Port Throttling GAD™ Trim

FOR CONVENTIONAL OR CUSTOM ENGINEERED CHARACTERISTICS

Copes-Vulcan®

The Copes-Vulcan Port Throttling GAD™ trim is developed to meet the rigorous requirements of applications such as feedwater and feedwater startup control, high pressure steam and gas letdown and other high mass flow rate pressure reductions. Designed to give optimum flexibility in electric, hydraulic and air operated control valves, the trim is available in Double Seat, Balanced Single Seat and Tandem versions. The GAD trim is equally suitable for use with steam and many other fluids. It has been successfully used on high pressure water applications involving pressure of up to 5075 psi (34,970 kPa) and pressure differential of up to 3625 psi (24,980 kPa).

Copes-Vulcan has been providing control valves and desuperheaters for the power, process and nuclear industries since 1903. SPX provides a wide range of valves for the control of pressure, temperature and flow-induced noise in all types of power plants. Products include severe service and general service control valves, variable orifice desuperheaters, Raven™, trim and steam conditioning valves and nuclear control valves, as well as custom designed specialty valves. Copes-Vulcan is recognized worldwide as a leader in valves for severe and critical service applications. Our strength lies in our ability to provide innovative valve solutions for our customers' application needs.

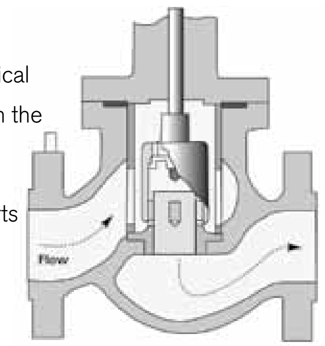
Port Throttling GAD™ Trim

TYPICAL FEATURES

The GAD trim is a proven design utilizing a unique concept in flow management.

- The control mechanism is situated in a zone of low turbulence which avoids flow induced instability or standing pressure waves.
- External cage guiding results in low hydraulic unbalance requiring reduced actuator force.
- Custom engineering of the flow control areas optimizes the valve characteristic to system requirements.
- The flow streams through the stationary cage result in energy dissipating jet impingement within the bore of the cage.
- Three versions of the trim are available: Double Seat, Balanced Single Seat and Tandem.

OPERATION



The GAD trim is quick change and consists of a cylindrical cage spacer and cage which are the boundary between the upstream and downstream sections of the valve body.

The control of the fluid through the valve is through ports provided around the perimeter of both the cage spacer and cage. The ports in the cage spacer are very large. Therefore, no significant pressure drop is created. The cage ports, which are either from a standard range or designed to provide a specific characteristic, create the required valve pressure drop. Standard ports are available in linear, modified parabolic or equal percentage characteristics.

The cage ports are arranged diametrically opposite each other and effectively break the mass flow of fluid down into a series of jets which impinge upon each other in the center of the cage. This jet impingement also creates a back pressure within the bore of the cage which reduces the pressure drop across the ports thus minimizing trim velocity, erosion and noise. Also, all flow reaction is contained within the center of the cage, preventing plug instability.

A hollowed out cylindrical plug is located outside and across the top of the cage which is repositioned by the valve actuator in order to regulate the amount of port opening exposed to flow, and thus control the discharge through the valve trim. As the plug is stroked open by the valve actuator through the valve stem, a greater amount of port opening is exposed to flow.

By locating the plug control surface outside the cage, the moving part of the trim is not subject to the effects of throttling flow turbulence and standing waves. Pressure transients associated with highly turbulent flow or system standing waves reflecting from open or closed systems, are absorbed within the cage, which is basically a capped cylinder locked in position by the cage spacer. The pressure transients are therefore not seen by the moving plug which is the controlling element of the valve.

Ports in the cage are carefully positioned some distance away from the valve seats, which ensures that the seats are protected from erosion due to wire drawing when the valve is in the minimum throttling position. Consequently, a reasonable degree of valve opening has to be achieved before flow commences.

CONSTRUCTION FEATURES

The cage is retained in the valve body by means of the cage spacer which provides for easy replacement of components. The direction of flow is over the seat.

Care is taken in the design of both the plug and cage to ensure that the mass of both components is roughly equal. Since both components are produced from the same material, they have the same coefficient of expansion and are, therefore, not affected by temperature changes within the valve itself. Because of this, once the valve seats have been lapped, the seating achieved is not affected by temperature fluctuations.

Particular care has been taken in the balancing of the plug in this trim design, and seats on both the cage and the plug are produced from a common diameter, i.e. the outside diameter of the cage. This ensures that on the Double Seat variety, the difference in area between the two seats is kept to an absolute minimum and consequently the unbalanced area of the valve trim is very small. When the valve is off its seat, the unbalanced forces on the plug disappear and the only force to be overcome by the valve actuator is that created by the fluid pressure acting on the valve stem area.

In the case of the Single Seat Balanced version, or the Tandem Trim variety, only a single seat exists and very low out-of-balance forces exist throughout the full range of valve travel. Therefore, a relatively small actuator can be used to operate the valve and this ensures that a high degree of positional accuracy is obtained throughout the valve stroke.

With the Copes-Vulcan GAD design, the moving part of the trim is cage guided, therefore the plug is supported at the point where throttling takes place. The use of cage guiding ensures that trim vibration due to lateral instability is eliminated.

The plug and stem connection used on GAD trim is a taper junction. With this design a male taper is provided on the stem which engages with a matching female taper in the neck of the plug. These tapers are carefully controlled during manufacture and when the two tapers are drawn together by the screw thread they assure perfect alignment of the assembly. The loading between the two components is carried by the full service area of the tapers. Any attempt to over-tighten the two components is prevented by the two tapers fusing together. A specially designed pin is provided in the junction as an added precaution to prevent the two components from unscrewing.

SEATING CHARACTERISTICS

The Double Seat version of this trim achieves a leakage rate equivalent to Class III of ANSI FCI 70-2 that is 0.1 % of rated valve capacity.

The Single Seating Balanced and Tandem Trim versions of this trim achieve a seat leakage rate equivalent to Class IV of ANSI FCI 70-2 or 0.1 % of rated valve capacity.

By special machining and lapping of the latter two versions it is possible to achieve Class V of ANSI FCI 70-2, that is, .0005 ml/min/inch of orifice diameter/psi differential.

Typical product applications

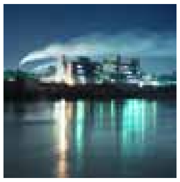
The GAD trim is typically used in high temperature/high pressure start up applications that require class V shut off or Feedwater control applications where there is high Cv rates, flashing and cavitation conditions.

Power

Chemical

Service Water

Paper



TURNDOWN RATIO

The approximate rangeability achieved with this trim is 50:1 (i.e. this represents the ratio of maximum flow to minimum controllable flow.

MATERIALS OF CONSTRUCTION

The GAD trim is produced from various grades of martensitic stainless steel, hardened after machining. This material ensures long life by resisting corrosion, erosion, vibration and other high stresses caused by dynamic forces under operating conditions and static forces when the valve is closed against high pressure.

Hardened stainless steel is considered preferable to the use of an austenitic stainless steel with hardfacing as it eliminates the risk of galling and the problems associated with hardface deposit.

For temperatures in excess of 800°F (427°C) and/or when the pressure drop exceeds 2000 psi (13,780 KPa), the trims are gas or boron nitrided for added wear and erosion resistance.

On applications where cavitation exists and it cannot be eliminated by the use of pressure staging or pressure profiling trims, GAD trims have been used with a high degree of success by using gas nitrided 420 stainless steel with an additional protective coating in the bore of the cage. Where the fluid being handled requires particular corrosion resistance, optional materials are used such as 316 stainless steel or monel.

The GAD trim design offers advantages over most other designs in that all flow reaction is contained within the center of the stationary cage. The moving part of the trim is, therefore, not subject to these reactions. In all cases the selected material is compatible with the flow medium and will operate satisfactorily without galling.

Valve materials in compliance with NACE MR 01-75 are readily available.

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SPX

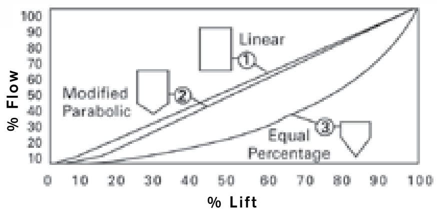
FLOW CHARACTERISTICS

Flow characteristic is a relationship of the valve capacity versus plug travel. Three standard characteristics are available each having its own advantages.

Standard Flow Characteristics

1. Linear

With linear characteristics the trim has a constant flow rate gain through travel, but has the disadvantage of poor control near the seat.



2. Modified Parabolic

This standard characteristic combines the advantages of both linear and equal percentage while avoiding their disadvantages. Modified parabolic has a low flow rate gain near the seat similar to equal percentage, but more closely resembles linear during the remainder of the travel.

3. Equal Percentage

The equal percentage characteristic produces a change in flow with a change in lift that is a constant percentage of the flow before the change was made. This characteristic has a very low flow gain near the seat that produces fine control in the first half of travel, but has a high flow gain in the top half of travel that has poorer control.

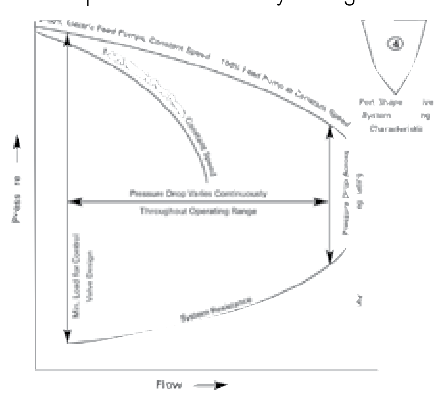
Cv/Kv Flow Coefficents

TRIM NO.	LINEAR/MOD. PARABOLIC			EQUAL %			SINGLE STAGE HUSH	STROKE
	FULL	MED.	MINI	FULL	MED.	MINI		
25	50 (43)	32 (28)	21 (18)	50 (43)	32 (28)	21 (18)	30 (26)	1" (25 mm)
26	120 (104)	85 (74)	50 (43)	120 (104)	85 (74)	50 (43)	75 (65)	1.5" (40 mm)
27	200 (173)	120 (104)	85 (74)	200 (173)	120 (104)	85 (74)	105 (91)	2" (50 mm)
28	440 (381)	325 (281)	200 (173)	440 (381)	325 (281)	200 (173)	280 (242)	2.5" (65 mm)
29	680 (588)	440 (381)	375 (324)	620 (536)	440 (381)	325 (281)	380 (329)	3" (80 mm)
30	1000 (865)	680 (588)	440 (381)	940 (863)	620 (536)	440 (381)	590 (510)	3" (80 mm)
31	1420 (1228)	1000 (865)	680 (588)	1340 (1159)	940 (813)	620 (536)	856 (740)	4" (100 mm)

Note: Custom Engineered trims to suit individual applications and capabilities also available.

4. Custom Engineered

On systems where the pressure drop varies continuously throughout the operating range, special porting can be individually designed to match the system requirements. This allows optimum control to be obtained and does not sacrifice control system adjustments to compensate for incorrect valve characteristics.



SPX FLOW TECHNOLOGY

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