve body.

Cavitation

Cavitation is a dynamic phenomenon that occurs only in liquid systems. The vaporous cavitation consists of a rapid vaporization of liquid around the microscopic gaseous nuclei and the subsequent collapse of the vaporous cavity caused by vapor condensation inside the cavity. The effects of the vaporization and condensation are the result of pressure fluctuations and the fluid vapor pressure. Local pressure fluctuations can also release dissolved gases, resulting in what is known as gaseous cavitation. The gaseous cavitation can be beneficial in mitigating the damage and vibrations related to the vaporous cavitation. The vaporous cavitation tends to aerate the liquid, increasing the compressibility of the mixture. The vaporous cavitation will be the subject of this text given the capacity to damage the control valve components and adjacent equipments.

In liquids, when the pressure at vena contracta drops below the liquid vapor pressure, vapor bubbles start to form in the fluid. If the vena contracta pressure is higher than the liquid vapor pressure, the proportionality between flow and pressure drop is quadratic, with no need for correction due to critical fluid conditions (Fig. 2).

Theoretically, at the beginning of vaporization of the liquid, occurs the formation of cavities or bubbles. The start of vaporization happens a bit before the point of vaporization of the liquid due to the fact that there are always dissolved gases within the liquid, which start to break off forming cavities or bubbles. This point is called the incipient cavitation. Besides the vaporization pressure point, other factors such as: the internal geometry of the valve, flow velocity, liquid superficial tension, viscosity, density and quantity of gas dissolved in the liquid, as well as tiny solid nucleus in its interior, all affect the cavitation phenomenon.

A practical way of discovering whether the liquid initiates the state of incipient cavitation can be determined by the equation that defines the differential pressure at which the cavitation begins (see page 4).

Typical Recovering Coefficients (F_L) and Typical Incipient Cavitation Factor (F_I)

Valve Type	Flow Direction	Trim Size	Factor F_L	Factor F_I
Globe	Flow to close	Integral	0.85	0.76
GLs GLH	Flow to close	Reduced	0.85	0.72
GLB	Flow to open	Integral	0.90	0.81
	Flow to open	Reduced	0.90	0.81
Omega	Flow over	Integral	0.93	0.90
Gama	Flow over	Integral	~1.0	0.87 to 0.995

Note: The values ndicated are for fully open valves.

At the beginning of its formation, cavitation can be detected by an intermittent noise such as small crackles. But as the differential pressure increases, the noise intensifies, resembling a constant whistle or crashes.

Various cavitation levels have been employed to correlate the performance data of hydraulic equipments. Nowadays, the Sigma index (σ) has been generally employed in control valves, and it can be determined by:

$$\sigma = \frac{(P_2 - P_v)}{(P_1 - P_2)}$$

Where:

P_1 = Upstream pressure (Bar A) or (psi a), measured at a distance relative to one (1) pipe diameter upstream from the valve

P_2 = Downstream pressure (Bar A) or (psi a), measured at a distance relative to five (5) times the pipe diameter downstream from the valve

P_v = Liquid vapor pressure at operational temperature

Sigma is a recently used cavitation index correlated to the performance of hydraulic equipments, especially control valves. The Sigma index represents the ratio between the potential for resistance to cavitation formation and the potential for cavitation formation. When the Sigma index is zero or a negative value, the vaporization (flashing) is evident. Tests indicate that damage caused by cavitation (σ destructive) with continuous operation valves start with numbers around σ = 0.73. Point in which the incipient cavitation (σ incipient) occurs.

Some other factors that influence the intensity of cavitation are the extent of the actual operational pressures, when compared to the pressures of technological development tests, the geometric profile of the flow and fluid purity. In the development and study of these factors, methods of measurement were established for those variables.

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The solution for avoiding cavitation is to gradually reduce the pressure from the entrance until the exit of the valve, preventing that the liquid pressure drops below its vapor pressure, keeping it constant through the valve, above the vapor pressure. This can successfully avoid cavitation.

Index

The Sigma index offers better condition for the evaluation and selection of a valve for the diverse cavitation conditions. The acceptable Sigma operational values for Globe valves, working on low pressures, are between 2 and 1.7. Usually, in these cases, the use of trim for cavitation control is not necessary. However, when the Sigma index is between 1.7 and 1.15 cavitation control is needed. When Sigma indexes are lower than 1.15, there is a huge potential for destruction and, due to severe cavitation, trims with various pressure reduction stages must be considered for the correct selection of the control valve.

Choked Flow

Choked flow happens when the fluid velocity approaches sonic values at any point of the valve body, trims or line. It happens with liquids when the vapor formed as a result of the drop of fluid pressure below the value of its vapor pressure increases the fluid specific volume until the point that the sonic velocity is reached. Therefore additional reductions of the exit pressure will not produce further increase of flow. This phenomenon is known as choked flow.
The choked flow can be determined by the equation:

$$\Delta P_{(choked)} = F_L^{\,2}(P_1 - F_F P_V)$$

Where:
F_L = Liquid pressure recovery factor
F_F = Liquid Critical Pressure Ratio Factor
P_1 = Upstream Pressure (Bar A) / (psi a)
P_V = Liquid Vapor Pressure at flowing conditions (Bar A) / (psi a)

Velocity

The general rule for control valves operating with liquids is that the maximum velocity at the valve exit should be limited to 50 ft/sec. (15 m/sec.), and for gas and liquid mixtures up to 500 ft/sec. (152 m/sec.).
However, smaller valves can operate with slightly higher velocities and bigger valves with lower velocities. Whenever the fluid temperature approaches the saturation point, the velocity should be limited to 30 ft/sec. (9 m/sec.) in order to avoid reduction of vapor pressure. This is also an approximating limit for applications where the total flow will pass through the valve with a minimum pressure drop.
The control valves that operate under severe cavitation regime must also have their velocity limited to 30 ft/sec. (9 m/sec.) in order to minimize the damage to the downstream pipe. This limitation also allows to allocate the recovery pressure, which causes cavitation right at downstream of vena contracta.
At vaporization regimes (flashing), the velocities become much higher due to the increase in volume caused by vapor formation. For most applications, it is important to keep the velocity below 500 ft/sec. (152 m/sec.)
The use of control valves with expanded exit helps to control the exit velocity in those applications.
At smaller valves that are kept closed for most of the time, such as drain valves, the velocity can reach up to 800 to 1500 ft/sec. (244 to 457 m/sec.), employing alloy steel materials for the body and trims with Alloy #6 (Stellite #6) coated.

The Globe control valves with Gamma® trim of ValtekSul prevent damage caused by cavitation and minimize the hydrodynamic noise even under the most severe applications.

This design does not only eliminate the damage caused by cavitation but also provides easy maintenance and long lifespan, even in the most difficult applications.

The holes at the cartridge of Gamma® trims, more than just restricting the flow, are used as expansion areas for the fluid as it passes through them coming from the restrictive channels machined in the outside of all interior cylinders. The successive intersections of restrictive channels and magnification holes create a series of expansions and contractions that result in successive pressure drops. This staged pressure drop assures that the destructive cavitation does not occur. The Gamma® cartridge was designed to effectively eliminate cavitation by employing a variety of mechanisms, reducing high differential pressures. The flow is directed over the plug by a series of cylindrical stages assembled on each other, each of which consists of expansion holes and circumferential intersection channels, restricting the free flow passage. The fluid first passes through the expansion holes in the external cylinder, and then enters the machined channels present in the internal

Severe Services Trim
Special Trim - Gamma®
Liquids

surface of the same cylinder. The liquid remains confined to the channel until it reaches the intermediate expansion hole in the second cylinder, passing through to the restrictive channel and so forth.

This path of multiple restrictions, enlargements and direction changes are energy dispelling, causing multiple pressure reducer stages and avoiding a sharp pressure drop at an unique point, which is characteristic of conventional trims.

A certain number of holes are machined near the top of the Gamma® cartridge. Several of these holes allow the fluid to vent upstream from the volume above the plug during normal operation. Other assemble holes permit an alignment by pins between the stages, placing them at the correct rotational alignment. The pins and alignment holes have shoulders that indicate the correct position inside the cartridge. A bead weld prevents the pin from loosening.

This weld can be easily removed by grinding or machining, for disassembly. The plug fits firmly inside the cartridge hole and its movement makes the expansion internal holes to gradually open or close, thus controlling the flow. The Gamma® plug-cartridge set can be used with either metal or soft seat rings. It is manufactured in two versions: Balanced and Unbalanced.

Pressure reduction mechanism

While there are diverse pressure reduction mechanisms, the gradual reduction of pressure using the Gamma® cartridge occurs mainly because of four physical principles:

1. **Sudden expansion** of the flow areas, as the fluid leaves the restrictive channels and enters through the intermediate expansion holes.
2. **Frictional Losses** due to multiple, small passageways through which the fuid must pass.
3. **Turbulent mixing** in the expansion holes.
4. **Mutual impact** of opposing streams in the expansion holes.

Besides, the small channel size generates a small vortex turbulence, that rapidly dissipates, reducing the vortex cavitation associated with the larger flow geometrics.

The above principles, in addition to others happening at multiple stages, minimize pressure recovery.

Quantity of stages

The quantity and area of flow of the channels at each stage of the Gamma® cartridge were designed to produce the total differential pressure, at the same time it prevents the occurrence of cavitation at any point. The flow area is gradually bigger at each successive stage, so as to minimize also the number of stages. The result is that bigger differential pressures are absorbed at the external (or initial) stages if compared to the internal (or final) stages.

Velocity and Pressure

The velocities at the inlet and outlet of a ValtekSul Globe valve with Gamma® trim are generally limited to a maximum of 30 ft/sec. (9 m/sec.). In addition, these valves are designed to ensure that the fluid pressure in the valve body (including the cartridge) is always greater than the vapor pressure.

Flow Characteristics

The ValtekSul Globe valves with Gamma® cartridge offer linear flow characteristic as standard. Producing essentially equal changes of flow with equal changes in valve stroke.

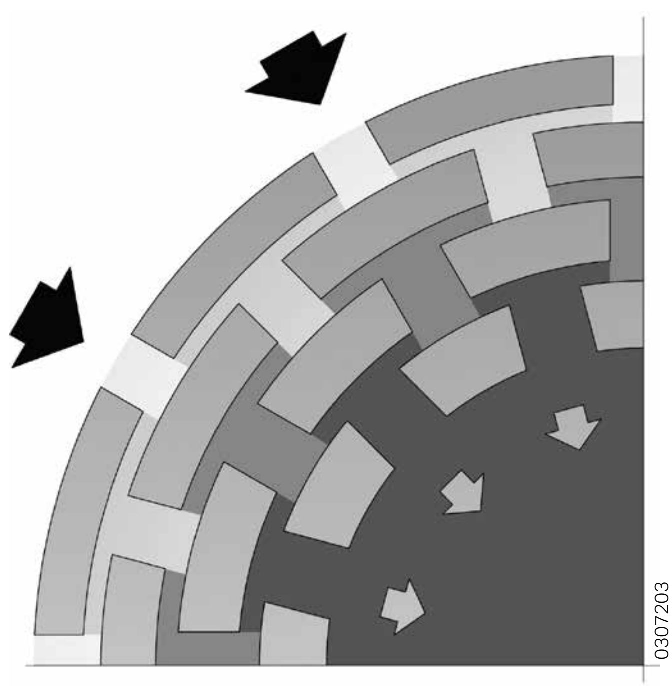

Fig. 5 - Unique Flow Direction at the Gamma® cartridge

Severe Services Trim
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The cartridge of linear characteristic consists of an axially standardized arrangement of holes and channels. The linear characteristic is most commonly used for liquid applications with high differential pressure. The equal percentage characteristic can be provided with a non-uniform pattern of holes along with a corresponding axial change in the area of the restrictive channels, producing the desired characteristic.

Maintenance

Most of the control valves with anti-cavitation trim are manufactured with internal cartridge that guides the plug movement. Experience shows that these simple mechanical systems cause sticking problems between the retainer cartridge and the plug, causing damages and unscheduled operational maintenance work. The Gamma® cartridge was designed to provide simple, easy and low cost maintenance. It contains an extra strong upper double guide as standard and fitted-in seat ring plus top-entry trim, so the disassembly is quickly performed and the problems associated with screwed-in corroded seats are eliminated. The piston-cylinder actuator is smaller, lighter and easier to disassemble, when compared to corresponding spring-diaphragm actuators.

While the equivalent anti-cavitation valves present tolerance problems between the plug and the discs that are superimposed on each other, the Gamma® cartridge does not display such drawbacks, because it presents a smooth and continuous superficial uniformity in the internal side and the plug is guided by the upper and lower guides at the stem.

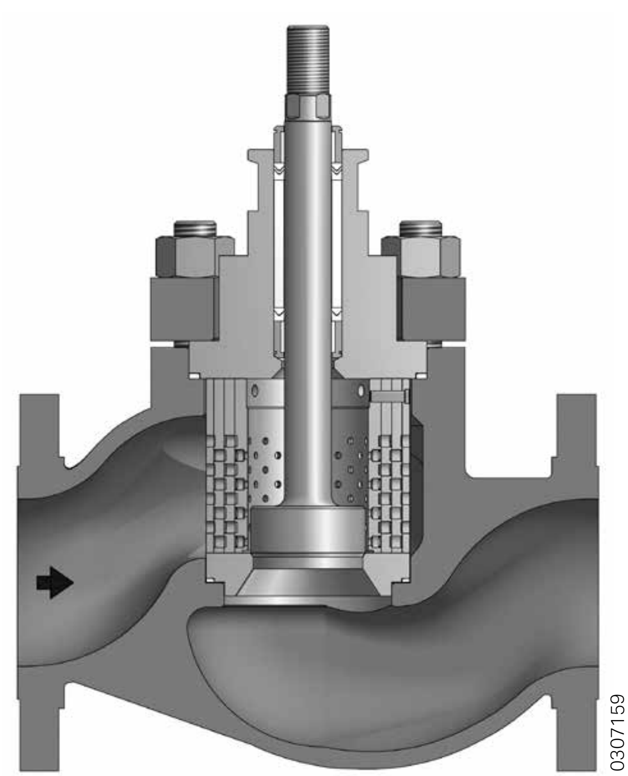

Fig. 6 - Gamma Trim Unbalanced Plug

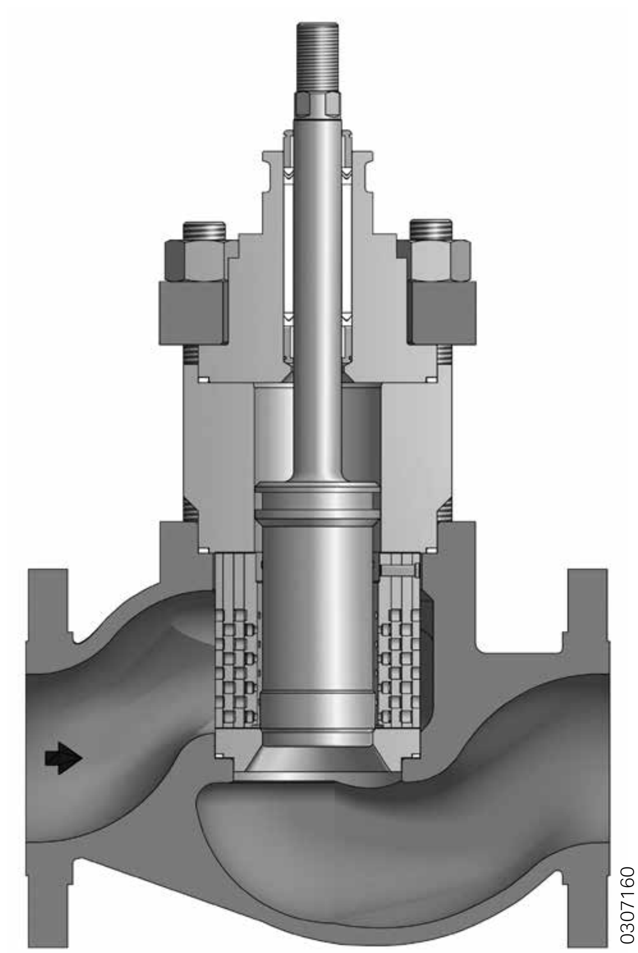

Fig. 7 - Gamma Trim Balanced Plug

Severe Services Trim
Special Trim - Gamma®
Liquids

Dirt and Particles

The anti-cavitation valves are typically built with small flow passages that can become clogged by dirt or other impurities present in the fluid. Such devices usually direct the flow through the plug before it passes through the restrictive device. This results in sticking and galling as dirt or particles become trapped between the moving plug and the inside surface of the anti-cavitation device.

On the other hand, the Gamma® cartridge is designed with two important protective features to minimize those clogging problems:

1. First, the flow passes through the cartridge. Particles of the fluid that are too large to pass through the small channels are retained on the outside of the first stage, preventing that these particles get through the other cartridge stages towards the plug.
2. Because the inner channels become progressively larger, the small particles that pass through the first set of channels can easily pass through the rest of the cartridge.

At extremely dirty services, the cartridge must be dismantled and cleaned periodically.

Flow Coefficient - C_v

Due to the physical size of the Gamma® cartridge, the flow coefficient (Cv) of a globe valve with Gamma® trim is generally lower than the Cv of a standard ValtekSul globe valve of the same size. When selecting a valve for determined application, it is necessary to consider not only the Cv but also the velocity and Sigma index that this valve must admit. The information on the flow coefficient described on pages 11 and 12 are for general orientation on the selection for a determined application. Different flow coefficients are available under request.

Severe Services Trim
Special Trim - Gamma®
Flow Coefficient - C_V

Gamma® Trim
ANSI Class 150 - 600

Valve Nominal Size (in.)	Trim Code (T/N)	Number of Stages	Stroke (mm)	C_V	σ_{min}
1.5	35 (1.38)	2	38	18	.170
	32 (1.25)	3	38	11	.070
	30 (1.18)	4	38	5	.020
2.0	35 (1.38)	2	38	18	.170
	32 (1.25)	3	38	12	.070
	30 (1.18)	4	38	6	.020
3.0	65 (2.56)	2	64	51	.200
	60 (2.36)	3	64	35	.080
	50 (2.00)	4	64	20	.025
	40 (1.58)	5	64	11	.007
	30 (1.18)	6	64	6	.002
4.0	90 (3.54)	2	76	86	.200
	80 (3.14)	3	76	55	.080
	70 (2.75)	4	76	32	.025
	60 (2.35)	5	76	21	.007
	50 (1.96)	6	76	12	.002
6.0	135 (5.31)	2	102	176	.200
	120 (4.75)	3	102	105	.080
	110 (4.33)	4	102	66	.025
	90 (3.54)	5	102	41	.007
	80 (3.14)	6	102	24	.002
8.0	165 (6.50)	2	152	325	.200
	150 (5.90)	3	152	202	.080
	140 (5.50)	4	152	130	.025
	130 (5.12)	5	152	85	.007
	115 (4.52)	6	152	56	.002
10	225 (8.85)	2	190	535	.230
	215 (8.46)	3	190	352	.090
	200 (7.90)	4	190	230	.028
	190 (7.50)	5	190	158	.008
	175 (6.90)	6	190	107	.002
12	250 (9.85)	2	203	645	.230
	230 (9.05)	3	203	405	.090
	215 (8.46)	4	203	265	.028
	200 (7.90)	5	203	180	.008
	190 (7.50)	6	203	127	.002

Gamma® Trim
ANSI Class 900 -1500

Valve Nominal Size (in.)	Trim Code (T/N)	Number of Stages	Stroke (mm)	C_V	σ_{min}
1.5	41 (1.63)	2	38	21	.170
	35 (1.38)	3	38	12	.070
	28-20 (1.12)	4	38	6.0	.020
	28-10 (1.12)	5	38	4.0	.006
2.0	41 (1.63)	2	38	21	.170
	35 (1.38)	3	38	12	.070
	28-20 (1.12)	4	38	6.0	.020
	28-10 (1.12)	5	38	4.0	.007
3.0	65 (2.56)	2	64	51	.180
	60 (2.35)	3	64	33	.075
	50 (2.00)	4	64	20	.022
	40 (1.58)	5	64	11	.007
	30 (1.18)	6	64	6.0	.002
4.0	90 (3.50)	2	76	86	.200
	80 (3.15)	3	76	54	.080
	70 (2.75)	4	76	31	.025
	60 (2.35)	5	76	20	.007
	50 (2.00)	6	76	12	.002
6.0	135 (5.31)	2	102	171	.200
	120 (4.75)	3	102	100	.080
	110 (4.33)	4	102	66	.025
	90 (3.50)	5	102	41	.007
	80 (3.15)	6	102	24	.002
8.0	165 (6.50)	2	152	315	.200
	150 (5.90)	3	152	202	.080
	140 (5.50)	4	152	130	.025
	130 (5.12)	5	152	85	.007
	115 (4.50)	6	152	56	.002
10	200 (7.90)	2	203	495	.230
	185 (7.25)	3	203	312	.090
	170 (6.70)	4	203	200	.028
	160 (6.25)	5	203	143	.008
	145 (5.70)	6	203	97	.002
12	250 (9.85)	2	203	635	230
	230 (9.05)	3	203	395	.090
	215 (8.46)	4	203	255	.028
	200 (7.90)	5	203	170	.008
	190 (7.50)	6	203	122	.002

Severe Services Trim
Special Trim - Gamma®
Flow Coefficient - C_V

Gamma® Trim
ANSI Class 2500

Valve Nominal Size (in.)	Trim Code (T/N)	Number of Stages	Stroke (mm)	C_V	σ_{min}
1.5	41 (1.63)	2	38	21	.170
	35 (1.38)	3	38	13	.070
	28-20 (1.12)	4	38	8	.020
	28-10 (1.12)	5	38	4	.006
2.0	41 (1.63)	2	38	21	.170
	35 (1.38)	3	38	13	.070
	32 (1.25)	4	38	8	.020
	28 (1.12)	5	38	4	.006
3.0	60 (2.35)	2	64	45	.180
	50 (2.00)	3	64	28	.075
	44 (1.73)	4	64	19	.022
	38 (1.50)	5	64	10	.007
	32 (1.25)	6	64	6	.002

Valve Nominal Size (in.)	Trim Code (T/N)	Number of Stages	Stroke (mm)	C_V	σ_{min}
4.0	82 (3.25)	2	76	76	.200
	75 (3.00)	3	76	50	.080
	67 (2.63)	4	76	32	.025
	55 (2.25)	5	76	21	.007
	44 (1.73)	6	76	12	.002
6.0	120 (4.75)	2	102	150	.200
	110 (4.33)	3	102	92	.080
	90 (3.50)	4	102	56	.025
	75 (3.00)	5	102	35	.007
	65 (2.56)	6	102	23	.002
8.0	150 (5.90)	2	152	151	.200
	140 (5.50)	3	152	99	.080
	130 (5.12)	4	152	66	.025
	115 (4.50)	5	152	43	.002
10	185 (7.25)	2	203	238	.090
	170 (6.70)	3	203	156	.090
	160 (6.25)	4	203	108	.028
	150 (5.90)	5	203	74	.008

Manufacturing

The valves with Gamma® trim, balanced or unbalanced models, are manufactured in sizes from 1 1/2 to 24 inches, using the body of regular ValtekSul globe valves. All parts - except the Gamma® cartridge, the plug, sleeve and bonnet - are interchangeable with regular ValtekSul globe valves, reducing the stock of parts and lowering costs.

The valves with Gamma® trim in sizes from 16 to 36 inches can be manufactured with angle-style body with a lateral inlet and the outlet in the lower part of the valve. Aiming a reduction of the costs related to globe valves with large dimension bodies, the angle valves are usually manufactured with a modified tube in "tee" and welded flanges.

Standard Manufacturing Materials - Gamma® Trim

Component	Materials
Standard Cartridge	AISI 316 Stainless Steel (UNS S 31600) AISI 416 Stainless Steel (UNS S 41600) Duplex ASTM A 479 / A 182 (UNS S 32205) Super-Duplex (UNS S 32760) Inconel (UNS S N07718)
Plug	AISI 316 Stainless Steel with Alloy 6 (UNS R 30006) AISI 416 Stainless Steel (UNS S 41600) AISI 420 Stainless Steel (UNS S 42000) Super-Duplex (UNS S 32760)
Seat	AetlaSiln 3e1r 6 Stainless Steel with Alloy 6 (UNS R 30006) AISI 416 Stainless Steel (UNS S 41600) AISI 420 Stainless Steel (UNS S 42000) Super-Duplex (UNS S 32760)

Note: See ValtekSul GLS and GLH models valves catalogues for more information on basic manufacturing materials.

Severe Services Trim
Special Trim - Omega®
Low Flow

When the valve operates on low flow, with C_V values between 1.0 and 2.5, a special Omega® cartridge is used. The Omega® cartridge is manufactured into the plug itself (Fig. 8). The cartridge/plug set is guided in the valve seat ring. As there is no retainer cartridge, the movement of the plug causes the increase of flow as the cartridge/plug moves away from the seat. The diverse stages of the Omega® trim technologically follow the design and function of the standard Gamma® cartridge. This cartridge design provides operational advantages on low flows because of its manufacturing simplicity. The Omega® trim for low flows can be used on clean liquids only, as its holes and passage channels present reduced dimensions.

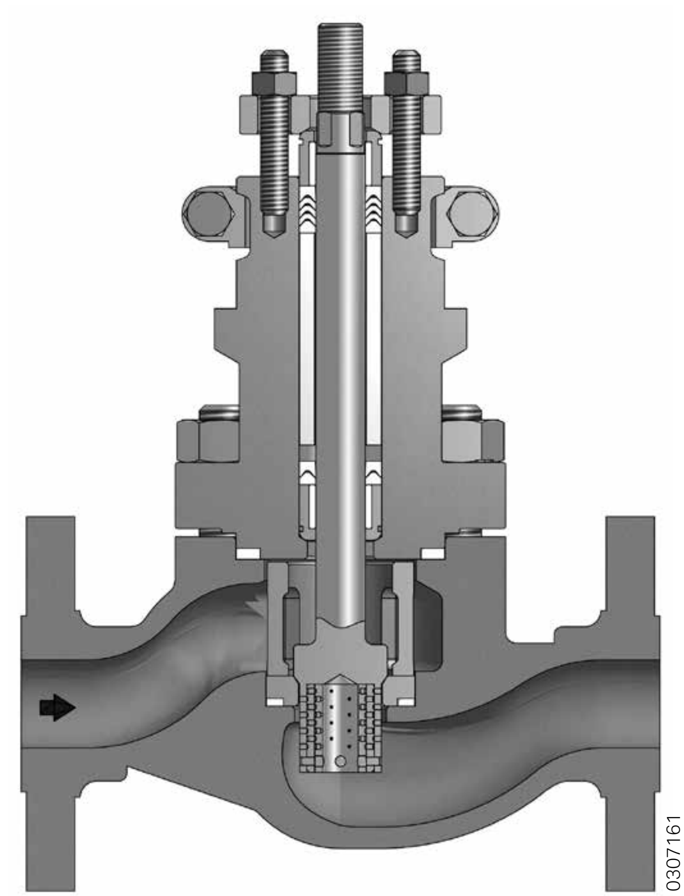

Fig. 8 - Omega® Trim for Low Flows

Flow Coefficients (C_V)

Trim Code	Stroke (mm)	C_V
0.80 - 70	25	1.00
0.80 - 80	25	1.20
0.80 - 90	25	1.50
0.90 - 60(1)	38	1.75
0.90 - 70(1)	38	2.00
0.90 - 80(1)	38	2.20
0.90 - 90(1)	38	2.50

Notes: (1) Only for valve sizes 1.5 and 2 inches.

Standard Manufacturing Materials - Omega® Trim

Component	Materials
Plug/Cartridge	AISI 420 Stainless Steel (UNS S 42000) Super-Duplex (UNS S 32760) Solid Alloy 6 (Stellite #6) (UNS R 30006)
Seat	AISI 420 Stainless Steel (UNS S 42000) Super-Duplex (UNS S 32760) Solid Alloy 6 (Stellite #6) (UNS R 30006)

Note: See ValtekSul GLS, GLH and GLB models valves catalogues for more information on basic manufacturing materials.

Severe Services Trim
Special Trim - Omicron®
Small Flow

Anticavitation Trim
Small Flow

The Omicron® anticavitation trims are used when small flow rates are needed (maximum C_V between 0.010 and 1.30). For an effective anticavitation prevention in this kind of plug, the instalation of angle-style bodies is recommended.
The micro-plug design is inserted within the guided seat ring and presents a spiral contour that causes velocity increase with the systematic contraction and expansion of the fluid.

The plug is designed with a series of special channels that expand as they progress diagonally along the length and around the circumference of the plug head.
As the fluid passes through the channel, it experiences a continual increase in flow area and consequent pressure reduction. The reduction of pressure takes place as the fluid impinges upon itself when the channels intersect.

Flow Coefficient (C_V)

Trim Code (T/N)	Stroke (mm)	C_V
0.38 - 10	13	0.010
0.38 - 15	13	0.015
0.38 - 20	13	0.021
0.38 - 30	13	0.032
0.38 - 40	13	0.040
0.38 - 50	19	0.050
0.50 - 10	19	0.075
0.50 - 20	19	0.085
0.50 - 30	19	0.100
0.50 - 40	19	0.125
0.50 - 50	19	0.15
0.50 - 60	19	0.20
0.50 - 70	19	0.22
0.50 - 80	19	0.25
0.50 - 90	19	0.30
0.70 - 10	25	0.35
0.70 - 20[1]	25	0.45
0.70 - 30[1]	25	0.50
0.70 - 40[1]	38	0.70
0.70 - 50[1]	38	0.80
0.70 - 60[1]	38	1.00
0.70 - 70[1]	38	1.15
0.70 - 80[1]	38	1.30

Notes: (1) Only for valve sizes 1.5 and 2 inches with angle-style body

Standard Manufacturing Materials

Component	Materials
Plug	400 Series Stainless Steel Solid Alloy 6 (Stellite #6) (R 30006)
Seat ring	400 Series Stainless Steel Solid Alloy 6 (Stellite #6) (R 3006)

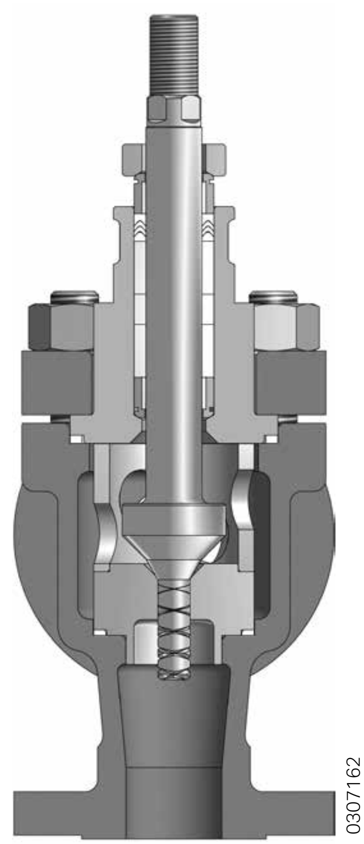

Fig. 9 - Omicron® Trim

Severe Services Trim
Special Trim - Alpha®
Liquids

Introduction

The anticavitation Alpha® trim of ValtekSul minimizes cavitation damage to valve components by directing the vapor bubbles, as their implosion happens in an area away from metal parts.

The anticavitation Alpha® trim employs a determined quantity of small holes through the retainer wall, through which the fluid is passed. As the plug moves away from the seat, increasing pairs of holes begin to open. Each hole lets through a jet of cavitating liquid, which impinges in the center of the retainer upon another jet of liquid coming from an opposing hole.

The impact of the fluid jets forms an area of pressure recovery and cushion of fluid stream, all this away from metal parts. The vena contracta is formed outside the retainer instead of inside it. The turbulence of the flow during impact causes the collapse of vapor bubbles at the center of the seat retainer, minimizing in this way the damage to valve trim.

The Alpha® trim fits in the standard ValtekSul bodies, being available in pressure-balanced and unbalanced versions. The plug firmly fits to the retainer, controlling the fluid flow through the holes. However, the fluid must be entirely clean to avoid stick and galling between the plug and retainer. The flow capacity and characteristics are determined by the size and spacing of the seat retainer holes. Holes with different size and variable spacing can be used in the same retainer in order to get the required flow characteristic. The flow direction for valves with Alpha® trim is always over the plug.

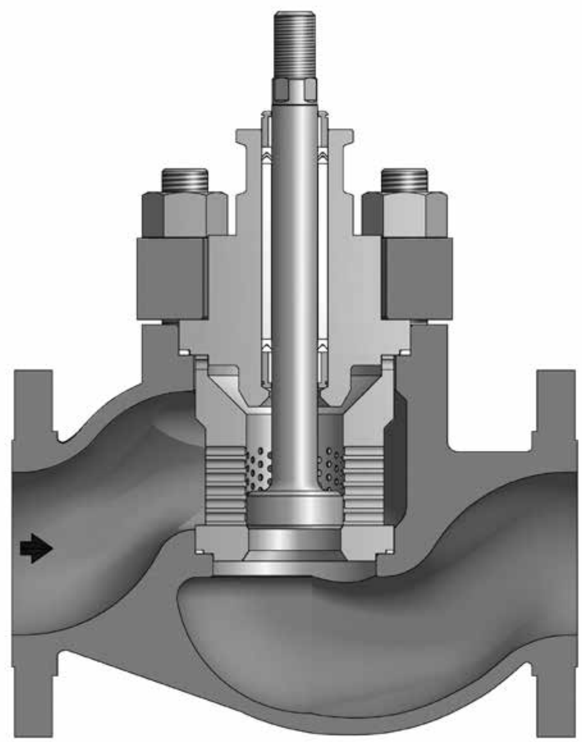

Fig. 10 - Unbalanced Alpha® Trim

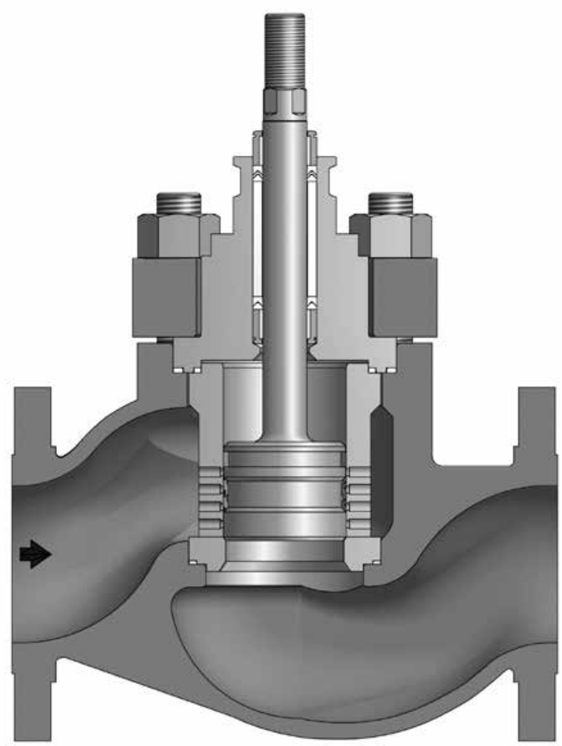

Fig. 11 - Balanced Alpha® Trim

Standard Manufacturing Materials

Component	Materials
Retainer	AISI 316 Stainless Steel (UNS S 31600) AISI 420 Stainless Steel (UNS S 42000) Super Duplex (UNS S 32760)
Plug	AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 AISI 420 Stainless Steel (UNS S 42000) Super Duplex (UNS S 32760)
Seat ring	AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 AISI 420 Stainless Steel (UNS S 42000) Super Duplex (UNS S 32760)

Severe Services Trim
Special Trim - Alpha®
Flow Coefficient ((C_V)

Alpha® Trim
Class ANSI 150-600

Valve Nominal Size (in.)	Trim Code (T/N)	Stroke (mm)	C_V			
			Unbalanced		Balanced	
			Linear	Equal %	Linear	Equal %
1.0	0.75-10	19	1.5	1.5		
	0.75-20	19	2.5	2.5		
	0.75-30	19	4.0	4.0		
	0.75-40	19	6.0	6.0		
	0.75-50	19	8.0	6.5		
	0.75.60	25	10.0	8.5		
1.5	1.25-10	19	4.0	4.0	4.0	4.0
	1.25-20	19	6.0	6.0	6.0	6.0
	1.25-30	19	10.0	10.0	10.0	10.0
	1.63-10	25	16.0	16.0	16.0	16.0
	1.63-20	25	25.0	25.0	25.0	25.0
	1.63-30	38	31.0	31.0	31.0	31.0
2.0	1.25-10	19	4.0	4.0	4.0	4.0
	1.25-20	19	6.0	6.0	6.0	6.0
	1.25-30	19	10.0	10.0	10.0	10.0
	1.63-10	25	16.0	16.0	16.0	16.0
	1.63-20	25	25.0	25.0	25.0	25.0
	1.63-30	38	34.0	34.0	34.0	34.0
	1.63-40	51	44.0	38.0	44.0	38.0
3.0	1.50-10	19	10.0	10.0	10.0	10.0
	1.85-10	25	16.0	16.0	16.0	16.0
	1.85-20	25	28.0	28.0	28.0	28.0
	2.25-10	38	45.0	45.0	45.0	45.0
	2.25-20	38	65.0	55.0	65.0	55.0
	2.50-10	51	88.0	68.0	88.0	68.0
4.0	1.85-10	38	28.0	28.0	28.0	28.0
	1.85-20	38	44.0	44.0	44.0	44.0
	3.00-10	51	65.0	65.0	65.0	65.0
	3.00-20	51	95.0	95.0	95.0	95.0
	3.75-10	51	138.0	108.0	138.0	108.0
	3.75-20	64	163.0	138.0	163.0	138.0
6.0	3.25-10	51	110.0	110.0	110.0	110.0
	4.75-10	64	160.0	160.0	160.0	160.0
	4.75-20	64	238.0	193.0	238.0	193.0
	4.75-30	76	345.0	305.0	345.0	305.0
8.0	6.50-10	76	240.0	240.0	240.0	240.0
	6.50-20	76	328.0	328.0	328.0	328.0
	6.50-30	76	538.0	408.0	538.0	408.0
	6.50-40	76	595,0	495.0	595.0	495.0
10	8.50-10	76	300.0	300.0	300.0	300.0
	8.50-20	76	510.0	510.0	510.0	510.0
	8.50-30	76	667.0	597.0	667.0	597.0
	8.50-40	102	935.0	895.0	935.0	875.0
12	9.75-10	102	400.0	400.0	400.0	400.0
	9.75-20	102	600.0	600.0	600.0	600.0
	9.75-30	102	798.0	698.0	798.0	698.0
	9.75-40	102	995.0	795.0	995.0	795.0

Alpha® Trim
Class ANSI 900-1500

Valve Nominal Size (in.)	Trim Code (T/N)	Stroke (mm)	C_V			
			Unbalanced		Balanced	
			Linear	Equal %	Linear	Equal %
1.0	0.75-10	19	1.5	1.5		
	0.75-20	19	2.5	2.5		
	0.75-30	19	4.0	4.0		
	0.75-40	19	6.0	6.0		
	0.75-50	19	8.0	7.0		
	0.75.60	25	9.0	8.0		
1.5	1.25-10	19	4.0	4.0	4.0	4.0
	1.25-20	19	6.0	6.0	6.0	6.0
	1.25-30	19	10.0	10.0	10.0	10.0
	1.63-10	25	12.0	12.0	12.0	12.0
	1.63-20	25	15.0	15.0	15.0	15.0
	1.63-30	38	20.0	20.0	20.0	20.0
2.0	1.25-10	19	4.0	4.0	4.0	4.0
	1.25-20	19	6.0	6.0	6.0	6.0
	1.25-30	19	10.0	10.0	10.0	10.0
	1.63-10	25	12.0	12.0	12.0	12.0
	1.63-20	25	15.0	15.0	15.0	15.0
	1.63-30	38	23.0	23.0	23.0	23.0
	1.63-40	51	30.0	30.0	30.0	30.0
3.0	1.50-10	19	10.0	10.0	10.0	10.0
	1.85-10	25	15.0	15.0	15.0	15.0
	1.85-20	25	28.0	28.0	28.0	28.0
	2.25-10	38	44.0	44.0	44.0	44.0
	2.25-20	38	65.0	55.0	65.0	55.0
	2.50-10	51	90.0	65.0	90.0	65.0
4.0	1.85-10	25	28.0	28.0	28.0	28.0
	1.85-20	38	44.0	44.0	44.0	44.0
	3.00-10	38	65.0	65.0	65.0	65.0
	3.00-20	51	95.0	75.0	95.0	75.0
	3.75-20	51	144.0	112.0	144.0	112.0
6.0	3.00-10	38	65.0	65.0	65.0	65.0
	3.25-10	51	110.0	110.0	110.0	110.0
	4.75-10	64	155.0	133.0	155.0	133.0
	4.75-20	64	235.0	155.0	235.0	155.0
8.0	5.50-10	64	240.0	240.0	240.0	240.0
	5.50-20	76	325.0	290.0	325.0	290.0
	6.50-10	76	495,0	325.0	495.0	325.0
10	5.50-30	64	200.0	150.0	200.0	150.0
	7.50-10	76	300.0	200.0	300.0	200.0
	7.50-20	76	455.0	295.0	455.0	295.0
	8.50-10	76	695.0	455.0	695.0	455.0

Severe Services Trim
Special Trim - Alpha®
Flow Coefficient (Cv)

Internos Alpha
Classe ANSI 2500

Valve Nominal Size (in.)	Trim Code (T/N)	Stroke (mm)	C_V			
			Unbalanced		Balanced	
			Linear	%c	Linear	%c
1.0	0.75-10	19	1.5	1.5		
	0.75-20	19	2.5	2.5		
	0.75-30	19	4.0	4.0		
	0.75-40	19	6.0	6.0		
	0.75.50	25	8.0	7.0		
1.5	1.25-10	19	4.0	4.0	4.0	4.0
	1.25-20	19	6.0	6.0	6.0	6.0
	1.25-30	19	10.0	10.0	10.0	10.0
	1.63-70	19	13.0	13.0	13.0	13.0
2.0	0.75-10	19	4.0	4.0	4.0	4.0
	0.75-20	19	6.0	6.0	6.0	6.0
	0.75-30	19	10.0	10.0	10.0	10.0
	1.63-10	19	12.0	12.0	12.0	12.0
	1.63-20	25	16.0	16.0	16.0	16.0
	1.63-30	25	23.0	23.0	23.0	23.0

Valve Nominal Size (in.)	Trim Code (T/N)	Stroke (mm)	C_V			
			Unbalanced		Balanced	
			Linear	Equal %	Linear	Equal %
3.0	1.85-10	19	16.0	10.0	16.0	10.0
	1.85-20	19	28.0	16.0	28.0	16.0
	2.25-10	38	44.0	28.0	44.0	28.0
	2.25-20	38	65.0	44.0	65.0	44.0
4.0	1.85-10	25	28.0	28.0	28.0	28.0
	1.85-20	38	44.0	44.0	44.0	44.0
	3.00-10	38	65.0	55.0	65.0	55.0
	3.00-20	51	110.0	70.0	110.0	70.0
6.0	3.00-10	38	65.0	50.0	65.0	50.0
	3.25-10	51	110.0	65.0	110.0	65.0
	4.75-20	64	160.0	110.0	160.0	110.0
	4.75-30	64	195.0	160.0	195.0	160.0

Trim for Gaseous Severe Services
Special Trim

Introduction

The aerodynamic noise produced by the passage of a fluid through a control valve is considered the most problematic in terms of environmental noise of downstream equipments of an industrial plant. Associated with the presence of high levels of turbulence and shock waves in the valve after restriction, the energy dissipated by the turbulence is mainly converted into acoustic energy that propagates downstream the valve, approximately between 1 and 2 diameters of the exit pipe. In physics, noise is a form of energy that propagates through pressure waves, on an elastic medium and at a speed that is characteristic of the medium through which it propagates. The noise produced by cavitation should not be considered, once the cavitation must be avoided, so its noise should not exist.
On gaseous services, the noise is generated by the high pressure drops through the valve and the turbulence carried into the downstream piping. As a direct result, the noise is radiated to the surrounding system area at the downstream piping.
In situations where damages to nearby equipments or injuries to people may have been caused by the source generator of high noise levels, the attenuation of this noise is not only desired, but mandatory.
The overlapping of the pressure and velocity profile (Fig. 12) is the main cause for noise generation in a control valve, where at vena contracta the velocity has a considerable increase. Laboratory tests have showed that in a control valve the sound pressure level (SPL) is directly proportional to the cube of the fluid velocity (SPL ~v^3).
Due to the extension of the processes involved in the generation of noise as well as in its propagation downstream the control valve, this is object of more detailed analysis in the Sizing and Selection of Control Valves catalogue edited by ValtekSul.

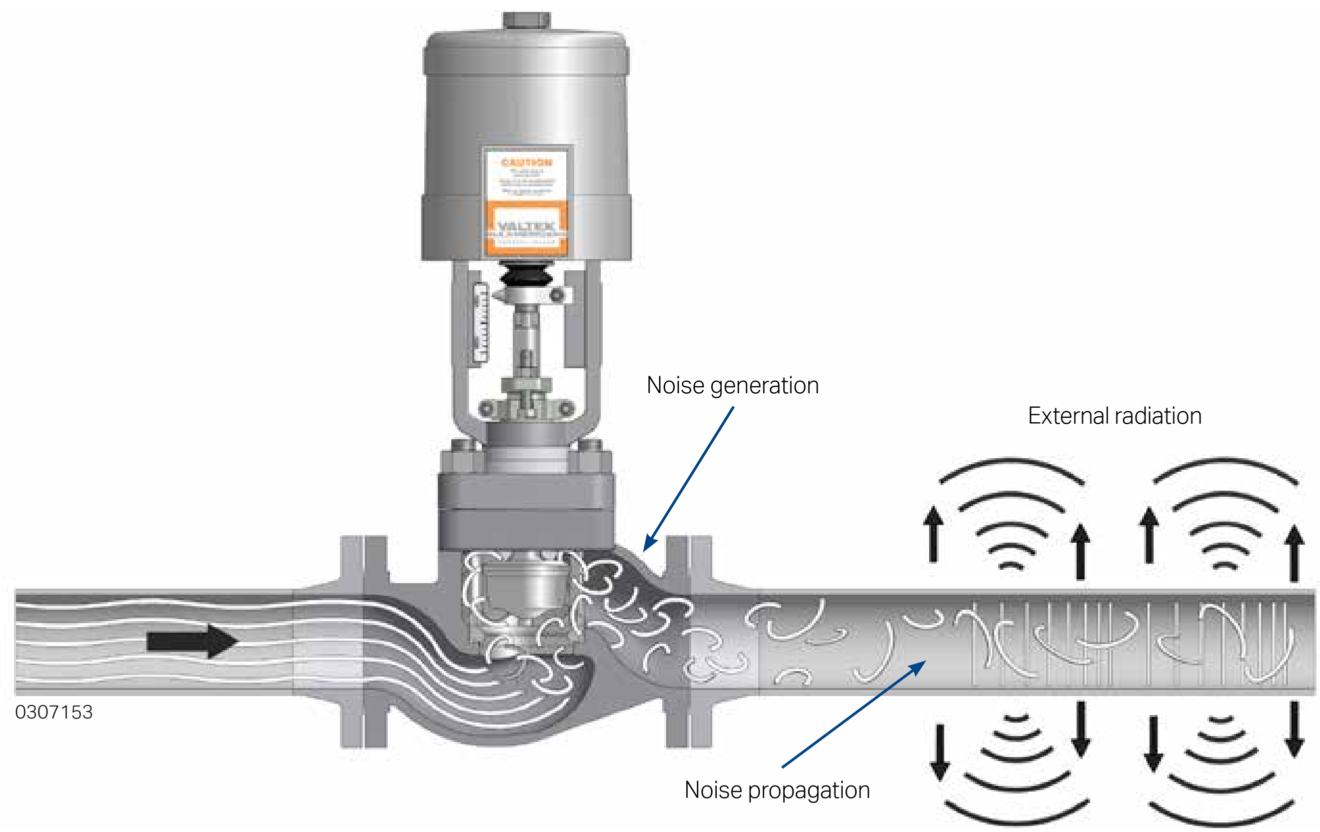

Fig. 12 - Noise Generation and Propagation at Vena Contracta

Trim for Gaseous Severe Services
Special Trim - Beta®

Introduction - Cont.

Current legislation requires that equipments, such as control valves, operate with operational noise levels not exceeding 85 dBA. Usually, the noise level produced by most of the control valves is lower than this. However, some operational structures of the fluid, such as: cavitation, flashing and mechanical vibration, alter these criteria.
The Beta® trim of ValtekSul were developed to effectively reduce noise levels in gaseous applications. The Beta® trim eliminates the noise problem in the valve by applying an effective action on the pressure reduction of gases, as well as controlling the turbulence dragged in the downstream pipe.
The Beta® trim are available in two options: an economical one, with a retainer of one or two stages for noise reductions of up to 15 dBA, and another with a multiple-stages retainer for noise reductions of up to 30 dBA.

Turbulence Generation

The noise in the control valve is mainly the result of the turbulence generated within it. This turbulence dragged in the downstream pipe, where the pressure fluctuations are located, vibrates the relatively thin pipe wall, radiating noise to the environment. The control valves with Beta® trim of ValtekSul were designed to control this turbulence. Each stage was designed with a large number of holes or orifices. Each successive stage presents additional holes or orifices, creating a growing flow area that manipulates the expanded volume of the gas, as a result of the pressure drop.
The turbulence existing in the fluid, as it leaves the last stage of the Beta® trim, is limited by the physical control of individual flows of fluid. The smallest flow leaving the final stage of the Beta® trim limits the amount of energy of the existing turbulence. Besides, the small turbulent swirls are dissipated more easily.
As a result, the fluid leaving the valve does not contain turbulent swirls on a sufficient scale to cause substantial noise generation in the downstream pipe. The stages also effectively limit most of the sound vibration generated in the throttling control region.
This attenuating effect is only possible due to the material´s acoustic impedance characteristics and the trims own design, which provide resistance to the additional transmissions of incident sound energy.
The described acoustic impedance is the main factor that permits the noise control when the valve plug moves close to the seat ring.

Pressure Reduction

The pressure drop in the Beta® trim is dispersed so that it does not occur only at the throttling point between the seat ring and the plug, but also at each stage, from the internal part of the retainer to its exterior. This pressure drop happens mainly as a result of sudden expansions and contractions that occur as the fluid flows through the Beta® trim.
Each stage is constructed to absorb a small fraction of the differential pressure, thus avoiding the high velocities present in simple trims with a unique throttling control point. This gradual pressure reduction is achieved by selecting sufficient number of stages, which keep the flow velocity low.

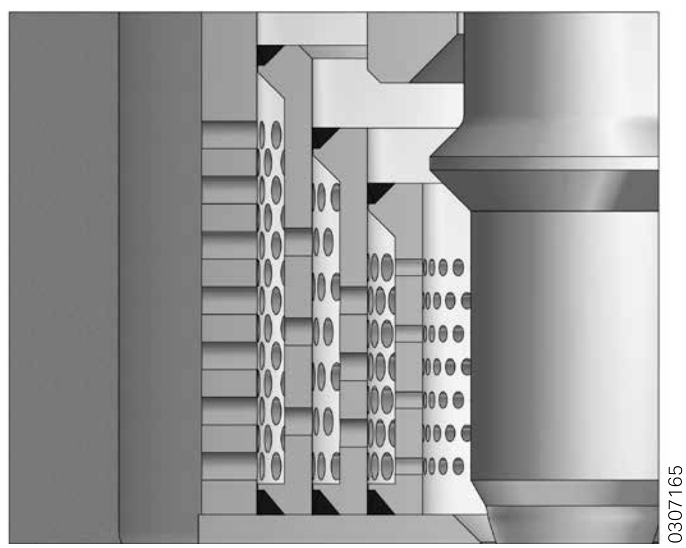

Fig. 13 - Beta® Stages

Each stage of the retainer of the Beta® trim manipulates a part of the differential pressure, significantly reducing the high velocity and the turbulence generated in a unique throttling control point

Trim for Gaseous Severe Services
Special Trim - Beta®

Velocities

One of the fundamental concepts in the design of the Beta® control valves consists in keeping reasonable and acceptable velocities in each internal point of the valve as the fluid flows through the valve. This requires careful attention to the flowing areas, as well as the interrelated areas between the various retainer stages, and at any other point inside the valve. As it concerns gases, it is known that as the velocity approaches the speed of sound, the valve emits noise. The noise in control valves usually becomes excessive in velocities much lower than the sonic speed. The valves with Beta® trim were designed to work with maximum gas velocity of 0.33 Mach at the valve outlet.

In the design of the Beta® cartridge, the velocities in the most critical flow conditions were considered and at the following points (see Fig. 14):

1. The area of fluid passage in the valve inlet.
2. The area of the internal flow of the Beta® retainer in diverse plug positions.
3. The flow area of the gallery formed between the external retainer diameter and the internal diameter of the valve body.
4. The flow passage area in the valve outlet. For an effective noise control, the downstream pipe should have equal or larger diameter than the valve outlet.

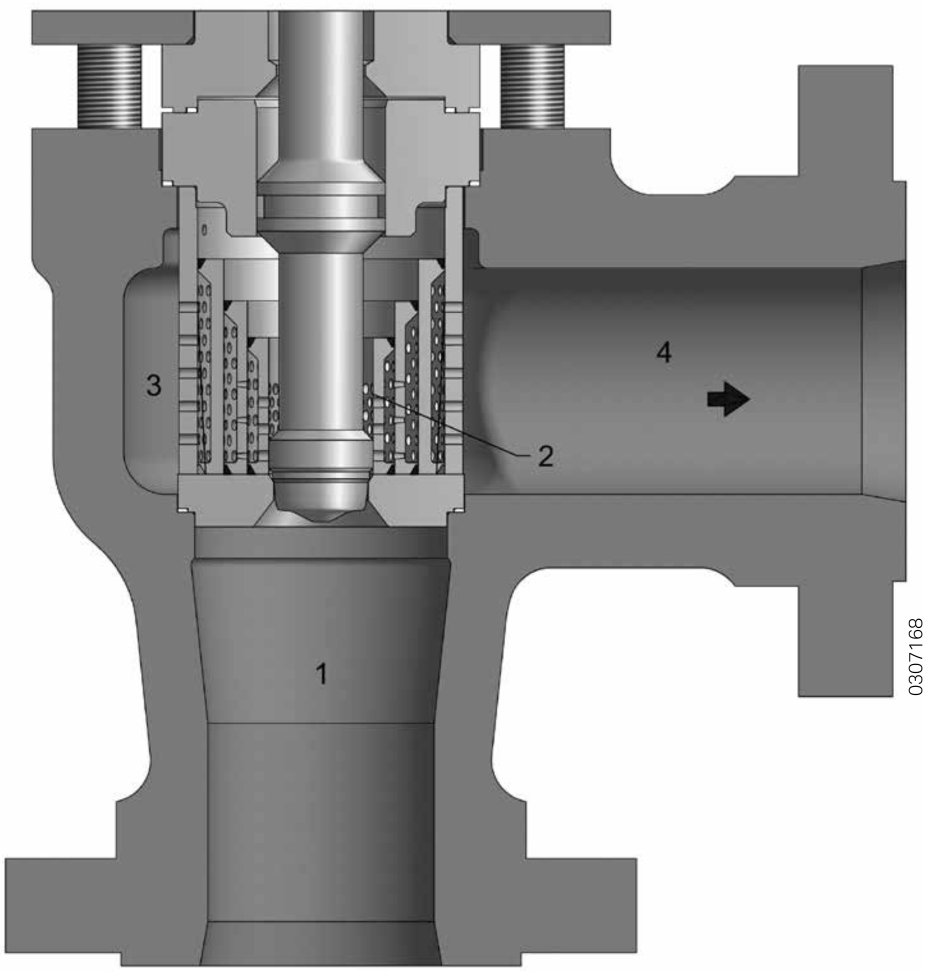

Fig. 14 - Points of Velocity Verification

Trim for Gaseous Severe Services
Special Trim - Beta®

Flow Characteristics

Three flow characteristics are available for ValtekSul control valves with Beta® trim.
"Equal Percentage" is the most commonly employed in processes control. In this, the flow change per unit of stroke of the valve is directly proportional to the flow present before this change occurs.
"Linear" is the characteristic that produces equal flow changes per unit of stroke of the valve. This characteristic is usually applied in those systems where the differential pressure is relatively constant, or the differential pressure in the valve forms the biggest part of the total loss of the system.
"Quick-open" is the characteristic usually used on "on/off" services. This characteristic was developed to quickly produce the maximum flow, when used together with the Beta® retainer, and effectively reduce the noise.

One and Two Stages Retainers

The globe valves with Beta® trims equipped with retainers of one or two stages represent an economical and innovative choice for low noise applications, permitting a reduction of up to 15 dBA.
The standard retainer is manufactured with reinforced dimension in 316 stainless steel and composed of perforated cylinders.
Considering that there is a standardized manufacturing for each valve size, special engineering works are not necessary for each case.
This results in low prices and faster deliveries. Due to its parts interchangeability, the retainers of up to two stages can be assembled in standard globe valves of ValtekSul without the inclusion of additional or special parts. Its simplicity of construction allows for an easy removal and cleaning.

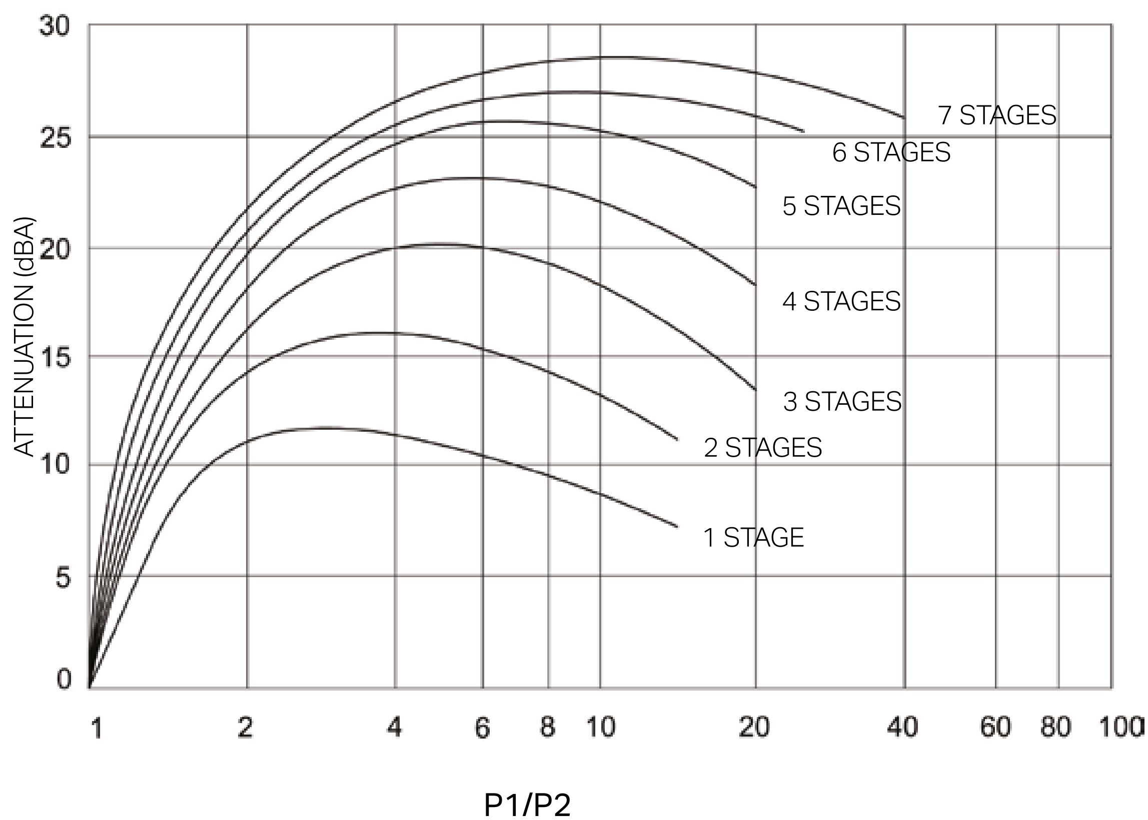

Fig. 15 - Noise Attenuation Curves for Beta® Trims of One Stage and Multiple-Stages

Trim for Gaseous Severe Services
Special Trim - Beta®

Standard Manufacturing Material

Trim Part	Materials
Attenuating Cartridge	AISI 316 Stainless Steel (UNS S 31600) Duplex (UNS S 32205) Super Duplex (UNS S 32760) Inconel (UNS N 07718) Other alloys as required
Plug	AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 AISI 420 Stainless Steel (UNS S 42000) Série 400 Stainless Steel Duplex (UNS S 32205) Super Duplex (UNS S 32760) Inconel (UNS N 07718) Other alloys as required
Seat Ring	AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 AISI 420 Stainless Steel (UNS S 42000) Series 400 Stainless Steel Duplex (UNS S 32205) Super Duplex (UNS S 32760) Inconel (UNS N 07718) Other alloys as required

Multiple-Stages Retainers

For the reduction of more significant noise levels (up to 30dBA), the multiple-stages retainers incorporate from three to seven stages. The stages are welded together. The external stage of the retainer allows that an uniform and sufficient compression of the gaskets is applied, through the bonnet and seat ring. See on Fig. 15 the standard attenuation data.

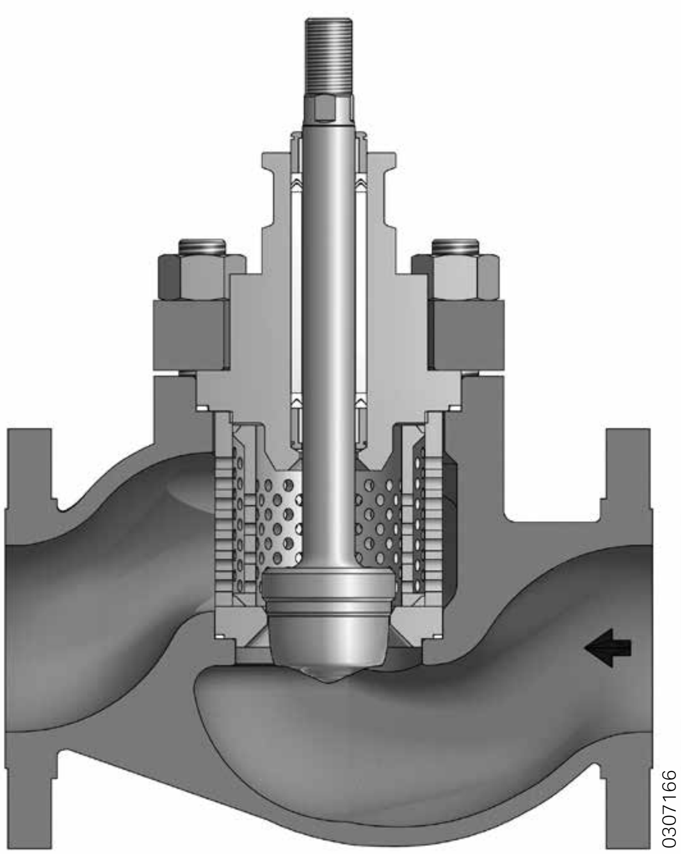

Fig. 16 - Unbalanced Beta® Trim

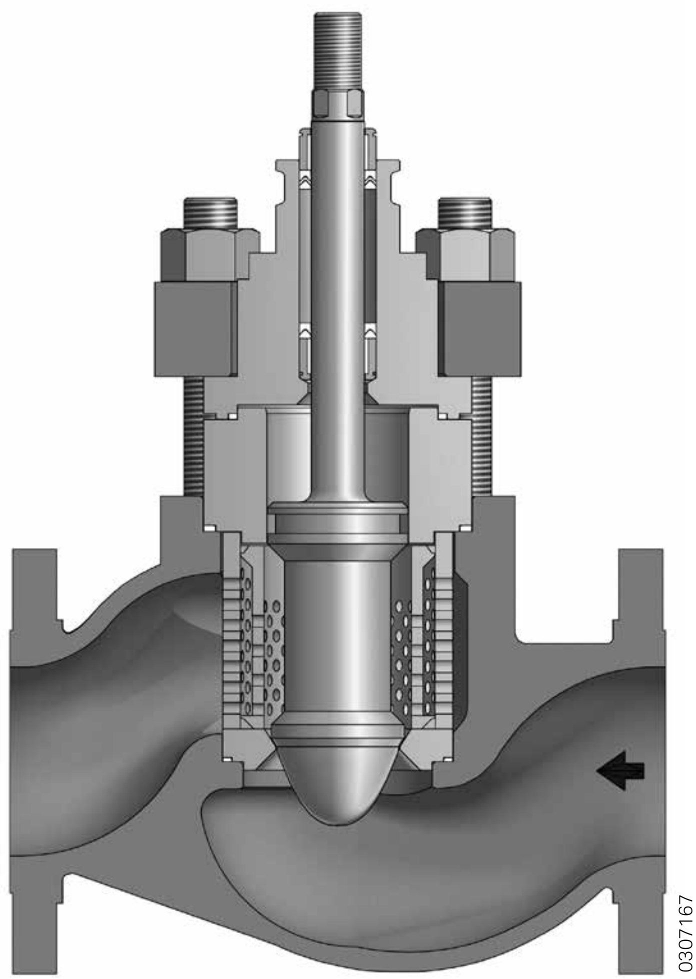

Fig. 17 - Balanced Beta® Trim

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 150-600

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
1.0	20 (0.81)	1	19	*	10.5	10.2		
	13 (0.50)	2	19	*	5.2	5.0		
1.5	32 (1.25)	1	25	*	24	22	24	22
	25 (1.00)	2	19	*	16.0	15.0	16.0	15.0
2.0	41 (1.63)	1	38	*	42	41	42	41
	25 (1.00)	2	19	*	22	21	22	21
3.0	67 (2.63)	1	51	*	97	94	97	94
	50-10 (1.50)	2	38	*	62	60	62	60
	32 (1.25)	3	25	4.3	32	31	32	31
4.0	90 (3.50)	1	64	*	175	170	175	170
	67 (2.63)	2	51	*	108	105	108	105
	41 (1.63)	3	38	4.3	55	54	55	54
6.0	125 (5.00)	1	76	*	381	370	381	370
	90 (3.50)	2	64	*	222	215	222	215
	75 (3.00)	3	51	4.3	156	153	156	153
	55 (2.25)	4	51	6.4	98	96	98	96
8.0	160 (6.25)	1	102	*	632	610	632	610
	125 (5.00)	2	76	*	415	400	415	400
	102 (4.00)	3	64	4.3	272	268	272	268
	75 (3.00)	4	64	6.4	168	165	168	165
	67 (2.63)	5	51	9.6	121	120	121	120
	50 (2.00)	6	38	14.5	76	75	76	75
10	200 (7.90)	1	152	*	990	960	990	960
	150 (5.90)	2	102	*	620	600	620	600
	115 (4.50)	3	76	4.3	380	372	380	372
	90 (3.50)	4	64	6.4	243	238	243	238
	75 (3.00)	5	64	9.6	173	170	173	170
	67 (2.63)	6	51	14.5	125	123	125	123
12	240 (9.50)	1	152	*	1420	1380	1420	1380
	190 (7.40)	2	102	*	920	890	920	890
	150 (6.00)	3	102	4.3	615	605	615	605
	125 (5.00)	4	102	6.4	420	415	420	415
	90 (3.50)	5	64	9.6	279	275	279	275
	75 (3.00)	6	64	14.5	174	172	174	172
	67(2.63)	7	51	32.0	125	123	125	123

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - Cv

Beta® Trim
ANSI Class 150-600

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
14	254 (10.00)	1	152	*	1480	1480	1480	1427
	203 (8.00)	2	132	*	1010	1010	1010	941
	165 (6.50)	3	102	4.3	702	690	702	690
	125 (5.00)	4	76	6.4	460	450	460	450
	102 (4.00)	5	64	9.6	307	300	307	300
	90 (3.50)	6	64	14.5	223	220	223	220
	67 (2.63)	7	51	32.0	138	135	138	135
16	303 (12.00)	1	152	*	2040	2040	2040	1997
	230 (9.00)	2	152	*	1310	1310	1310	1269
	185 (7.25)	3	102	4.3	905	890	905	890
	150 (6.00)	4	102	6.4	630	620	630	620
	125 (5.00)	5	76	9.6	437	430	437	430
	102 (4.00)	6	64	14.5	294	290	294	290
	85 (3.25)	7	64	32.0	198	195	198	195
18	335 (13.25)	1	204	*	2515	2515	2515	2470
	254 (10.00)	2	152	*	1625	1625	1625	1564
	210 (8.25)	3	152	4.3	1145	1125	1145	1125
	170 (6.75)	4	102	6.4	793	780	793	780
	140 (5.50)	5	76	9.6	543	535	543	535
	113 (4,50)	6	76	14.5	370	365	370	365
	95 (3.75)	7	64	32.0	253	250	253	250
20	375 (14.75)	1	203	*	3100	3100	3100	3011
	280 (11.00)	2	152	*	1980	1980	1980	1907
	230 (9.00)	3	152	4.3	1385	1360	1385	1360
	190 (7.50)	4	102	6.4	975	960	975	960
	150 (6.00)	5	102	9.6	655	645	655	645
	125 (5.00)	6	76	14.5	455	450	455	450
	110 (425)	7	64	32.0	320	315	320	315
24	450 (17.75)	1	203	*	4490	4490	4490	4347
	335 (13.25)	2	203	*	2870	2870	2870	2786
	280 (11.00)	3	152	4.3	2035	2000	2035	2000
	230 (9.00)	4	152	6.4	1410	1390	1410	1390
	185 (7.25)	5	102	9.6	955	940	955	940
	150 (6.00)	6	102	14.5	655	645	655	645
	125 (5.00)	7	76	32.0	450	445	450	445

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 900-1500

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
1.0	20 (0.81)	1	19	*	8.3	8.0		
	18 (0.71)	1	19	*	7.2	7.0		
	16 (0.63)	1	19	*	6.2	6.0		
	13 (0.50)	2	19	*	4.7	4.5		
	10 (0.38)	2	19	*	3.3	3.2		
1.5	32 (1.25)	1	38	*	21	20	21	20
	25-20	1	19	*	15.0	15.0	15.0	15.0
	25-10	2	19	*	13.0	13.0	13.0	13.0
	20 (0.81)	2	19	*	12.0	10.5	12.0	10.5
2.0	41 (1.63)	1	38	*	36	35	36	35
	32 (1.25)	1	38	*	28	27	28	27
	25 (1.00)	2	19	*	21	20	21	20
	20 (0.81)	2	19	*	16.0	15.0	16.0	15.0
3.0	67 (2.63)	1	64	*	83	80	83	80
	50-20	1	51	*	62	60	62	60
	50-10	2	51	*	52	50	52	50
	41 (1.63)	2	38	*	46	45	46	45
	32 (1.25)	3	38	4.3	31	30	31	30
4.0	90 (3.50)	1	76	*	145	140	145	140
	67-20	1	64	*	124	120	124	120
	67-10	2	64	*	93	90	93	90
	55 (2.25)	2	51	*	83	80	83	80
	41 (1.63)	3	51	4.3	53	52	53	52

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 900-1500

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
6.0	125 (5.00)	1	102	*	310	300	310	300
	102 (4.00)	1	76	*	248	240	248	240
	90 (3.50)	2	76	*	191	185	191	185
	75-20	2	64	*	170	165	170	165
	75-10	3	64	4.3	137	133	137	133
	55 (2.25)	4	51	6.4	91	89	91	89
8.0	160 (6.25)	1	152	*	505	490	505	490
	125-20	1	102	*	410	400	410	400
	125-10	2	102	*	340	330	340	330
	102 (4.00)	2	76	*	295	285	295	285
	102 (4.00)	3	76	4.3	238	230	238	230
	75 (3.00)	4	64	6.4	155	150	155	150
	50 (2.00)	5	64	9.6	110	107	110	107
10	200 (7.90)	1	152	*	815	790	815	790
	190 (7.50)	1	152	*	745	720	745	720
	160 (6.25)	2	152	*	530	515	530	515
	125 (5.00)	2	102	*	460	495	460	445
	115 (4.50)	3	102	4.3	346	335	346	335
	90 (3.50)	4	76	6.4	232	225	232	225
	75 (3.00)	5	63	9.6	165	160	165	160
	67 (2.63)	6	63	14.5	115	110	115	110
12	240 (9.50)	1	152	*	1140	1110	1140	1110
	200 (7.90)	1	152	*	960	930	960	930
	190 (7.50)	2	152	*	745	720	745	720
	160 (6.25)	2	152	*	670	650	670	650
	150 (6.00)	3	152	4.3	525	510	525	510
	125 (5.00)	4	102	6.4	365	355	365	335
	102 (4.00)	5	76	9.6	247	240	247	240
	90 (3.50)	6	76	14.5	173	168	173	168
	67 (2.63)	7	63	32.0	111	107	111	107

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 900-1500

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
14	235 (9.25)	1	152	*	1245	1210	1245	1210
	230 (9.00)	1	152	*	1180	1145	1180	1145
	190 (7.48)	2	152	*	850	820	850	820
	165 (6.50)	2	152	*	775	750	775	750
	140 (5.50)	3	152	4.3	562	545	562	545
	115 (4.50)	4	102	6.4	386	375	386	375
	102 (4.00)	5	76	9.6	280	270	280	270
	75 (3.00)	6	63	14.5	176	170	176	170
	67 (2.63)	7	63	32.0	125	122	125	122
16	265 (10.45)	1	203	32.0	1575	1530	1575	1530
	255 (10.00)	1	203	32.0	1510	1460	1510	1460
	200 (7.90)	2	152	32.0	1070	1040	1070	1040
	190 (7.48)	2	152	32.0	1005	975	1005	975
	165 (6.50)	3	152	32.0	752	730	752	730
	140 (5.50)	4	152	32.0	530	515	530	515
	102 (4.00)	5	76	32.0	330	320	330	320
	90 (3.50)	6	76	32.0	237	230	237	230
	75 (3.00)	7	63	32.0	165	160	165	160
18	290 (11.50)	1	203	32.0	1944	1885	1944	1885
	280 (11.00)	1	203	32.0	1871	1815	1871	1815
	230 (9.00)	2	152	32.0	1355	1315	1355	1315
	203 (8.00)	2	152	32.0	1235	1200	1235	1200
	185 (7.30)	3	152	32.0	958	930	958	930
	150 (6.00)	4	152	32.0	660	640	660	640
	125 (5.00)	5	102	32.0	455	440	455	440
	102 (400)	6	76	32.0	304	295	304	295
	75 (3.00)	7	63	32.0	190	185	190	185
20	330 (13.00)	1	203	32.0	2460	2385	2460	2385
	315 (12.50)	1	203	32.0	2375	2305	2375	2305
	255 (10.00)	2	203	32.0	1690	1640	1690	1640
	240 (9.50)	2	152	32.0	1625	1575	1625	1575
	203 (8.00)	3	152	32.0	1175	1140	1175	1140
	165 (6.50)	4	152	32.0	805	780	805	780
	140 (5.50)	5	152	32.0	562	545	562	545
	115 (450)	6	102	32.0	380	370	380	370
	90 (3.50)	7	76	32.0	247	240	247	240

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 2500

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
1.0	18 (0.71)	1	19	*	6.2	6.0		
	16 (0.63)	1	19	*	5.2	5.0		
	13 (0.50)	2	19	*	3.7	3.5		
	10 (0.38)	2	19	*	3.1	3.0		
1.5	25 (1.00)	1	19	*	13.0	13.0	13.0	13.0
	20 (0.81)	1	19	*	11.0	10.0	11.0	10.0
	18 (0.71)	2	19	*	8.3	8.0	8.3	8.0
	16 (0.63)	2	19	*	7.2	7.0	7.2	7.0
2.0	32 (1.25)	1	38	*	21	20	21	20
	25-20	1	19	*	18.0	17.0	18.0	17.0
	25-10	2	19	*	15.0	15.0	15.0	15.0
	20 (0.81)	2	19	*	13.0	12.0	13.0	12.0
3.0	50 (2.00)	1	51	*	51	50	51	50
	38-20	1	51	*	41	40	41	40
	38-10	2	51	*	35	35	35	35
	32 (1.25)	2	38	4.3	31	30	31	30
4.0	67 (2.63)	1	64	*	87	85	87	85
	50-20	1	51	*	67	65	67	65
	50-10	2	51	*	56	55	56	55
	41 (1.63)	2	51	*	48	46	48	46
	41 (1.63)	3	51	4.3	40	38	40	38
6.0	90 (3.50)	1	76	*	176	170	176	170
	75 (3.00)	1	64	*	155	150	155	150
	67 (2.63)	2	64	*	119	115	119	115
	60 (2.36)	2	64	*	108	105	108	105
	50 (2.00)	3	51	4.3	77	75	77	75
	41 (1.63)	4	51	6.4	52	50	52	50
8.0	125 (5.00)	1	102	*	330	320	330	320
	102-20	1	76	*	270	260	270	260
	102-10	2	76	*	225	220	225	220
	90 (3.50)	2	76	*	206	200	206	200
	90 (3.50)	3	76	4.3	165	160	165	160
	75 (3.00)	4	64	6.4	115	111	115	111
	67 (2.63)	5	64	9.6	83	80	83	80

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Beta®
Flow Coefficients - C_V

Beta® Trim
ANSI Class 2500

Valve Nominal Diameter (in.)	Trim Code (T/N)	Number of Stages	Stroke mm	P_1/P_2 Max.	Unbalanced Trim		Balanced Trim	
					Linear	Equal %	Linear	Equal %
10	140 (5.50)	1	102	*	465	450	465	450
	127-20	1	102	*	430	415	430	415
	127-10	2	102	*	355	345	355	345
	102 (4.00)	2	76	*	305	300	305	300
	90 (3.50)	3	76	4.3	227	220	227	220
	67 (2.63)	4	76	6.4	144	140	144	140
	50 (2.00)	5	63	9.6	93	90	93	90
12	165 (6.50)	1	152	*	650	630	650	630
	152 (6.00)	1	152	*	610	590	610	590
	127 (5.00)	2	102	*	450	435	450	435
	102 (4.00)	2	76	*	360	350	360	350
	102 (4.00)	3	76	4.3	310	300	310	300
	75 (3.00)	4	63	6.4	196	190	196	190
	67 (2.63)	5	63	9.6	145	140	145	140

Note: *See Fig. 15 for attenuation P_1/P_2

Trim for Gaseous Severe Services
Special Trim - Delta®

Introduction

The Delta® trim, when assembled in globe valves of ValtekSul, can effectively reduce noise levels for more than 30 dBA. The Delta® trim can also be used in conditions of high pressure drops in liquids, eliminating the effects of cavitation. Its exclusive design combined with the robust intrinsic characteristics of the globe valves of ValtekSul result in a control valve proven effective in reducing and eliminating gaseous and hydrodynamic noise, as well as the causes of cavitation.

Fluid Passage

The flow line, exclusively in the Delta® cartridge, allows the radial expansion of the fluid. The Delta® cartridge is effective with large pressure reductions in gases due to the additional expansion of the flow line.
The number of discs, as well as the cartridge shape, vary according to the application requirements.

Expansion and Sudden Contraction Phenomenon

The most important physical mechanisms that act to reduce the pressure through the discs are the expansion and sudden contraction of the flow as it passes across the discs teeth (see Fig. 20). The fluid that passes through the first tooth, by area restriction, presents an increase of velocity and consequently a pressure drop. This fluid changes direction and expands at the second tooth due to the increase in area and then contracts again continuously resulting in the necessary pressure drop that will eliminate the mentioned phenomena.

Flow Characteristic

The globe valves of ValtekSul with Delta® trim are specially designed with flow characteristic of linear type. Deviations from the linear characteristic can be achieved by manufacturing discs with individually distinct capabilities, thus approaching to a control with equal percentage characteristic.
The discs can also be manufactured with a fully open area at the top of the cartridge, in order to provide additional flow capability.

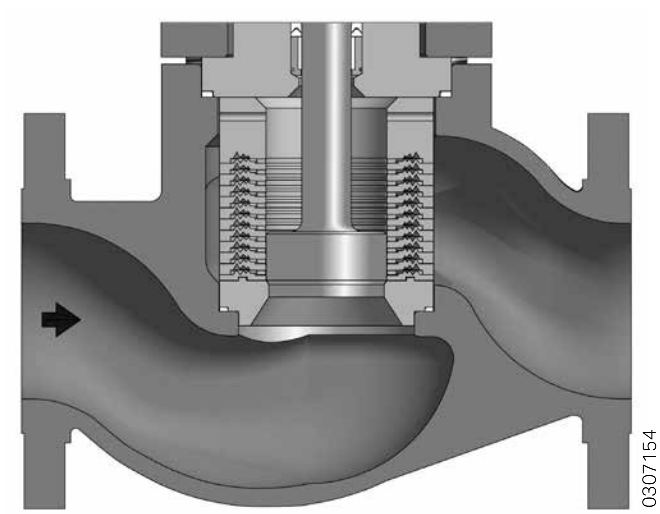

Fig. 18 - Unbalanced Delta® Trim

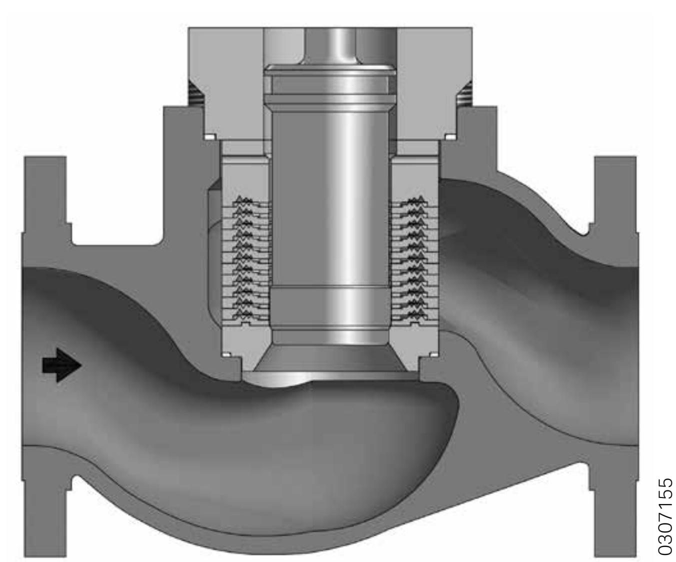

Fig. 19 - Balanced Delta® Trim

Trim for Gaseous Severe Services
Special Trim - Delta®

Velocity

One of the fundamental design concepts of the globe control valves of ValtekSul with Delta® trim is the establishment of velocities in each point as the flow passes through the valve.

The control valves with Delta® cartridge totally reduce the erosion, the hydrodynamic noise and the formation of cavitation phenomenon with liquids whose velocities do not exceed 30 ft/sec. (9 m/sec.) in most applications. Velocities of up to 50 ft/sec. (15 m/ sec.) can be acceptable in specific applications.

In gaseous applications, when the velocity in the valve reaches values higher than 0.5 mach, there is the formation of excessive noise and the valve will be noisy. The valves with Delta® trim are designed to operate with maximum gas velocity of 0.3 Mach or even 0.5 Mach under certain limited conditions.

The velocities should be evaluated at the critical flow conditions in the following points (see Fig. 20):

Point 1: The valve inlet passageway.

Point 2: The internal flow area in all plug positions inside the cartridge.

Point 3: The flow area at the discs, between the teeth, including the inlet and outlet area of the cartridge.

Point 4: The area formed by the internal gallery of the body and the external area of the Delta® cartridge.

Point 5: The valve outlet passage area.

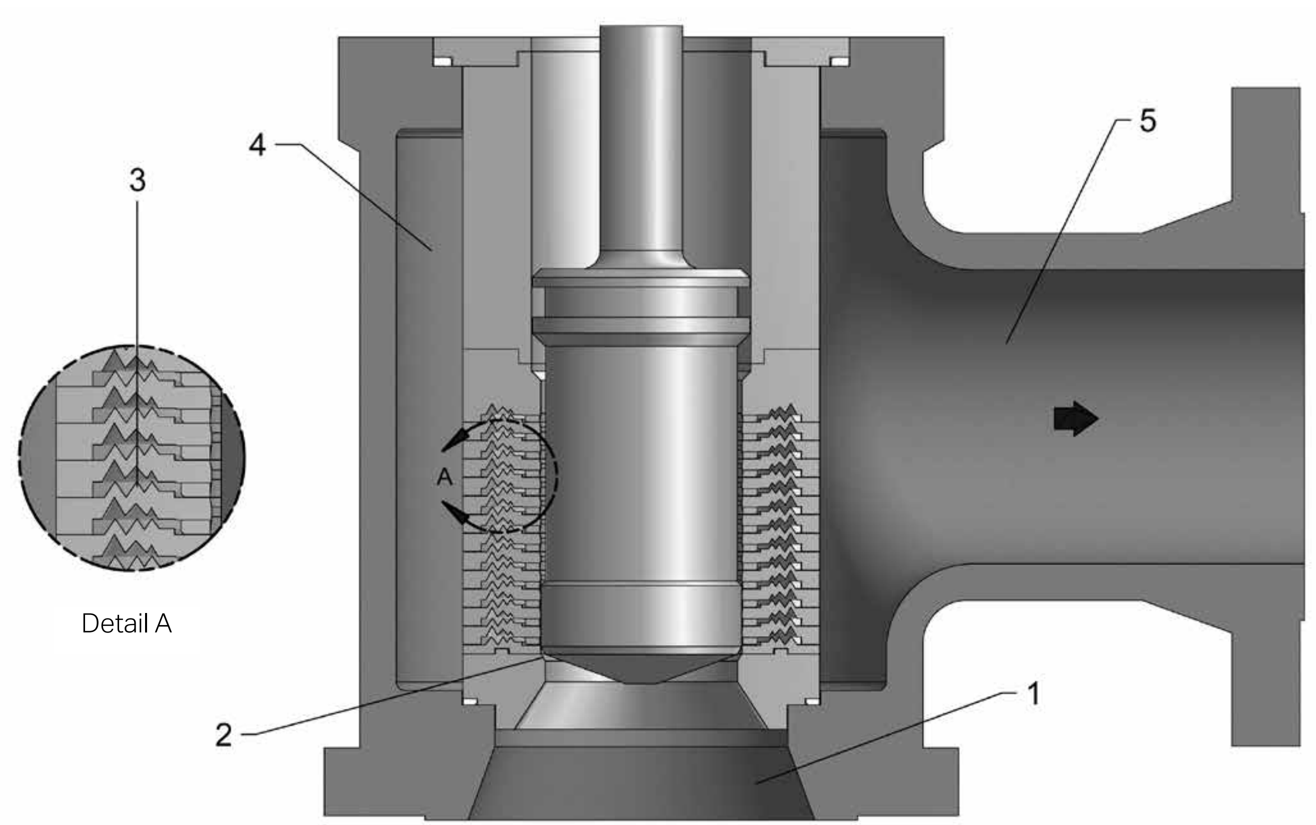

Fig. 20 - Points of Velocity Verification with Delta® Cartridge

Trim for Gaseous Severe Services
Special Trim - Delta®

Maintenance

The maintenance of the control valves with Delta® trims is widely facilitated by the easy removal of the Delta® cartridge from the valve interior. The Delta® cartridge is easily removed for inspection or cleaning. Maintaining the technological characteristics that comprise the unique design of the globe valves of ValtekSul, the assembly of the valves with Delta® trim is the "top-entry" type; and the guides system at the robust plug stem, which guides the plug head resulting in a perfect alignment in its entire course.

Characteristics and Advantages

Characteristics	Advantages
Advantages	Effective reduction of the gaseous and hydrodynamic noise. • Elimination of cavitation • Pressure drops reduced by stages • High pressure drops internally prevented
Controlled velocities	• Controlled velocity throughout the entire cartridge course
Constructive Design of Stack Discs	• Particles easily pass through stacked discs • Easy inspection • The cartridge permits its disassembly for maintenance services
Variety of materials	• As it is machined, it permits manufacturing in diverse types of materials
Wide diameter variation	• Available for valves with 1 ½ to 36 in. diameters in ANSI pressure classes of 150
High interchangeability	• Most of the parts are interchangeable in parts and actuators with the range of globe valves of ValtekSul
Piston-cylinder Actuator	• High performance • Compact and light • Easy maintenance • High interchangeability
Digital positioners	• Chronos positioner

Standard Manufacturing Materials

Body and Bonnet	ASTM A 216 Carbon Steel Gr. WCC ASTM A 217 Chrome-Moly Steel ASTM A 351 Stainless Steel CF8M Other cast metal alloys
Plug	AISI 316 Stainless Steel (UNS S 31600) AISI 410 Stainless Steel (UNS S 41000) AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 (Stellite #6) (UNS R 30006) Other metal alloys
Seat Ring	AISI 316 Stainless Steel (UNS S 31600) AISI 410 Stainless Steel (UNS S 41000) AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 (Stellite #6) (UNS R 30006) Other metal alloys
Delta® Discs	Bronze-Aluminum AISI 316 Stainless Steel (UNS S 31600) AISI 410 Stainless Steel (UNS S 41000) AISI 316 Stainless Steel (UNS S 31600) w/Alloy 6 (Stellite #6) (UNS R 30006) Other metal alloys
Bonnet Flange	ASTM A 105 Carbon Steel ASTM A 351 Stainless Steel CF8M
Plug Guides	Bronze AISI 316 Stainless Steel (UNS S 31600) w/PTFE AISI 316 Stainless Steel (UNS S 31600) w/Grafoil Solid Stellite #6
Gaskets	Spiral wound (See GLs and GLH Globe Valves Catalogue)
Packing	(See GLs and GLH Globe Valves Catalogue)

Trim for Gaseous Severe Services
Special Trim - Delta®

Flow Coefficient - C_V ANSI Class 150-600

Valve Nominal Diameter[1] (in.)	Trim Code (T/N)	Stroke mm	C_V	Min. Sigma	Number of Teeth
1½ - 2	38 28-20 28-10 25	51 51 51 51	24 12 7.0 4.0	0.2800 0.0520 0.0160 0.0046	2 3 4 5
3.0	55 48 45 38 32-30 32-20 32-10	64 64 64 64 64 64 64	45 31 22 15 10 7.0 5.0	0.1700 0.0750 0.0400 0.0186 0.0083 0.0043 0.0027	2 3 4 5 6 7 8
4.0	80 67 60 48 38 35 32	76 76 76 76 76 76 76	80 55 40 28 18 14 10	0.2000 0.0800 0.0424 0.0196 0.0086 0.0044 0.0028	2 3 4 5 6 7 8
6.0	110 90 80 65 55 45 38	102 102 102 102 102 102 102	150 105 75 50 35 25 17	0.2200 0.0570 0.0298 0.0129 0.0060 0.0035 0.0023	2 3 4 5 6 7 8
8.0	140 125 105 80 74 65-20 65-10	152 152 152 152 152 152 152	270 190 130 90 65 45 30	0.1700 0.0580 0.0310 0.0133 0.0062 0.0035 0.0023	2 3 4 5 6 7 8
10	190 165 140 115 102 90-20 90-10	190 190 190 190 190 190 190	500 350 250 170 120 80 60	0.1700 0.0790 0.0424 0.0197 0.0086 0.0045 0.0028	2 3 4 5 6 7 8
12	215 185 150 130 115 102 95	203 203 203 203 203 203 203	600 420 290 200 140 100 70	0.1700 0.0570 0.0298 0.0129 0.0061 0.0035 0.0023	2 3 4 5 6 7 8

Flow Coefficient - C_V ANSI Class 900-1500

Valve Nominal Diameter[1] (in.)	Trim Code (T/N)	C_V	Min. Sigma	Number of Teeth
1½ - 2	35 28-30 28-20 28-10	22 13 7.0 4.0	0.1700 0.0520 0.0130 0.0040	2 3 4 5
3.0	57 45 32-20 32-10	44 22 12 7.0	0.1000 0.0520 0.0140 0.0040	2 3 4 5
4.0	70 57 48 45 40-30 40-20 40-10	65 45 30 22 16 12 8.0	0.1840 0.1038 0.0558 0.0263 0.0153 0.0079 0.0033	2 3 4 5 6 7 8
6.0	90 80 74 65 55-30 55-20 55-10	130 100 75 55 40 30 20	0.2006 0.1042 0.0671 0.0379 0.0219 0.0109 0.0050	2 3 4 5 6 7 8
8.0	127 110 95 80 74 67-20 67-10	265 195 140 105 75 55 38	0.1849 0.0974 0.0511 0.0289 0.0170 0.0091 0.0044	2 3 4 5 6 7 8
10	165 140 120 102 95 85-20 85-10	410 300 220 165 130 100 70	0.1805 0.0990 0.0539 0.0325 0.0189 0.0113 0.0057	2 3 4 5 6 7 8
12	195 170 142 127 117 98 90	580 430 320 235 180 140 110	0.1878 0.1067 0.0619 0.0318 0.0182 0.0118 0.0072	2 3 4 5 6 7 8

Gaseous Severe Services
Downstream Equipment for Gas Noise Reduction

The noise in control valves is generated by high pressure drops in the valve and by the subsequent turbulence downstream. As consequence, noise is radiated to the surrounding area by the piping system. In situations where damage to equipment or personal accidents could be caused by a noise source, the noise attenuation is not only desired, but mandatory. Several of the following factors must be considered before choosing expensive noise suppression equipment:

- Does the application really demand noise attenuation?
- What are the low- or no-cost options that can attenuate the noise?
- If noise attenuation devices are needed, which low-cost equipment can be specified?

Is the Noise Attenuation Necessary?

If the sound pressure level (SPL) exceeds 85 or 90 dBA, it is usually recommended the use of noise suppression devices.

However, higher noise levels can be accepted if the noise is not associated to damage to equipments and it is located away from workers. For example, if the valve is installed in a tower at a certain distance from the workers, the distance itself can solve the problem, though an ear protection may be necessary if workers approach or climb the tower.

Other Low-Cost Alternatives

Other possible low-cost alternatives for the noise suppression of equipments are (1) isolate the piping, (2) direct the valve discharge to a vessel, (3) relocate the noise source (such as the downstream pipe) outside a closed area, (4) reverse the flow direction through the valve or (5) reduce the valve pressure drop.

Alternative Economic Noise Suppression Equipment

If the above suggestions are not viable, noise suppression equipments are necessary in most of the cases.

To reduce the noise levels or the sound pressure to an acceptable value, ValtekSul offers a wide variety of economic noise reduction devices that minimize and often eliminate higher priced solutions. These devices include:

- **Valves with Beta® trim of one or two stages** to reduce the SPL up to 15 dBA
- **Beta® resistance plates and diffusers** for reductions of up to 15 dBA
- **Valves with Delta® trim** to reduce the SPL up to 30 dBA
- **Inline silencers** for gas outlet applications or reductions above 25 dBA

Usually, any of these noise devices in series with a control valve can be selected to attenuate the noise to the needed acceptable SPL. For example, a Beta® plate or a diffuser, when installed downstream of a standard ValtekSul control valve, offers approximately the same dBA reduction than a valve with Beta® trim of one or two stages, although at a lower cost. For extremely high pressure drops, where valves with multiplestages trims must be considered, it can be more advantageous financially to install a Beta® plate, diffuser or silencer downstream of a small valve with Beta® trim of one or two stages.

Beta® Plates

Similar in many ways to a Beta® attenuator, the Beta® resistance plates are installed between the flanges with raised faces downstream of a ValtekSul control valve. Each plate incorporates a series of stages. To control the downstream line turbulence, each stage absorbs a part of the pressure drop through its many multiple holes.

Beta® plates are designed for each individual application, offering SPL reductions of up to 15 dBA. Depending on the kind of gas and the pressure drop ratio, these plates may need one to four stages. At the standard Beta® plates, both the housing and the plate stages with perforated holes are manufactured in carbon steel. However, an additional option manufactured in 304 stainless steel can be provided, for the housing and the stages. Bigger plates are available with lifting eye bolts.

Gaseous Severe Services
Downstream Equipament - Beta® Plates

Typical Beta® plates applications include gas pressure reduction stations, gas vents and flare systems.

Beta® plate specifications

Body Style	Disc without flange Disc with flange
Diameter	1 1/2 - 24 in.
Nominal pressure	ANSI 150 - 600, 900, 1500, 2500
Flow Direction	One way only
Valve Recovery Factor (F_L)	0.8 for a single stage 0.9 for multiple-stages
Manufacturing Materials	Carbon steel (standard) and 304 stainless steel (optional)

Beta® Plates C_v

Diameter	One stage	2 Stages	3 Stages
1 1/2	13	8	6
2	23	15	11
3	52	34	26
4	92	60	46
6	208	136	104
8	371	243	185
10	580	380	290
12	835	547	417
14	1136	774	568
16	1484	972	742
18	1879	1231	939
20	2320	1520	1160
24	3340	2188	1670

Note: All indicated values are for a maximum Cv for a determined size; reduced Cv´s are available under request.

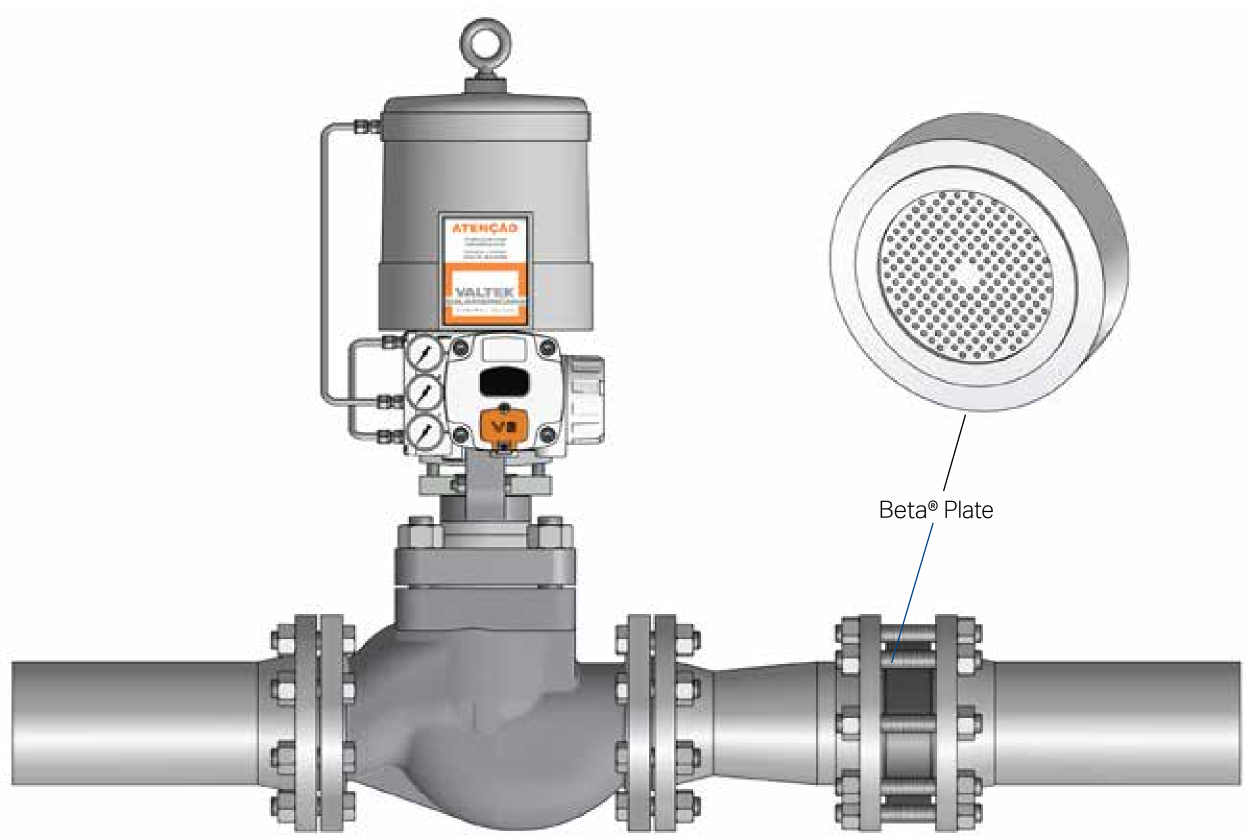

Fig. 21 - Beta® Plate Assembled Downstream of a Globe Valve

Quality Management System

ISO 9001-2015
Certificate nº 31001 QM 15
DQS GmbH
DQS Brazil
ISO 14001™ Certified

The information and specifications contained in this literature are considered accurate. However, they are supplied for informative purposes and should not be considered certified.
The products of Valtek Sulamericana are continually being improved and the specifications, dimensions and information contained in this catalogue are subject to change without notice. For additional information, please consult your Valtek Sulamericana representative. Specific assembly, operation and maintenance instructions for Severe Services Trims can be found at the Maintenance Catalogues nº 01, 07, 18 and 25.

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