HOPKINSONS
BLAKEBOROUGH CONTROL VALVES

LOW FLOW CAGE TRIM VALVES
BV502/3/4/5

BV502 series valve fitted with contour trim and normalising bonnet

FEATURES

Body

- A choice of globe or angle patterns is available
- BV502 Globe Body (cast) • BV504 Globe Body (forged)
- BV503 Angle Body (cast) • BV505 Angle Body (forged)

Body materials

The valves can be produced in most alloys. Standard cast body materials are:-

- Carbon steel; Grade WCB
- Monel
- Stainless steel; Grade 316/304/347
- Aluminium Bronze
- Chrome moly steel; Grade WC5,WC6 & WC9
- Hastelloy B/C
- Duplex
- Most other materials can be produced in the on-site foundry

Main design standards

- ANSI B16.34 – Valves-Flanged, Threaded & Welding End
- ANSI FCI 70-2 – Control Valve Seat Leakage
- ANSI B16.25 – Butt Welding Ends
- ANSI B16.5 – Pipe Flanges & Flange Fittings
- NACE MR-01-75 Valve Materials
- BS1560 – Circular Flanges for Pipes, Valves & Fittings
- BS4504 – Circular Flanges for Pipes, Valves & Fittings

DESCRIPTION

This versatile range of globe and angle valves available in sizes 15mm to 25mm (1/2" to 1") offer a wide variety of trim selections to suit all flow conditions in a non-balanced construction. The body design can be supplied in cast or forged materials.

There is a wide range of standard and high duty trims available that can be fitted within the same valve body. Flow characterisation is determined by the shape of the valve plug, or in the 'Multi-flow' trim, a radial pattern of holes in the cage is arranged to give the required valve characteristic.

At the enquiry stage Blakeborough will consider the most suitable combination of valve components for each application. Pressure drop, noise, potential for cavitation are all considered to give the most cost effective solution for the particular application. Parts substitution, internal inspection and maintenance can be performed with minimum trouble, the essential working components being removable while the body remains in the pipe line.

DESIGN FEATURES

- Top cage guided
- Wide range of trim options
- High stability
- Easy maintenance

PRESSURE RATING

- Class 150LB to 4500LB

Equivalent metric ratings

SIZES

- 15mm to 25mm

1/2" to 1"

End connection sizes 40mm ($1^1/_2$") & 50mm (2") can be supplied

TRAVELS

- 10mm to 25mm

3/8" to 1"

END CONNECTIONS

- Flanged
- Butt weld
- Socket weld
- Screwed

TRIM DESIGN

Contour

The contour trim is suitable for most flow applications and is provided as standard in most valves. The valve characteristic is determined by the contour of the plug head. The contour trim is available in eight trim sizes with equal percentage, linear or quick opening characteristics. The trim is available as a metal to metal or for tight shut off a soft face design is available.

Spline

The spline trim is designed specifically for accurate control of very small flows. The design consists of a long parallel nosed plug with a accurately cut "V" notch cut down the centre. The linear movement of the valve plug exposes a variable amount of the notch to the flow. The plug head shank is usually made from stellite or other hard wearing materials for galling resistance and to prevent erosion of the plug tip. The actual characteristic derived from the "V" notch is modified equal percentage. The spline trim is available in either metal to metal design or where bubble tight shut off is required a soft face is fitted.

Multi-flow (single stage of pressure drop)

In this design flow is broken up into multiple jets by a number of radial holes drilled in the cage. The flow is conventionally from outside to inside the cage so that jet impingement/high turbulence levels are controlled within the confines of the valve cage. The flow jets impinge together in the centre of the cage bore producing a more stable downstream flow which in turn reduces the effect of large scale separation thus producing a smaller scale turbulence structure in the valve outlet. This results in a reduction in acoustic efficiency, changes the power spectrum of the generated noise both of which contribute to noise level reduction of between 15 and 20 dBA, compared to a contoured trim valve.

Step cone

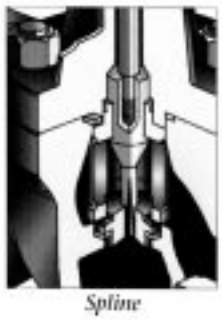
This design is offered where a high degree of pressure breakdown is required on low flows. The plug head is designed with an extended shank having a number of stepped grooves down its length. As the flow medium passes the plug head the pressure drop is broken down in stages across the labyrinth steps of the plug. The plug head shank is usually made from stellite or other such hard wearing materials to prevent erosion of the plug tip.

2 & 3 Stage Pressure Letdown Trim

These trim designs are suited to applications where a high degree of pressure letdown is required to eliminate cavitation on low flow applications. The trim is designed so that flow passes through each stage of the trim. The design requires a very tight tolerance between the plug and seat to eliminate anular flow between the plug and seat.

Contour trim

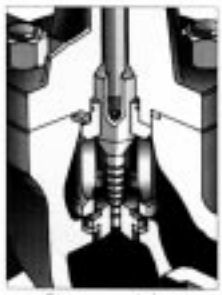
Soft face contour trim



Spline

Spline with diffuser

Multi-flow trim



Step cone trim

2-stage trim with diffuser

3-stage trim with diffuser

Body Protection Unit (Diffuser)

Is specified on globe valves where a high pressure across the valve leads to high velocity jet flow from the trim impinging directly onto the valve body wall. The seat diffuser deflects the jet away from the body wall towards the valve outlet. The seat diffuser is constructed of hardened steel which is more resistant to the effects of jet impingement than the valve body wall. This feature is particularly useful on flashing flows where high velocity two phase flows can lead to body erosion.


Standard


Normalising


Bellows Seal


Cryogenic

BONNET FORMS

Standard

For applications where the temperature of the controlled fluid is between -18 °C (0 °F) and 232 °C (450 °F). May be used with graphite packing up to 315 °C (600 °F). Although modern packings are suitable for much higher temperatures, it is recommended that the normalising bonnet be fitted in cases where the temperatures exceed the above values to accommodate lagging of the control valve body.

Normalising

For protection of the gland packing at temperatures above 232 °C (450 °F) and below 18 °C (0 °F) down to -100 °C (-150 °F). The bonnet is designed with fins which dissipate the heat from the process fluid and help protect the packing from excessive temperatures. In addition the normalising bonnet is longer than the standard plain bonnet so that the valve can easily be lagged without interference with the actuator.

Bellows seal

A positive leakproof stem seal for cases where gland leakage cannot be permitted. The standard bellows material is 321 stainless steel, although many other materials are available on request. The design consists of a welded flexible steel bellows which is clamped in an extended bonnet/bonnet hood. This effectively cuts out any possible leakage path around the plug stem and therefore prevents emissions from the valve packings. Packings are fitted in these valves but they only act as a backup for the bellows.

Cryogenic

Used for temperatures below -100 °C (-150 °F). This is designed with a long necked section which distances the packing away from the process fluid. The necked section is designed with a minimum wall section to minimise heat transfer. Cold box extension/cryogenic bonnets are also available.

PACKING

Packings are selected based on fluid temperature and fluid type. The most common packing system materials are PTFE for low temperature and graphite for high temperature. For hydrocarbons service and where emission levels need to be controlled there are two further types of packings available. These incorporate specially selected materials and live loading to both minimise emissions and extend packing life allowing for cyclic operation. These packings are referred to as LTEP and HTEP.

Packings have been tested to prove emission levels of less than 500 parts per million over 50,000 valve plug cycles and under thermal cycling conditions.

PTFE Chevron packing is used for applications where the temperature is between cryogenic to 232 °C (450 °F)

Grafoil packing is used on high temperature applications where the temperature exceeds 232 °C (450 °F)

LTEP low emission packing, temperatures below 260 °C (500 °F)

HTEP low emission packing, temperatures above 260 °C (500 °F)

Other packing types can be accommodated as required


PTFE Chevron


Grafoil


LTEP – Carbon filled PTFE Chevron


HTEP – Graphite wedge rings

HOPKINSONS
BLAKEBOROUGH
CONTROL VALVES

CHARACTERISITICS

Linear

This characteristic provides a flow rate which is directly proportional to the valve lift. The proportional relationship produces a characteristic with a constant slope, so that with constant pressure drop the valve gain will be the same at all flows. The linear valve plug is commonly specified for liquid level control and for flow control applications requiring constant gain.

Equal Percentage

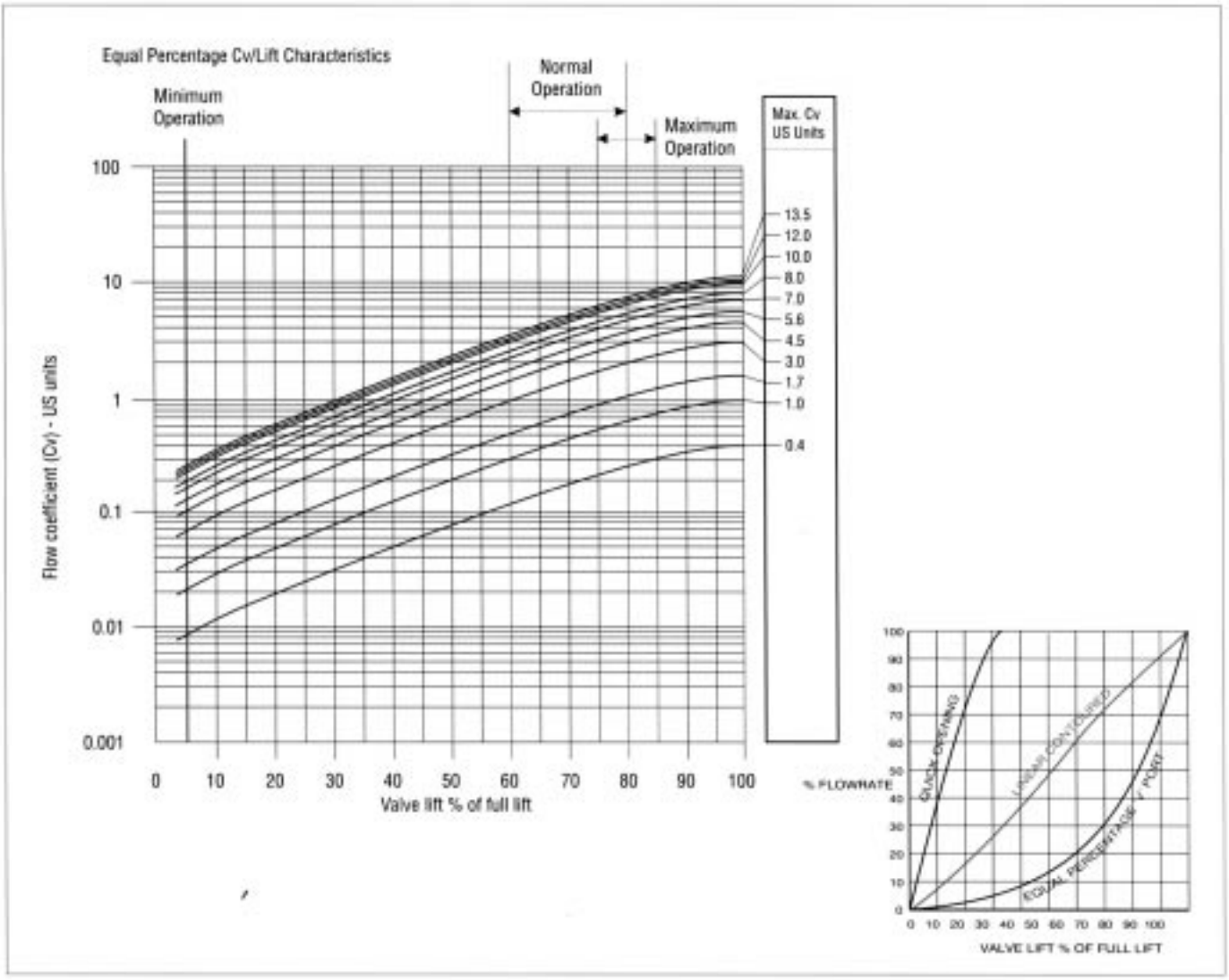
Equal increments of valve lift produce equal percentage changes in the fluid flow. The change in flow rate is always proportional to the flow rate just before the change in plug position is made. The equal percentage characteristic is generally used on pressure control applications, and on other applications where a large percentage of pressure drop is normally absorbed by the system itself. Valves with this characteristic should also be considered where highly varying pressure drop conditions occur or high rangeability is required.

Quick Opening

This provides for maximum change in flow rate at low valve lifts with a fairly linear relationship. Additional increases in valve lift give sharply reduced changes in flow rate, when the valve plug nears the wide open position, the change in flow rate approaches zero.

Intermediate

Other intermediate or special characteristics are available on request to meet specific control requirements.



VALVE SELECTION GUIDELINES

Valve flow co-efficient

All valves are sized using the valve flow co-efficient, CV, in accordance with ISA 75.01 as detailed in the Blakeborough sizing and selection manual. Design CV values are given in table 5.

Body Selection

The valve body size and style is selected on the basis of supporting the selected trim design and design CV. In addition consideration is made of the velocity and the required pressure drop application. Liquid velocities are limited mainly due to erosion considerations, whereas gas/vapour flow velocities are limited for trim stability noise and vibration considerations.

Trim Selection

The selection criteria of the valve trim ranges from valve flow co-efficient, rangeability, pressure drop, cavitation, flashing and noise consideration. Blakeborough sizing and selection manual details the various calculation methods and selection limitations for each trim design.

TABLE 1 – STANDARD TRIM MATERIAL COMBINATIONS

TRIM TYPE	PLUG	SEAT	CAGE TEMP 400°C (750°F) MAX	CAGE TEMP 400°C (750°F) & ABOVE
CONTOUR	316 ST.ST.	316 ST.ST.		
	316 ST.ST. WITH STELLITE FACE	316 ST.ST. WITH STELLITE FACE		
SPLINE	316 ST.ST. WITH FULL STELLITE	316 ST.ST. WITH FULL STELLITE		
STEP CONE	316 ST. ST. WITH STELLITE	316 ST. ST. WITH STELLITE	17-4PH ST.ST.	420 ST.ST.
MULTIFLOW	316 ST.ST. WITH STELLITE FACE	INTEGRAL WITH GUIDE	HARDENED	HARDENED
SOFT FACE	316 ST.ST.	316 ST.ST. WITH PTFE		
STAGED TRIM	316 ST.ST. WITH STELLITE FACE	316 ST.ST. WITH STELLITE FACE		
ALL TRIMS	CERAMIC WITH ST.ST.	CERAMIC WITH ST.ST.		

FOR SERVICES BELOW -35°C (-30°F), ALL 316 ST.ST. CONSTRUCTION WITH PTFE SEALS.
THE ABOVE TABLE SHOWS STANDARD 316 ST.ST. COMBINATION. MANY OTHER MATERIALS CAN BE USED DEPENDING ON THE APPLICATION.

TABLE 2 – RECOMMENDED LIMITING INLET VELOCITIES FOR CONTROL VALVES

VALVE SIZE	LIQUID M/S	LIQUID FT/S	STEAM OR GAS M/S	STEAM OR GAS FT/S	MAX OUTLET (STEAM OR GAS)
15,20 & 25MM					
1/2", 3/4" & 1"	13.5	45	115	375	0.65 X SONIC

NOTE: 0.3 SONIC FOR LOW NOISE APPLICATIONS

TABLE 3 – RANGEABILITY FOR CONTROL VALVES

VALVE SIZE	CONTOUR (METAL & SOFT FACED)	SPLINE (METAL & SOFT FACED)	STEP CONE	MULTI-FLOW	STAGE TRIM
15,20 & 25MM	50.1	100.1	50.1	30.1	100.1
1/2", 3/4" & 1"					

NOTE: CONTROL AT OPENINGS OF LESS THAN 5% IS NOT RECOMMENDED FOR PROLONGED PERIODS

TABLE 4 – CONTROL VALVE LEAK RATES in accordance with ANSI/FCI 70-2-1976

ANSI LEAKAGE CLASS	TRIM STYLE	MAXIMUM ALLOWABLE LEAKAGE
CLASS IV	METAL FACED	0.01% OF RATED CAPACITY
CLASSES V	METAL FACED-LAPPED SEATS	0.0005ML/MIN OF WATER PER INCH OF PORT PER PSI PRESSURE DROP
CLASS VI	SOFT SEAT	BUBBLE TIGHT

TABLE 5 –DESIGN CV VALUES

	CONTOUR TRIM					SPLINE/M SPLINE				STEP CONE			MULTIFLOW			
VALVE SIZE	TRIM SIZE	QUICK OPEN	LINEAR & =%	TRAVEL	VALVE SIZE	TRIM SIZE	MOD=%	TRAVEL		TRIM SIZE	LINEAR	TRAVEL	TRIM SIZE	=%	LINEAR	TRAVEL
25 MM	DC1	13.5	13.5	25mm (1")	ALL SIZES	MC01	3.2	STANDARD SPLINE 25mm (1") MULTI STAGE SPLINE 19mm (3/4")		SC4	4.5		MF1	12	12	25 (1")
						MC00	2									
	DC2		10			MC0	1.26			SC5	3	25mm (1")	MF2	8	8	25mm (1")
20 MM	DC3	7	7			MC1	0.63			SC6	1.7		MF3	5.6	5.6	25mm (1")
15 MM	DC4	4.5	4.5			MC2	0.4			SC7	1		MF4	3.2	3.2	19mm (3/4")
	DC5		3			MC3	0.25			SC8	0.63					
	DC6		1.7			MC4	0.16			SC9	0.4					
	DC7		1			MC5	0.1			SC10	0.25					
	DC9		0.4			MC6	0.0063									
					NOT AVAILABLE AS M/SPLINE	MC7	0.04									
						MC8	0.025									
						MC9	0.016									
						MC10	0.01									
						MC11	0.0063									
						MC12	0.004									
						MC13	0.0025									
						MC14	0.0016									
						MC15	0.001									

TABLE 6 – VALVE WEIGHTS (KG)

VALVE SIZE AND BODY STYLE	BONNET TYPE	UP TO 600LB (PN100) RTG		UP TO 1500LB (PN250) RTG		UP TO 2500LB (PN420) RTG		UP TO 4500LB RTG	
		FLG	B.W	FLG	B.W	FLG	B.W	FLG	B.W
UP TO 25MM	PLAIN	16	8	18	8	NA	NA	NA	NA
(1") CAST	NORMALISING	19	11	20	11	NA	NA	NA	NA
BV502 & BV503	BELLOWS	25	17	26	17	NA	NA	NA	NA
	CRYOGENIC	24	16	25	26	NA	NA	NA	NA
UP TO 25MM	PLAIN	26	18	28	18	30	20	35	25
(1") FORGED	NORMALISING	29	21	30	21	32	23	37	28
BV504 & BV505	BELLOWS	35	17	36	27	NA	NA	NA	NA
	CRYOGENIC	34	26	35	26	37	28	42	32

TABLE 7 – VALVE DIMENSIONS

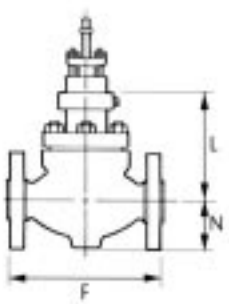
BV502/503 CAST BODIES

NOMINAL VALVE SIZE	UP TO ANSI 300 LBR.F. (BS PN40)	ANSI 600 LB R.F. & RTJ (BS PN 64 & 100)	ANSI 900 LB & 1500 LB R.F. & RTJ (BS PN 160 & 250)	BUTT WELD UP TO ANSI 600 LB (BS PN 250)		BUTT WELD ANSI 900 & 1500 LB (BS PN 160 & 250)		PLAIN		NORM		BELLOWS		CRYOGENIC		N (MAX)
	F	F	F	F	F/2	F	F/2	L	M	L	M	L	M	L	M	
15mm	191	203	273	187	105	197	105	151	130	206	185	333	311	375	406	
1/2"	7 1/2	8	10 3/4	7 3/8	4 1/8	7 3/4	4 1/8	6	5 1/8	8 1/8	7 5/16	13/ 1/8	12 1/4	14 3/4	16	
20	194	206	273	187	105	197	105	151	130	206	185	333	311	375	406	
3/4	7 5/8	8 1/8	10 3/4	7 3/8	4 1/8	7 3/4	4 1/8	6	5 1/8	8 1/8	7 5/16	13/ 1/8	12 1/4	14 3/4	16	
25	197	210	273	187	105	197	105	151	130	206	185	333	311	375	406	75
1	7 3/4	8 1/4	10 3/4	7 3/8	4 1/8	7 3/4	4 1/8	6	5 1/8	8 1/8	7 5/16	13/ 1/8	12 1/4	14 3/4	16	3"
40 x 25 x 40	235	251	305	251	127	305	152	151	130	206	185	333	311	375	406	
1.5 x 1 x 1.5	9 1/4	9 7/8	12	9 7/8	5	12	6	6	5 1/8	8 1/8	7 5/16	13/ 1/8	12 1/4	14 3/4	16	
50 x 25 x 50	267	286	340	286	143	337	168	151	130	206	185	333	311	375	406	
2 x 1 x 2	10 1/2	11 1/4	13 3/8	11/14	5 5/8	13/14	6 5/8	6	5 1/8	8 1/8	7 5/16	13/ 1/8	12 1/4	14 3/4	16	

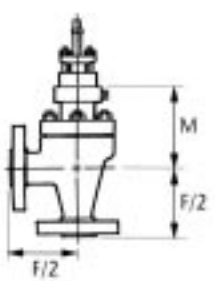
TABLE 8 – VALVE DIMENSIONS

BV504/505 FORGED BODIES

NOMINAL VALVE SIZE	UP TO INCL. ANSI 1500 LB R.F. RTJ (BS PN440)	ANSI 2500 LB R.F. & RTJ (BS PN 420)	BUTT WELD UP TO ANSI 2500 LB (BS PN 420)		BUTT WELD ANSI 4500 LB		PLAIN		NORM		N (MAX)
	F	F	F	F/2	F	F/2	L	M	L	M	
15	238	318	318	160	330	165	228	228	283	283	
1/2	9 3/8	12 1/2	12 1/2	6 5/16	13	6 1/2	9	9	11 1/8	11 1/8	
20	238	318	318	160	330	165	228	228	283	283	
3/4	9 3/8	12 1/2	12 1/2	6 5/16	13	6 1/2	9	9	11 1/8	11 1/8	
25	238	318	318	160	330	165	228	228	283	283	85
1	9 3/8	12 1/2	12 1/2	6 5/16	13	6 1/2	9	9	11 1/8	11 1/8	3 3/8"
40 x 25 x 40	318	318	318	160	330	165	228	228	283	283	
1.5 x 1 x 1.5	12 1/2	12 1/2	12 1/2	6 5/16	13	6 1/2	9	9	11 1/8	11 1/8	
50 x 25 x 50	318	318	318	160	330	165	228	228	283	283	
2 x 1 x 2	12 1/2	12 1/2	12 1/2	6 5/16	13	6 1/2	9	9	11 1/8	11 1/8	



BV502 valve



BV503 valve

HOPKINSONS

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