

Control Valves



RINGO 
VALVULAS



COMPANY OVERVIEW

Ringo Válvulas (RV) is located in the industrial city of Zaragoza, Spain. Since its establishment RV has designed and manufactured its own cast and forged valves. Our experience over 40 years on the valve industry is the key to our international success and recognition. We export more than 75% of our production all over the world.

RV activities include the design, material procurement, manufacturing, assembly and the testing of valves. We supply Gate, Globe, Check, Ball Plug, Butterfly, Control and Special Valves produced according to different standards (ASME-ANSI, DIN, API, BS), sizes, pressure ratings and materials (Carbon Steel, Alloy Steel, Stainless Steel, Duplex, Monel, etc.).

Our valves are used in many different applications such as Oil & Gas, chemical and Petrochemical, Cryogenic and Power Generation (including Nuclear, Combined Cycle, Thermoelectric and Hydraulic Plants).

RV facilities are modern and fitted with advanced equipment for manufacturing, assembly, testing and inspection. This equipment guarantees the conformity with the most stringent specifications.



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■ OUR INTERNATIONAL ACREDITATIONS:



ISO 9001:2008 by LRQA



API 6A - 0729
API 6D - 0495

API 6A Licensse Nr. 6A-0729
API 6D Licensse Nr. 6D-0495



CE stamp holder
PED 97/23/CE



ATEX stamp holder



GOST certificate



Certified by TÜV according to EN ISO 3834-2
Certified by TÜV according to AD 2000-Merkblatt HP 0, TRD 201
Certified by TÜV according to AD 2000-Merkblatt W 0/A4



Industrie Service



ROSTECHNADZOR
Certificate



Inspection Type Certificate
issued by INSPECTA nuclear



ISCIR Certificate of
authorization

A full-page photograph capturing a serene sunset scene. The sky is a gradient of warm colors, from a deep orange at the horizon to a lighter, hazy yellow at the top. The sun is positioned on the left side, just above the horizon, creating a bright glow. In the background, a range of dark, silhouetted mountains stretches across the horizon. The foreground shows a calm body of water reflecting the warm colors of the sky, with some darker, silhouetted land visible in the immediate foreground.

Ringo Válvulas is qualified to ISO 9001-2000 by Lloyd's Register as well as PED, ATEX, TUV AD-2000 HPO & WO, EN-ISO 3834-2, Functional Safety Management system (SIL), among others.

■ MARKETS

We export more than 75% of our production to countries all over the world.

Worldwide customer service, we provide spare parts and field engineers to support our customers anywhere.

Ringo Válvulas has been involved in many large international projects carried out by the world's leading engineering construction companies.



01 Control Valves

■ Ringo, a complete range of control valves for heavy duty service

Contrarily to other types of valves, the function of control valves is to absorb a fraction of the inlet pressure to modulate the fluid flow rate and maintain under control the plant conditions.

In this process an amount of energy proportional to the pressure drop and the flow rate is converted into turbulences, heat, vibration, noise and wearing of valve components. In some heavy duty applications (surge control or turbine bypass), the energy amounts to hundreds of Kilowatts, even megawatts.

Best approach to the problem is the cage guided valve. Cage guides valves have been designed for sizes up to 32" (DN400) and pressure class ratings, depending on sizes, up to 2.500# (PN400).

In the cage guided design, the plug is guided along its full stroke by the cage, with very small clearance, so that vibration is suppressed. Cage guided design is recognized as the best design in heavy duty service control valves.

Designs include unbalanced plug disc for valve sizes up to 4" and balanced plug disc for valve sizes 3" and larger. The use of balanced plugs allows achieving Class IV and V seat leak rates, whichever the pressure and the temperature. Also, if temperature does not exceed 250°C / 480°F, Class VI (bubble tight) can be given as an option.

Ringo valve range offers full and reduced values of Cv for every valve size, linear or equal percent characteristics, standard or low dB cages, tightness up to class VI and a large choice of materials.

Ringo valvulas control valves have been designed to be operated by pneumatic, electric or electro-hydraulic actuators, including any type of accessories, at request, and accepting any type of control signals. When electric actuators / accessories are used all type of protections can be provided, including explosion proof or intrinsically safe.

Special designs have been developed during the past years, mainly for use in power plants where high pressure and high temperature are usual conditions. These applications normally include flashing or cavitation conditions, causing vibration, noise and wearing.

Our designs have been successfully used in power plants as well as gas, oil, fertilizers and other process industries. Noise and vibration have been reduced, and valve internals life has been extended.

Low noise trims and diffusers can be supplied as an integral part of our design. Downstream plates or diffusers are used to give further noise reduction while improving valve performance.

Ringo valvulas control valves offer the best combination of design and materials suitable to work in the most severe conditions. All our designs have been proven in successful operation for years.

FOTO VÁLVULAS CONTROL

FOTO VÁLVULAS CONTROL

FOTO VÁLVULAS CONTROL

FOTO VÁLVULAS CONTROL

■ **Pressure retaining parts**

Design of pressure retaining parts including body, bonnet and bolting, meets all the ANSI, ASME and DIN applicable standards. Face to face dimensions are according to ISA S75.12, 15 and 16 where they have been published.

Sealing of body-bonnet joint is achieved by spiral gaskets made from stainless steel wound with graphite or other filler materials. Gaskets are fully enclosed between the body and bonnet and they work under the principle of the controlled compression. To achieve this, manufacturing / maintenance procedures provide the correct torques for every size of the bolting.



■ **Manufacturing Range**

VALVE TYPE	BODY SIZE		PRESSURE CLASS		END CONNECTIONS
	ANSI	DIN	ANSI	DIN	
Cast globe, angle and three-way	3/4" thru 2"	DN20 thru DN50	150# thru 2.500#	PN10 thru PN400	SW, BW, FLG
	3" thru 16"	DN250 thru DN400	150# thru 2.500#	PN10 thru PN400	BW, FLG
Forged globe, angle and three-way	3/4 thru 2"	DN20 thru DN50	150# thru 2.500#	PN10 thru PN400	SW, BW
	3" thru 16"	DN250 thru DN400	150# thru 2.500#	PN10 thru PN400	BW

* Other sizes by request, special design for any service



02 Valve Materials

■ Body and bonnet materials

Selection of materials of body and bonnet are based on design pressure and design temperature as well as in the type of fluid.

As standard, carbon steel, stainless steel and alloy steel are commonly used. Special alloys material can also be provided for special applications such as duplex, superduplex, hastelloy, inconel, monel, etc.

MATERIAL	FORGED			CAST		
	ASTM	DIN NAME	DIN MAT. N°	ASTM	DIN NAME	DIN MAT. N°
Carbon steel	A105	C22.8	1.0460	A216 WCB	GS-C25	1.0619
Alloy steel	A182 F11	13CrMo44	1.7335	A217 WC6	GS17CrMo55	1.7357
	A182 F22	10CrMo9.10	1.7380	A217 WC9	GS16CrMo19.10	1.7379
Stainless steel	A182 F316	X5CrNiMo18.10	1.4401	A351 CF8M	GXCrNiMo18.10	1.4408
Duplex steel	A 182 F51					
Superduplex steel	A 182 F44/53					
Inconel						

*Other materials upon request

■ Trim materials

Selection of the internals material is based on two factors: corrosion resistance and wear resistance. Pressure drop and temperature conditions are considered to choose the best wear resistance material. Our selection includes, but is not limited to: Standard materials for seat, plug, cage and balancing cylinder are 316 stainless steel and hardened 410 or 420 corrosion resistant stainless steel alloys.

Optional materials are hardfaced series 300, 17-4PH and 440 stainless steel alloys. Other alloy trims available on application. Hastelloy, Monel, Colmonoy and other high hardness coatings. Tungsten carbide for extra high hardness is a good choice for highly erosive fluids.

NACE materials are also offered at request.

MATERIAL	AISI NAME	DIN NAME	DIN MAT. NUMBER	HARDNESS (Rc)
410 SS	AISI 410	X10Cr13	1.4006	34-38
420 SS	AISI 420	X20Cr13	1.4021	47-51
316 SS	AISI 316	X10CrNiTi18 9	1.4541	-
Duplex steel				
Superduplex steel				
Inconel				

03 Actuators

■ Diaphragm actuators

RINGO VALVULAS control valves can be operated by any type of actuators, at customer request. When pneumatic actuators are requested we use our well proved, stiff and versatile RV 300 model.

Special designs are available when seismic conditions are specified, to increase stiffness and natural frequency.

Standard materials are WCB cast steel yoke, stamped steel for cover and base plates, reinforced Buna, Neoprene, EPDM, etc, diaphragm. All parts are protected against rust and corrosion.

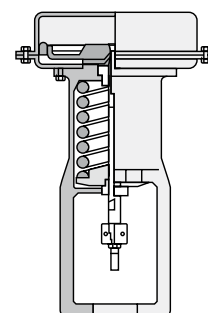
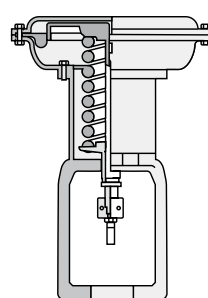
Any type of accessories such as positioners, converters, air-sets, solenoid valves, limit switches and others as well handwheel are fitted as necessary.



SIDE MOUNTED
HAND WHEEL



TOP MOUNTED
HAND WHEEL

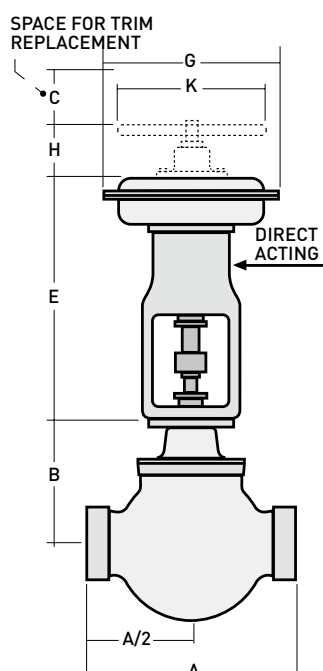


■ Maximum thrust in Kg.

OPERATOR MODEL	EFFECTIVE DIAPHRAGMA	DIRECT ACTING TRAVEL (1)					REVERSE ACTING TRAVEL				
		1"	2"	3"	4"	5"	1"	2"	3"	4"	5"
330	387 cm ²	1.363*					545*				
350	645 cm ²	2.955	2.272*				1.364	909*			
380	1.032 cm ²	5.091	4.364	3.636*			2.545	1.818	1.090*		
390	1.032 cm ²	5.382	5.273	5.091	4.727	3.636*	3.098	2.560	2.022	1.484	945*

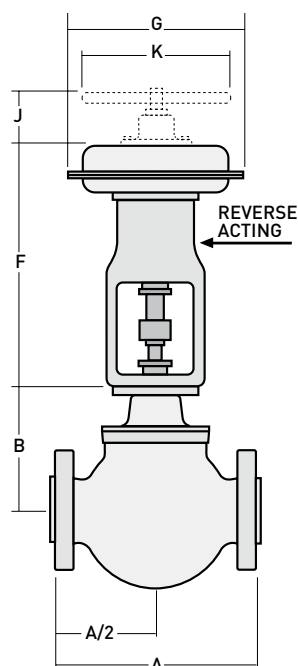
■ Valve dimensions (all dimensions in mm.)

BW / SW / Threaded body



VALVE SIZE		3/4" DN20	1" DN25	1.5" DN40	2" DN50	3" DN80	4" DN100	6" DN150	8" DN200	10" DN250	12" DN300	14" DN350	16" DN400
150# 300# 600#	A	187	187	222	254	318	368	451	543	752	819	1.029	1.108
	B	217	217	217	217	282	320	392	443	535	630	640	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
900# 1.500#	A	194	197	235	292	318	368	508	610	762	914	1.257	1.422
	B	217	217	217	242	282	320	392	457	572	630	689	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
2.500#	A	216	216	260	318	381	406	610	762	1.016	1.118	1.803	1.930
	B	217	217	217	242	282	320	392	457	572	630	689	759
	C	100	100	100	100	125	150	200	250	350	400	450	500

Flanged body



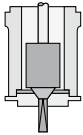
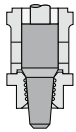
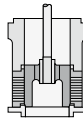
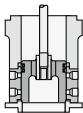
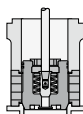
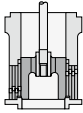
VALVE SIZE		3/4" DN20	1" DN25	1.5" DN40	2" DN50	3" DN80	4" DN100	6" DN150	8" DN200	10" DN250	12" DN300	14" DN350	16" DN400
150# PN 10 P16/25	A	184	184	222	254	298	352	451	543	673	737	889	1.016
	B	217	217	217	217	282	320	392	443	535	630	640	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
300# PN 40	A	194	197	235	267	318	368	473	568	708	775	927	1.057
	B	217	217	217	217	282	320	392	443	535	630	640	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
600# PN 64 PN 100	A	206	210	251	286	337	394	508	610	752	819	972	1.108
	B	217	217	217	217	282	320	392	443	535	630	640	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
900# PN 160	A	273	273	311	340	387	464	600	781	864	1.016	1.257	1.422
	B	217	217	217	242	282	320	392	457	572	630	689	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
1.500# PN 250	A	273	273	311	340	460	483	692	838	991	1.130	1.257	1.422
	B	217	217	217	242	282	320	392	457	572	630	689	759
	C	100	100	100	100	125	150	200	250	350	400	450	500
2.500# PN 320 PN 400	A	308	318	359	400	498	575	819	1.022	1.270	1.321	1.471	1.621
	B	217	217	217	242	282	320	392	457	572	630	689	759
	C	100	100	100	100	125	150	200	250	350	400	450	500

Pneumatic actuator dimensions

OPERATOR MODEL	DIMENSIONS					
	E	F	G	K	H DIRECT ACTING	J REVERSE ACTING
330	434	448	292	250	152	183
350	677	692	384	450	284	295
380	700	779	457	450	284	320
390	884	900	457	450	371	330

*Other sizes upon request

Trim types

TRIM TYPE	TRIM CHARACTERISTIC	ANSI B16.104-76 RATED SEAT LEAKAGE	TEMPERATURE LIMIT	APPLICATIONS	ANEX
MINIFLOW 	Modif. Equal percentage	Class IV STD Class V OPT	550 °C	- Very low flows. - Tight shut-off. - Modulating and on-off applications.	
MULTISTEP 	- Equal percentage - Modif. Equal percentage	Class IV STD Class V STD	550 °C	- Low and high pressure drop. - Low flows. - High pressure desuperheater cooling water control. - Supercritical boiler start-up. - Reheat and super-heat spray control. - Pump recirculation or by-pass in small size boiler.	
USS / STD or LBD Cage	- Linear - Equal percentage	Class IV STD Class V OPT Class VI OPT	550 °C	- Most basic plug type. - Low noise (with LDB Cage). - Modulating and on-off control. - For flashing service.	
BSS / STD or LBD Cage 	- Linear - Equal percentage	Class IV STD Class V OPT Class VI OPT	250 °C	- Low and medium pressure drop. - Tight shut off. - Low noise (with LDB Cage). - Modulating and on-off control. - Small actuators. - General purpose applications.	
		Class II STD Class III OPT	550 °C		
CAVLESS / BSS Plug 	Linear	Class IV STD Class V STD Class VI OPT	250 °C	- Medium and large flows. - Cavitating and flashing service. - Feedwater systems. - Condensed systems (deaerator level control, drain services, etc.). - Condensed recirculation systems.	
		Class II	550 °C		
PILOT Plug / STD or LBD Cage 	- Linear - Equal percentage	Class V STD	550 °C	- High temperature service. - Medium and large flows. - Tight shut-off. - Low noise (with LDB Cage). - HP and LP turbine by-pass. - Steam dump. - Steam throttling to atmosphere or to a condenser. - Isolation. - Super-critical boiler start-up.	
MULTICYL / BSS Plug 	- Linear - Equal percentage	Class IV STD Class V STD Class VI OPT	250 °C	- High pressure drop. - Large flows. - Very critical pressure drop steam or gas applications. - Very high pressure drop liquid applications for preventing cavitation and trim erosion damage.	
		Class II	550 °C		

The main function of a control valve is varying the flow rate of the fluid by producing a pressure drop.

This results in an energy loss which is converted into vibration or erosion. When handling high temperature water, cavitation is an added problem.

To minimize wearing and provide long life internals, selection of the best suited type of trim has the utmost importance. Also the correct materials have to be used.

04 Special Features

■ Other ringo control valves

PRESSURE REGULATORS

The self actuated valve control the downstream or the upstream pressure, which is applied to the actuator diaphragm.

When the downstream or upstream pressure increases the stem moves, thus reducing or increasing the flow rate and correcting the pressure change. If downstream or upstream pressure decreases the sprig will tend to compensate the deviation.

The characteristic of the valve is quick opening to minimize the pressure deviation.

Diagramas reguladores U/S Y d/s

DESUPERHEATERS

We offer two type of package of control valves for desuperheaters.

- Reducing and desuperheating, including a steam control valve and a water control valve.
- Desuperheating only, including only the water control valve.

foto desuperheaters

BUTTERFLY CONTROL VALVES

Also we can provide butterfly control valves with accuracy in the flow control similar to the globe control valves.

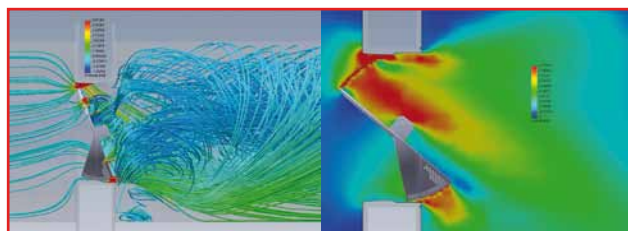
3D Mariposa control

BALL CONTROL VALVE

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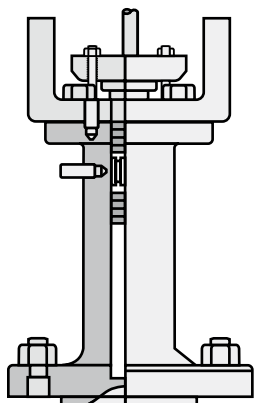
CHOKES

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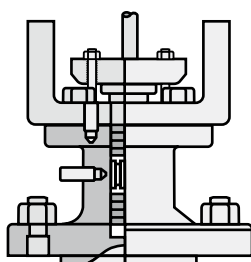


■ Special bonnets

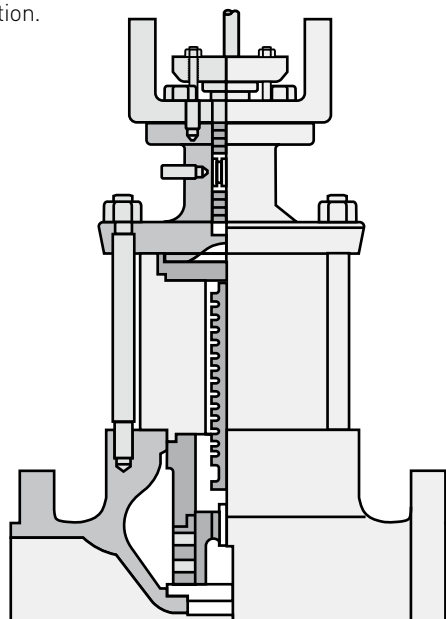
Special bonnet designs can be supplied according to suit the required valve application.



Extended bonnets for very high or very low temperature applications.



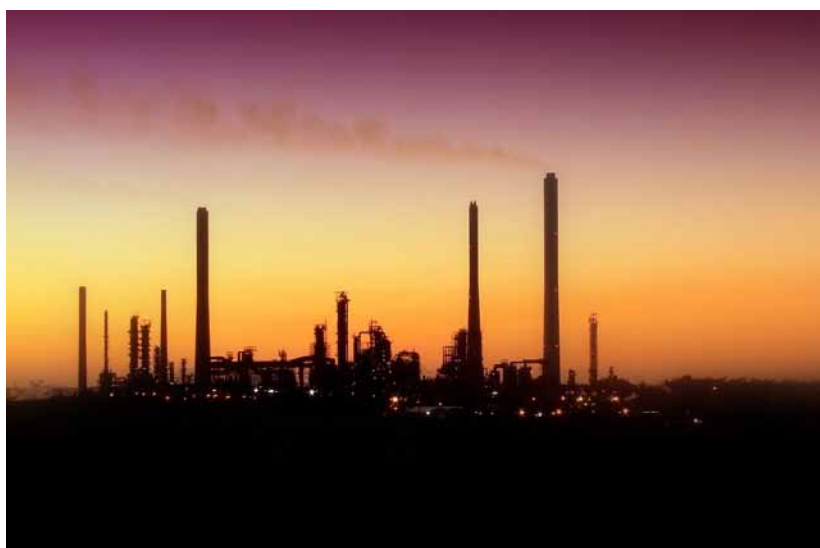
Double packing bonnets are used to minimize leak to atmosphere and can also include leak-off connection, lubricator or hydraulic seal.



Bellows sealed bonnet (zero leakage) for dangerous or radioactive fluids.

■ Electric actuators

When electrical actuators are requested ROTORK, SIEMENS, AUMA, LIMITORQUE, etc actuators or any other make are commonly used, following customer preferences. They accept 0-10 mA, 4-20 mA or other signals.



05 Calculation and Dimensioning

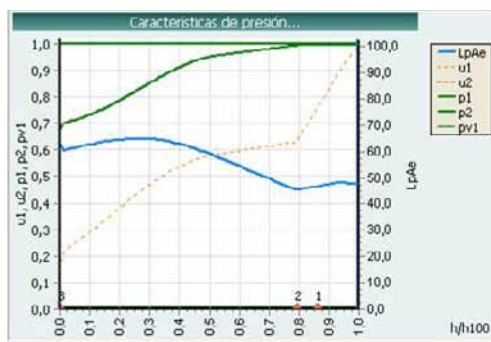
RV has specific control valve calculation software which is CONVAL 8. It calculates the flow properties based on client process specification, and select from the Ringo Valvulas database the control valve which is the most accurate for this process (size, pressure class, and trim type).

Some of the possible parameters which can be calculated with this program are:

- Cv calculation and % of travel for the different operation points
- Fluid properties and state in the operation conditions
- Noise level
- Fluid velocities
- Power loss inside de valve
- Two-phase fluid conditions if it is required
- Actuator forces
- Internal valve parameters

This software permits to export the calculation results to Ringo Valvulas datasheet format.

Also CONVAL 8 has the possibility to include process graphs to the calculations for optimize the valve selection, the noise level control, the specific process conditions such as cavitation or flashing, etc.



■ Noise reduction special designs

Large, medium size valve in gas or steam service, may give unacceptable noise levels, even if multistage cages are used, and sonic conditions avoided.

The answer to the problem is the increased number of holes of flow passages with the reduction of jet-diameters, and reduction of Fd factor. Depending on the size of the valve and the number of stage additional reductions, up to 25 dB can be obtained. Again here, engineering programs let us to know the number of holes required to reduce noise level down to acceptable levels.

When high pressure drops applications in gas or steam recommend the outlet pipe to be larger than inlet pipe, a good recommendation is to have one or more diffuser plates downstream the valve to match the pipe size. The combination of valve and barflies, when correctly calculated, offers several advantages:

- Reduced the velocity of gas/ steam at valve outlet
- Allows the use of smaller size valves,
- Reduces the valve and baffle overall noise levels
- Reduces noise and vibration transmitted by the downstream pipe

We have the technology and can advise on customers about the use, sizing and design of barflies or diffuser plates

Nos envían 3D



Miniflow

■ Valve capacity (Cv) values

Table 1

EQUAL PERCENTAGE inherent characteristic curve. Cv values of the valve at 10% opening intervals

[illegible]

Cv/d2	0,04	0,09	0,17	0,25	0,32	0,35	0,79	1,25	1,90	2,97
FL	0,99	0,98	0,98	0,97	0,97	0,97	0,96	0,96	0,95	0,95
Xt	0,84	0,84	0,84	0,83	0,83	0,82	0,81	0,80	0,78	0,76

07 Multistep™ Trim

DESIGN

Specially designed for low and medium flows combined with medium to high pressure drops. Also recommended when high rangeability is required.

With this outstanding design the total pressure drop across the valve is splitted in several smaller, decreasing pressure drops.

In this way erosion or cavitation, and therefore wearing of the plug and seat, are avoided.

This is achieved by a series of grooves machined on the seat ring. The grooves increase in diameter and also in depth as the fluid passes through. This results in decreasing values of individual pressure steps. The number of steps is constant whichever the position of the plug, thus being effective at low as well as at high flow rates.

The plug and cage are designed so that a metal-to-metal contact is made on bevelled seating surfaces and the clearance between plug and seat ring cage in the labyrinth groove section is calculated for proper cascading effect.

PERFORMANCE

The most difficult service conditions for a valve generally appears at low flow when the plug is just leaving the seat. At this position surface of seat ring and plug are subject to erosion and cavitation. Cavitation will occur when the liquid pressure drops to or below the vapour pressure; at which point small bubbles are formed. As recovery shock waves which if directed against valve trim or body can cause erosion damage. Our **Multistep** design minimizes these problems.

Multistep Trim features a series of labyrinth grooves, machined into the seat ring along its throttling surface. This series of grooves provides a stepping effect, so that pressure drop is divided equally among the grooves, thus reducing the amount of inner valve pressure recovery and subsequent vapour formation.

Multistep Trim therefore is ideally suited for applications where cavitation exists. But the same principle applies to any pressure reducing service in gas or steam. Because the total pressure drop is broken down into stages and because the pressure is prevented from reaching critical conditions at any point, erosion is held to a minimum.

Our **Multistep** design is suited for service where pressure drop decreases when flow increases, as well as for services when pressure drop keeps constant at all flows.

MATERIALS

Martensitic corrosion resistant steels are used for plug, cage and seat ring. Depending on the application 420 or 440 hardened steels are used.

Satellite 316 stainless steel can be used as an option.

Standard materials for body/bonnet are carbon steel A105, alloy steel F11, stainless steel 316 or others.

APPLICATIONS

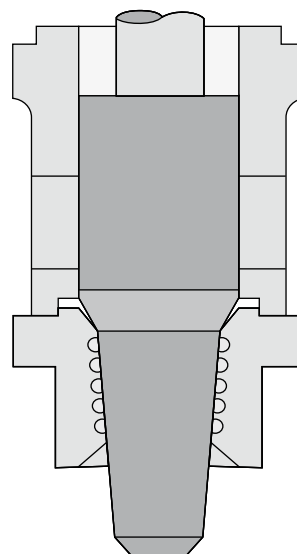
Multistep Trim solves the problems of short life and high replacement costs for valve trim in high pressure drop service. This single-seated trim is designed primarily for high pressure drop liquid or steam applications. Some examples are:

1. High pressure desuperheater-cooling water control
2. Supercritical boiler start-up
3. Reheat and super-heat spray control
4. Pump recirculation or by-pass in small size boiler

Due to the single seat design, it is equally applicable for on-off service, because it gives tight shut-off. This trim is not suited for non-deaerated liquid applications, but can be used for gas applications, but can be used for gas applications as well as steam or liquids.

Differential pressure ranges up to and including 300 bar.

Rangeability is good as 80 to 1.



Multistep Trim

■ Valve capacity (Cv) values

Table 1

EQUAL PERCENTAGE inherent characteristic curve. Cv values of the valve at 10% opening intervals

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
20	3/4	0,06	0,12	0,21	0,3	0,42	0,61	0,94	1,5	2,2	3,5	26
20\1	3/4\1	0,04	0,07	0,13	0,19	0,27	0,39	0,59	0,93	1,4	2,2	26
20\2	3/4\2	0,02	0,05	0,08	0,12	0,17	0,25	0,37	0,59	0,9	1,4	26
20\3	3/4\3	0,01	0,03	0,05	0,07	0,1	0,15	0,23	0,36	0,55	0,86	26
20\4	3/4\4	0,01	0,02	0,04	0,05	0,07	0,11	0,16	0,26	0,39	0,61	26
20\5	3/4\5	0,01	0,01	0,02	0,03	0,04	0,06	0,09	0,14	0,21	0,33	26
25	1	0,09	0,18	0,32	0,46	0,66	0,95	1,4	2,3	3,5	5,4	26
25\1	1\1	0,06	0,12	0,21	0,3	0,42	0,61	0,94	1,5	2,2	3,5	26
25\2	1\2	0,04	0,07	0,13	0,19	0,27	0,39	0,59	0,93	1,4	2,2	26
25\3	1\3	0,02	0,05	0,08	0,12	0,17	0,25	0,37	0,59	0,9	1,4	26
25\4	1\4	0,01	0,03	0,05	0,07	0,1	0,15	0,23	0,36	0,55	0,86	26
25\5	1\5	0,01	0,02	0,04	0,05	0,07	0,11	0,16	0,26	0,39	0,61	26
40	1,5	0,14	0,28	0,49	0,7	1,0	1,4	2,2	3,5	5,2	8,2	26
40\1	1,5\1	0,09	0,18	0,32	0,46	0,66	0,95	1,4	2,3	3,5	5,4	26
40\2	1,5\2	0,06	0,12	0,21	0,3	0,42	0,61	0,94	1,5	2,2	3,5	26
40\3	1,5\3	0,04	0,07	0,13	0,19	0,27	0,39	0,59	0,93	1,4	2,2	26
40\4	1,5\4	0,02	0,05	0,08	0,12	0,17	0,25	0,37	0,59	0,9	1,4	26
40\5	1,5\5	0,01	0,03	0,05	0,07	0,1	0,15	0,23	0,36	0,55	0,86	26
50	2	0,24	0,49	0,86	1,2	1,7	2,5	3,9	6,1	9,2	14,4	26
50\1	2\1	0,14	0,28	0,49	0,7	1,0	1,4	2,2	3,5	5,2	8,2	26
50\2	2\2	0,09	0,18	0,32	0,46	0,66	0,95	1,4	2,3	3,5	5,4	26
50\3	2\3	0,06	0,12	0,21	0,3	0,42	0,61	0,94	1,5	2,2	3,5	26
50\4	2\4	0,04	0,07	0,13	0,19	0,27	0,39	0,59	0,93	1,4	2,2	26
50\5	2\5	0,02	0,05	0,08	0,12	0,17	0,25	0,37	0,59	0,9	1,4	26

Cv/d2	0,04	0,09	0,17	0,25	0,32	0,35	0,79	1,25	1,90	2,97
FL	0,99	0,98	0,98	0,97	0,97	0,97	0,96	0,96	0,95	0,95
Xt	0,84	0,84	0,84	0,83	0,83	0,82	0,81	0,80	0,78	0,76

Table 2

MODIFIED EQUAL PERCENTAGE inherent characteristic curve. Cv values of the valve at 10% opening intervals

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
20	3/4	0,15	0,33	0,54	0,79	1,2	1,6	2,1	2,6	3,1	3,4	26
20\1	3/4\1	0,09	0,2	0,33	0,49	0,74	0,99	1,3	1,6	1,9	2,1	26
20\2	3/4\2	0,06	0,12	0,21	0,3	0,46	0,61	0,79	1	1,2	1,3	26
20\3	3/4\3	0,04	0,08	0,13	0,19	0,28	0,38	0,5	0,63	0,74	0,82	26
20\4	3/4\4	0,02	0,05	0,08	0,12	0,19	0,25	0,33	0,41	0,48	0,54	26
20\5	3/4\5	0,01	0,03	0,05	0,07	0,11	0,15	0,19	0,24	0,28	0,31	26
25	1	0,23	0,5	0,83	1,2	1,8	2,5	3,2	4,1	4,8	5,3	26
25\1	1\1	0,15	0,33	0,54	0,79	1,2	1,6	2,1	2,6	3,1	3,4	26
25\2	1\2	0,09	0,2	0,33	0,49	0,74	0,99	1,3	1,6	1,9	2,1	26
25\3	1\3	0,06	0,12	0,21	0,3	0,46	0,61	0,79	1	1,2	1,3	26
25\4	1\4	0,04	0,08	0,13	0,19	0,28	0,38	0,5	0,63	0,74	0,82	26
25\5	1\5	0,02	0,05	0,08	0,12	0,19	0,25	0,33	0,41	0,48	0,54	26
40	1,5	0,35	0,77	1,3	1,9	2,8	3,8	4,9	6,2	7,3	8,1	26
40\1	1,5\1	0,23	0,5	0,83	1,2	1,8	2,5	3,2	4,1	4,8	5,3	26
40\2	1,5\2	0,15	0,33	0,54	0,79	1,2	1,6	2,1	2,6	3,1	3,4	26
40\3	1,5\3	0,09	0,2	0,33	0,49	0,74	0,99	1,3	1,6	1,9	2,1	26
40\4	1,5\4	0,06	0,12	0,21	0,3	0,46	0,61	0,79	1	1,2	1,3	26
40\5	1,5\5	0,04	0,08	0,13	0,19	0,28	0,38	0,5	0,63	0,74	0,82	26
50	2	0,61	1,4	2,3	3,3	5	6,7	8,7	11	12,9	14,3	26
50\1	2\1	0,35	0,77	1,3	1,9	2,8	3,8	4,9	6,2	7,3	8,1	26
50\2	2\2	0,23	0,5	0,83	1,2	1,8	2,5	3,2	4,1	4,8	5,3	26
50\3	2\3	0,15	0,33	0,54	0,79	1,2	1,6	2,1	2,6	3,1	3,4	26
50\4	2\4	0,09	0,2	0,33	0,49	0,74	0,99	1,3	1,6	1,9	2,1	26
50\5	2\5	0,06	0,12	0,21	0,3	0,46	0,61	0,79	1	1,2	1,3	26

Cv/d2	0,12	0,27	0,45	0,67	1	1,36	1,77	2,24	2,64	2,9
FL	0,99	0,98	0,98	0,97	0,97	0,97	0,96	0,96	0,95	0,95
Xt	0,84	0,84	0,84	0,83	0,83	0,83	0,82	0,81	0,80	0,78

DESIGN

STD cage is a hold pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.

LDB cages maintain the same philosophy as **STD** cages with excellent features in noise reduction.

STD cage and **LDB** cage can be used with unbalanced plug over 250°C giving excellent solutions. Flow is going up through seat ring and out of cage.

Hole pattern design reduce the number of pieces for reduced frims and also provides excellent rangeability for reduced trims instead to reduce the travel. Spacing of the holes is carefully controlled to eliminate jet interaction and higher resultant noise levels.

STD and **LDB** cages give Cage characterized inherent characteristic curves (sizes from 2" through 8") and for sizes from 3/4" through 1 1/2" the inherent characteristic curve is given by the contoured plug.

PERFORMANCE

USS plug is used for general purpose in most liquid and gas for both modulating and on/off applications.

Trim flow characteristic (inherent characteristic curve) are Linear and Equal percentage. See attached CV values ant 10% different opening as follows:

- Table 1. Linear flow characteristic with Contoured Plug or STD Cages.
- Table 2. Equal percentage flow characteristic with Contoured Plug or STD Cages.
- Table 3. **LDB** cage, Linear flow characteristic.
- Table 4. **LDB** cage, Equal percentage flow characteristic.

Rated seat leakage is class IV as standard. Class VI is also available.

LDB trim offer some of the advantages of the multistage trims. **LDB** cage reduce the damaging effects of flashing and cavitation when using compressible and non-compressible fluids turn down ratios, seat leakage and dBA levels.

MATERIALS

1. Standard:

- 410/420 corrosion resistant steel.
- 316 and stellited 316 stainless steel.
- 440 and 17-4PH stainless steel.

2. Special:

Hastelloy, Monel, Colmonoy and other high hardness coatings. Tungsten carbide for extra high hardness is a good choice for highly erosive fluids.

NACE materials are also offered at request.

Standard materials for body/bonnet are carbon steel, alloy steel, stainless steel and others.

APPLICATIONS

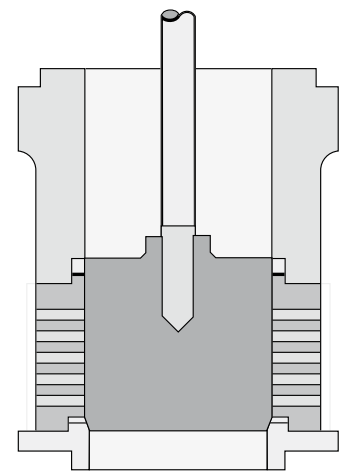
General purpose valve trim which can be used in most clean compressible and non-compressible fluid services for both modulating and on/off control.

Standard for 3/4" trim size and up to 8".

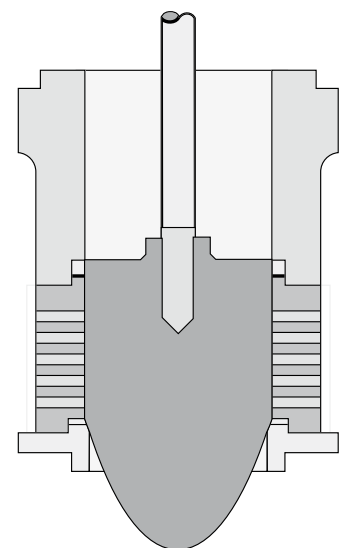
Unbalanced plug design offers capability of tight shutoff for service temperatures exceedign 250°C.

Alternative to Balanced Single Seat (BSS) when temperature exceeds 250°C. (See Bulletin VC152.)

USS with LDB cage for same applications as STD cage, when noise level is a factor in critical pressure drop compressible fluid service or when low level cavitation exist in liquid service.



USS Cage Characterized (STD or LDB)
Sizes from 2" to 8"



USS Plug Contoured
Sizes from 3/4" through 1 1/2"

NOISE ATTENUATION

In a closed system (not vented to the atmosphere) noise becomes airborne only by transmission through the valves and adjacent piping that contain the flowstream. The sound field in the flowstream forces these solid boundaries to vibrate, causing disturbances in the surrounding air to propagate as sound waves. Noise control techniques fall into one of two basic categories: Source treatment and Path treatment. While preventing noise at the source is the preferred approach to noise control, it is sometimes economically or physically impractical due to particular application requirements. Path treatment is then a reasonable approach. There are also instances when source treatment alone does not provide sufficient noise reduction; path treatment is then used as a supplement. We can analyze an example in source treatment. If we have two cages, one **STD** cage (1) and other one **LDB** cage (2) with more holes, and the low rate is the same, $(\text{Flow rate})_1 = (\text{Flow rate})_2$ and $(\text{Noise power})_1 = (\text{Noise power})_2$, then $(\text{dB})_1 = (\text{dB})_2 + K$. K value could be between 10 and 15 dBA, which is the attenuation between the **STD** cage and **LDB** cage with little sacrifice in flow capacity.

Due to noise source combining, use of multiple orifice trims, as **LDB** cage, can reduce the flow rate related noise component. The drilled **LDB** cage has been carefully engineered to reduce flow jet interaction and turbulence, thereby providing superior noise attenuation.

■ Valve capacity (Cv) values

Table 1

LINEAR inherent characteristic curve. Cv values of the valve at 10% opening intervals.

Plug characterized

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
20	3/4	0,54	1,8	3,2	4,6	5,9	7,1	8,3	9,6	11	12	20
20\1	3/4\1	0,36	1,2	2,2	3	3,9	4,7	5,5	6,4	7,3	8	20
25	1	0,77	2,6	4,6	6,5	8,3	10	12	14	15	17	20
25\1	1\1	0,50	1,7	3	4,2	5,4	6,5	7,6	8,8	10	11	20
40	1,5	1,5	4,8	8,2	12	15	18	21	24	27	30	20
40\1	1,5\1	1	3,4	5,7	8	10	13	15	17	19	21	20

STD Cage

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	2,7	8,6	15	21	26	32	37	43	49	54	20
50\1	2\1	1,9	6	10	14	19	22	26	30	34	38	20
80	3	6	19	33	46	60	72	84	97	110	122	32
80\1	3\1	4,2	14	23	32	42	50	59	68	77	85	32
100	4	10,8	35	58	82	106	127	150	173	194	216	45
100\1	4\1	7,5	24	41	57	74	90	104	120	135	150	45
150	6	25	78	132	186	240	289	338	390	441	490	64
150\1	6\1	17	55	93	130	168	202	237	274	309	343	64
200	8	43	138	233	328	423	510	596	690	778	864	85
200\1	8\1	30	97	163	230	296	357	417	484	544	605	85
FL	0,97	0,97	0,96	0,95	0,94	0,93	0,93	0,92	0,91	0,91		
Xt	0,8	0,8	0,8	0,8	0,79	0,78	0,76	0,73	0,72	0,7		

Table 2

EQUAL PERCENTAGE inherent characteristic curve. Cv values of the valve at 10% opening intervals.

Plug characterized

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
20	3/4	0,16	0,3	0,6	0,9	1,3	1,8	2,7	4,2	6	9	20
20\1	3/4\1	0,11	0,2	0,4	0,6	0,8	1,2	1,8	2,8	4	6	20
25	1	0,25	0,5	1	1,4	2	2,8	4,2	6,5	9,3	14	20
25\1	1\1	0,16	0,3	0,6	0,9	1,3	1,8	2,7	4,2	6	9	20
40	1,5	0,41	0,9	1,6	2,3	3,2	4,6	6,9	10,6	15,3	23	20
40\1	1,5\1	0,29	0,6	1,1	1,6	2,2	3,2	4,8	7,4	10,7	16	20
FL	0,97	0,97	0,96	0,95	0,94	0,93	0,93	0,92	0,91	0,91		
Xt	0,8	0,8	0,8	0,8	0,79	0,78	0,76	0,73	0,72	0,7		

STD Cage

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	0,80	1,6	2,8	4	6	8	12	19	26	40	20
50/1	2\1	0,56	1,1	2	2,8	4	6	8,4	13	18	28	20
80	3	1,8	3,6	6,3	9	13	18	27	41	59	90	32
80/1	3\1	1,2	2,5	4,4	6,3	9	13	19	29	42	63	32
100	4	3,2	6,4	11	16	22	32	48	74	106	160	45
100/1	4\1	2,2	4,5	7,8	11	16	22	34	52	74	112	45
150	6	7,2	15	25	36	50	72	108	166	238	360	64
150/1	6\1	5	10	18	25	35	50	76	116	166	252	64
200	8	13	26	45	64	90	128	192	294	422	640	85
200/1	8\1	9	18	32	45	63	90	135	207	297	450	85
FL	0,97	0,97	0,96	0,95	0,94	0,93	0,93	0,92	0,91	0,91		
Xt	0,8	0,8	0,8	0,8	0,79	0,78	0,76	0,73	0,72	0,7		

■ Valve capacity (Cv) values with LDB Cage

Table 3

LINEAR inherent characteristic curve. Cv values of the valve at 10% opening intervals.

LDB Cage

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	2,4	7,7	13	18	24	29	34	39	44	49	20
50/1	2\1	1,7	5,4	9,2	13	17	20	23	27	31	34	20
80	3	5,5	18	30	42	54	65	76	88	99	110	32
80/1	3\1	3,8	13	21	29	38	45	53	62	69	77	32
100	4	9,7	31	53	74	96	115	135	156	176	195	45
100/1	4\1	6,8	22	37	52	67	81	94	109	123	137	45
150	6	22	70	119	167	216	260	304	352	396	440	64
150/1	6\1	16	50	84	118	152	183	214	248	279	310	64
200	8	39	125	211	296	382	460	538	624	702	780	85
200/1	8\1	27	86	146	205	265	319	373	432	486	540	85
FL	0,98	0,98	0,97	0,96	0,95	0,94	0,94	0,93	0,92	0,92		
Xt	0,81	0,81	0,81	0,81	0,8	0,79	0,77	0,74	0,73	0,71		

Table 4

EQUAL PERCENTAGE inherent characteristic curve. Cv values of the valve at 10% opening intervals.

LDB Cage

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	0,72	1,4	2,5	3,6	5	7	11	17	24	36	20
50/1	2\1	0,5	1	1,7	2,5	4	5	8	12	17	25	20
80	3	1,6	3,2	5,6	8	12	16	24	37	53	81	32
80/1	3\1	1,1	2,2	4	5,6	8	12	17	26	37	57	32
100	4	2,9	5,7	10	14	20	29	43	66	95	144	45
100/1	4\1	2	4	7	10	14	20	30	46	66	100	45
150	6	6,5	13	23	33	46	65	98	150	215	325	64
150/1	6\1	4,6	9,2	16	23	32	46	69	106	152	230	64
200	8	11,5	23	41	58	81	116	174	267	383	580	85
200/1	8\1	8	16	28	41	57	81	122	186	267	405	85
FL	0,98	0,98	0,97	0,96	0,95	0,94	0,94	0,93	0,92	0,92		
Xt	0,81	0,81	0,81	0,81	0,8	0,79	0,77	0,74	0,73	0,71		

DESIGN

STD cage is a hold pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.

LDB cages maintain the same philosophy as **STD** cages with excellent features in noise reduction.

STD cage and **LDB** cage can be used with balanced plug (up to 250°C) and unbalanced plug (over 250°C) giving four excellent solutions:

- **STD** and **LDB** cage, balanced plug, flow into cage and down through seat ring.
- **STD** and **LDB** cage, unbalanced plug, flow up through seat ring and out of cage.

Hole pattern design reduce the number of pieces for reduced trims and also provides excellent rangeability for reduced trims instead to reduce the travel.

Spacing between holes is carefully controlled to eliminate jet interaction and higher resultant noise levels.

PERFORMANCE

STD and **LDB** cage are used in general purpose services in most liquid and gas for both modulating and on/off applications.

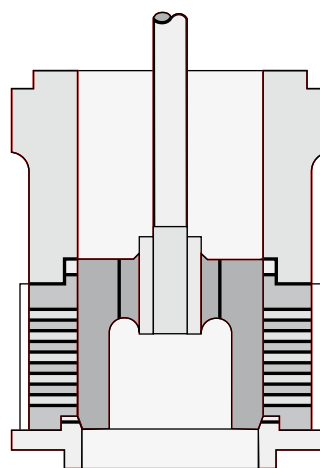
Trim flow characteristic (inherent characteristic curve) are Linear and Equal percentage. See attached Cv values at 10% different opening as follows:

- **Table 1.** **STD** cage. Linear flow characteristic.
- **Table 2.** **STD** cage, Equal percentage flow characteristic.
- **Table 3.** **LDB** cage, Linear flow characteristic.
- **Table 4.** **LDB** cage. Equal percentage flow characteristic.

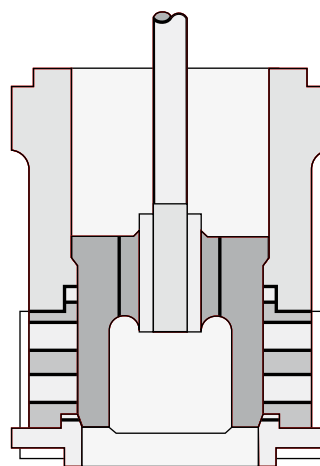
Rated seat leakage is class IV as standard. Class VI is also available.

LDB trim offer some of the advantages of the multistage trims. **LDB** cage reduce the damaging effects of flashing and cavitation when using compressible and non-compressible fluids turn down ratios, seat leakage and dBA levels.

The cage guided balanced plug provides for stable operation during valve throttling, in addition to light shut-off capability.



STD Cage



LDB Cage

MATERIALS

1. Standard:

- 410/420 corrosion resistant steel.
- 316 and stellited 316 stainless steel.
- 440 and 17 4PH stainless steel

2. Special:

Hastelloy, Monel, Colmonoy and other high hardness coatings. Tungsten carbide for extra high hardness is a good choice for highly erosive fluids.

NACE materials are also offered at request.

Standard materials for body/bonnet are carbon steel, ally steel, stainless steel and others.

APPLICATIONS

1. STD cage

General purpose cage guided valve trim which can be used in most clean compressible and non-compressible fluid services for both modulating and on/off control.

The balanced plug design reduces actuator force requirements thus permitting use of smaller, less expensive actuators while maintaining tight shutoff capability. Standard for 1.5" trim size and up when service temperature is less than 250°C.

Unbalanced plug design offers capability of tight shutoff for service temperatures exceeding 250°C

2. LDB cage

Same applications as STD cage, when noise level is a factor in critical pressure drop compressible fluid service or when low level cavitation exist in liquid service.

NOISE ATTENUATION

In a closed system (not vented to the atmosphere) noise becomes airborne only by transmission through the valves and adjacent piping that contain the flowstream. The sound field in the flowstream forces these solid boundaries to vibrate, causing disturbances in the surrounding air to propagate as sound waves. Noise control techniques fall into one of two basic categories: Source treatment and Path treatment. While preventing noise at the sources is the preferred approach to noise control, it is sometimes economically or physically impractical due to particular application requirements. Path treatment is then a reasonable approach. There are also instances when source treatment alone does not provide sufficient noise reduction; path treatment is then used as a supplement.

We can analyze an example in source treatment. If we have two cages, one STD cage (1) and other one **LDB** cage (2) with more holes, and the flow rate is the same $(\text{Flow rate})_1 = (\text{Flow rate})_2$ and $(\text{Noise power})_1 = (\text{Noise power})_2$, then $(\text{dB})_1 = (\text{dB})_2 + K$.

K value could be between 10 and 15 dBA, which is the attenuation between the STD cage and **LDB** cage with little sacrifice in flow capacity.

Due to noise source combining, use of multiple orifice trims, as **LDB** cage, can reduce the flow rate related noise component.

The drilled **LDB** cage has been carefully engineered to reduce flow jet interaction and turbulence, thereby providing superior noise attenuation.

■ Valve capacity (Cv) values

Table 1

STD Cage. LINEAR inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	2,7	8,6	15	21	26	32	37	43	49	54	20
50/1	2\1	1,9	6	10	14	19	22	26	30	34	38	20
80	3	6	19	33	46	60	72	84	97	110	122	32
80/1	3\1	4,2	14	23	32	42	50	59	68	77	85	32
100	4	10,8	35	58	82	106	127	150	173	194	216	45
100/1	4\1	7,5	24	41	57	74	90	104	120	135	150	45
150	6	25	78	132	186	240	289	338	390	441	490	64
150/1	6\1	17	55	93	130	168	202	237	274	309	343	64
200	8	43	138	233	328	423	510	596	690	778	864	85
200/1	8\1	30	97	163	230	296	357	417	484	544	605	85
250	10	68	216	365	513	662	800	932	1.080	1.215	1.350	107
250/1	10\1	47	151	255	360	463	560	652	756	850	945	107
300	12	98	312	527	740	956	1.150	1.346	1.560	1.755	1.950	127
300/1	12\1	68	218	369	519	669	805	940	1.090	1.229	1.365	127
350	14	133	424	716	1.007	1.300	1.560	1.829	2.120	2.380	2.650	152
350/1	14\1	93	297	501	705	909	1.094	1.280	1.484	1.670	1.855	152
400	16	173	554	934	1.315	1.695	2.040	2.387	2.768	3.114	3.460	177
400/1	16\1	121	387	653	920	1.186	1.430	1.670	1.936	2.178	2.420	177

Table 2

STD Cage. EQUAL PERCENTAGE inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	0,80	1,6	2,8	4	6	8	12	19	26	40	20
50/1	2\1	0,56	1,1	2	2,8	4	6	8,4	13	18	28	20
80	3	1,8	3,6	6,3	9	13	18	27	41	59	90	32
80/1	3\1	1,2	2,5	4,4	6,3	9	13	19	29	42	63	32
100	4	3,2	6,4	11	16	22	32	48	74	106	160	45
100/1	4\1	2,2	4,5	7,8	11	16	22	34	52	74	112	45
150	6	7,2	14,5	25	36	50	72	108	166	238	360	64
150/1	6\1	5	10	18	25	35	50	76	116	166	252	64
200	8	13	26	45	64	90	128	192	294	422	640	85
200/1	8\1	9	18	32	45	63	90	135	207	297	450	85
250	10	20	40	70	100	140	200	300	460	660	1.000	107
250/1	10\1	14	28	49	70	98	140	210	322	462	700	107
300	12	29	58	101	144	202	288	432	662	950	1.440	127
300/1	12\1	20	40	71	101	141	202	303	465	667	1.010	127
350	14	39	78	137	196	274	392	588	902	1.294	1.960	152
350/1	14\1	27	55	96	137	192	274	411	630	904	1.370	152
400	16	51	102	179	256	358	512	768	1.178	1.690	2.560	177
400/1	16\1	36	72	125	179	251	358	537	823	1.181	1.790	177

FL(1)	0,97	0,97	0,96	0,95	0,94	0,93	0,93	0,92	0,91	0,91	
FL(2)	0,87	0,87	0,85	0,85	0,84	0,83	0,83	0,82	0,81	0,81	
Xt(1)	0,8	0,8	0,8	0,8	0,79	0,78	0,76	0,73	0,72	0,7	
Xt(2)	0,75	0,75	0,73	0,72	0,7	0,68	0,68	0,67	0,65	0,65	

NOTES

(1) FL and Xt values for flow up through seat ring and out of cage.

(2) FL and Xt values for flow into cage and down through seat ring.

■ Valve capacity (Cv) values for LDB Cage

Table 3

LDB Cage. LINEAR inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	2,4	7,7	13	18	24	29	34	39	44	49	20
50/1	2\1	1,7	5,4	9,2	13	17	20	23	27	31	34	20
80	3	5,5	18	30	42	54	65	76	88	99	110	32
80/1	3\1	3,8	13	21	29	38	45	53	62	69	77	32
100	4	9,7	31	53	74	96	115	135	156	176	195	45
100/1	4\1	6,8	22	37	52	67	81	94	109	123	137	45
150	6	22	70	119	167	216	260	304	352	396	440	64
150/1	6\1	16	50	84	118	152	183	214	248	279	310	64
200	8	39	125	211	296	382	460	538	624	702	780	85
200/1	8\1	27	86	146	205	265	319	373	432	486	540	85
250	10	61	194	328	462	595	717	838	972	1.094	1.215	107
250/1	10\1	43	136	230	323	417	502	587	680	765	850	107
300	12	87	280	472	665	857	1.032	1.207	1.400	1.575	1.750	127
300/1	12\1	61	196	331	465	600	723	845	980	1.102	1.225	127
350	14	119	381	643	904	1.166	1.404	1.642	1.904	2.142	2.380	152
350/1	14\1	84	267	451	635	818	985	1.152	1.336	1.503	1.670	152
400	16	156	498	840	1.182	1.542	1.835	2.146	2.488	2.799	3.110	177
400/1	16\1	109	348	587	827	1.066	1.283	1.501	1.740	1.958	2.175	177

Table 4

LDB Cage. EQUAL PERCENTAGE inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	0,72	1,4	2,5	3,6	5	7	11	17	24	36	20
50/1	2\1	0,5	1	1,7	2,5	4	5	8	11,5	17	25	20
80	3	1,6	3,2	5,6	8	12	16	24	37	53	81	32
80/1	3\1	1,1	2,2	4	5,6	8	12	17	26	37	57	32
100	4	2,9	5,7	10	14	20	29	43	66	95	144	45
100/1	4\1	2	4	7	10	14	20	330	46	66	100	45
150	6	6,5	13	23	33	46	65	98	150	215	325	64
150/1	6\1	4,6	9,2	16	23	32	46	69	106	152	230	64
200	8	11,5	23	41	58	81	116	174	267	383	580	85
200/1	8\1	8	16	28	41	57	81	122	186	267	405	85
250	10	18	36	63	90	126	180	270	414	594	900	107
250/1	10\1	12,5	25	44	63	88	126	189	290	416	630	107
300	12	26	52	91	130	182	260	390	598	858	1.300	127
300/1	12\1	18	36	64	91	127	182	273	419	601	910	127
350	14	35	70	123	176	246	352	528	810	1.162	1.760	152
350/1	14\1	25	49	86	123	172	246	369	566	812	1.230	152
400	16	46	92	161	230	322	460	690	1.058	1.518	2.300	177
400/1	16\1	32	64	113	161	225	322	483	741	1.063	1.610	177

FL(1)	0,98	0,98	0,97	0,96	0,95	0,94	0,94	0,93	0,92	0,92
FL(2)	0,88	0,88	0,87	0,86	0,85	0,84	0,84	0,83	0,82	0,82
Xt(1)	0,81	0,81	0,81	0,81	0,8	0,79	0,77	0,74	0,73	0,71
Xt(2)	0,77	0,77	0,76	0,74	0,72	0,71	0,71	0,69	0,67	0,67

NOTES

- (1) FL and Xt values for flow up through seat ring and out of cage.
(2) FL and Xt values for flow into cage and down through seat ring.

10 Cavless™ Trim

DESIGN

The Cavless trim consists in a cage which has, double drilled, a series of timed radial holes which provides a nozzle effect. Each nozzle is diametrically opposed by an identical nozzle.

Using a balanced plug it acts as a control device which covers and uncovers those holes, thus controlling the flow fluid.

The design can control the location of the vena-contracta and therefore control the location where cavitation occurs. When the plug is throttling a number of nozzles will be uncovered and the resulting jet stream of cavitation liquid will be directed into the cage center. This diverts the harmful effects of cavitation away from the plug and cage.

The Cavless cage could be used with two types of plug, balanced or unbalanced, giving two excellent solutions:

- Cavless cage, balanced plug, flow into cage and down through seat ring for cavitation service.
- Cavless cage, unbalanced plug, flow up through seat ring and out of cage for flashing service.

PERFORMANCE

Cavless trim takes its name because it reduces the problem of cavitation, "less cavitation". Cavless trim does not eliminate cavitation but it reduces the resultant effects of cavitation and flashing and its associated noise, vibration and erosion problems.

Cavless trim should be used only where low level cavitation exists.

The Cavless trim with balanced plug, for cavitation service, utilizes a cage guided design with "U" cup seal for tight shut-off capabilities. The maximum allowable service temperature for Cavless trim with balanced plug is 300°C. For Cavless trim with unbalanced plug (flashing service) the temperature limits are according to material selection.

The cage guided balanced plug provides for stable operation during valve throttling, in addition to tight shut-off capability.

Our standard Cavless cage features excellent vibration and Sound Pressure Level (SPL) reduction combined with high flow capacity.

MATERIALS

Martensitic corrosion resistant steels type 420 are used for plug, cage and seat ring. Hardfaced 316 stainless steel and 17-4PH can be used as an option.

Standard materials for body/bonnet are carbon steel, alloy steel, stainless steel and others.

APPLICATIONS

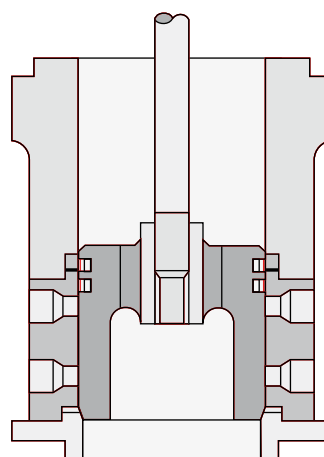
The Cavless trim is designed primarily for liquid service where low level cavitation is evident. Some examples are:

1. Feedwater systems.
2. Flashing services.
3. Condensate systems (deaerator level control, drain services, etc.)
4. Condensate recirculation systems.

Standard rated seat leakage class 4 according to ANSI B16.104.

Rangeability is good as 25 to 1

Direction of flow from over the seat for cavitating applications and from under the seat for flashing applications.



Cavless Trim
(Balanced plug)

■ Valve capacity (Cv) values

Table 1

Cv values of the valve at 10% opening intervals.
LINEAR inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	1,5	5	9	13	16,5	20	23,5	27,5	31	35	26
50/1	2\1	1	3,7	6,5	9,5	12	14,5	17	19,5	22,5	25	26
80	3	3,5	11,7	21	29,5	38	45,5	53	62	70	78	38
80/1	3\1	2,3	7,8	14	20	25,5	31	36	42	47,5	53	38
100	4	4,8	16,5	29,5	41	53	64	74,5	87	98,5	110	45
100/1	4\1	3,2	11	19,5	27,5	35,5	43	50,5	58,5	66,5	74	45
150	6	11	36,5	65	92	118	142	167	194	219	245	64
150/1	6\1	7	24	43	61	78	94	110	129	145	162	64
200	8	21,5	73	130	183	236	284	333	388	438	490	76
200/1	8\1	14	48	84	119	153	185	216	252	285	318	76
250	10	32	107	191	268	346	417	488	568	642	717	107
250/1	10\1	20	68	121	171	221	266	311	362	410	457	107
300	12	56	189	336	474	611	735	860	1.002	1.133	1.265	127
300/1	12\1	34,5	116	206	291	375	451	527	615	695	776	127
350	14	78	263	467	657	842	1.020	1.192	1.389	1.568	1.754	152
350/1	14\1	48	162	288	406	524	630	737	859	971	1.084	152
400	16	105	355	631	888	1.145	1.379	1.613	1.879	2.125	2.372	177
400/1	16\1	65	218	388	546	704	848	991	1.155	1.306	1.458	177
FL(1)	0,96	0,96	0,95	0,94	0,93	0,92	0,92	0,91	0,9	0,9		
FL(2)	0,86	0,85	0,84	0,83	0,83	0,82	0,81	0,81	0,8	0,8		
Xt(1)	0,82	0,82	0,82	0,82	0,81	0,8	0,78	0,75	0,74	0,72		
Xt(2)	0,73	0,72	0,7	0,68	0,68	0,67	0,65	0,65	0,64	0,64		

NOTES

(1) FL and Xt values for flow under the seat (flashing)

(2) FL and Xt values for flow over the seat (cavitating)

DESIGN

Pilot plug is specially designed for large size valves, 4in and above, to give tight shut-off with balanced trim at high temperature.

Pilot plug permits minimum actuator size when tight shut-off is required.

Pilot plug can be combined with **STD** and **LDB** cages with excellent solutions.

STD cage is a hold pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.

LDB cages maintain the same philosophy as **STD** cages with excellent features in noise reduction.

Hole pattern design reduce the number of pieces for reduced trims and also provides excellent rangeability for reduced trims instead to reduce the travel.

Spacing between holes is carefully controlled to eliminate jet interaction and higher resultant noise levels.

PERFORMANCE

Pilot plug with flow direction from over the seat and down through the seat ring.

Rangeability of 25:1

Temperature limits from 30°C to 565°C.

Leakage class V acc. ANSI B16.104

STD and **LDB** cage are for general purpose in most liquid and gas for both modulating and on/off applications.

Trim flow characteristic (inherent characteristic curve) are Linear and Equal percentage. See attached Cv values at 10% different opening as follows:

- Table 1. **STD** cage, Linear flow characteristic.
- Table 2. **STD** cage, Equal percentage flow characteristic.
- Table 3. **LDB** cage, Linear flow characteristic.
- Table 4. **LDB** cage, Equal percentage flow characteristic.

The cage guided balanced plug provides for stable operation during valve throttling, in addition to tight shut-off capability.

MATERIALS

1. Standard:

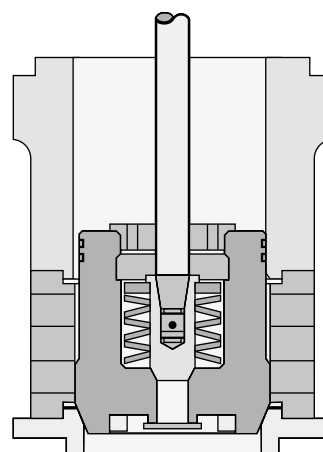
- 410/420 corrosion resistant steel.
- 316 and stellited 316 stainless steel.
- 440 and 17 4PH stainless steel

2. Special:

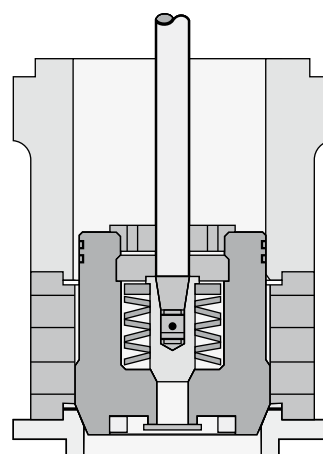
- Hastelloy, Monel, Colmonoy and other high hardness coatings. Tungsten carbide for extra high hardness is a good choice for highly erosive fluids.

NACE materials are also offered at request.

Standard materials for body/bonnet are carbon steel, alloy steel, stainless steel and others.



STD Cage



LDB Cage

■ Valve capacity (Cv) values with STD Cage

Table 1

PILOT plug with STD cage. Cv values of the valve at 10% opening intervals.
LINEAR inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
100	4	10,8	35	58	82	106	127	150	173	194	216	51
100/1	4/1	7,5	24	41	57	74	90	104	120	135	150	51
150	6	25	78	132	186	240	289	338	390	441	490	72
150/1	6/1	17	55	93	130	168	202	237	274	309	343	72
200	8	43	138	233	328	423	510	596	690	778	864	95
200/1	8/1	30	97	163	230	296	357	417	484	544	605	95
250	10	68	216	365	513	662	800	932	1.080	1.215	1.350	117
250/1	10/1	47	151	255	360	463	560	652	756	850	945	117
300	12	98	312	527	740	956	1.150	1.346	1.560	1.755	1.950	139
300/1	12/1	68	218	369	519	669	805	940	1.090	1.229	1.365	139
350	14	133	424	716	1.007	1.300	1.560	1.820	2.120	2.380	2.650	164
350/1	14/1	93	297	501	705	909	1.094	1.280	1.484	1.670	1.855	164
400	16	173	554	934	1.315	1.695	2.040	2.387	2.768	3.114	3.460	191
400/1	16/1	121	387	653	920	1.186	1.430	1.670	1.936	2.178	2.420	191
FL		0,87	0,87	0,85	0,85	0,84	0,83	0,83	0,82	0,81	0,81	
Xt		0,75	0,75	0,73	0,72	0,7	0,68	0,68	0,67	0,65	0,65	

Table 2

PILOT plug with STD cage. Cv values of the valve at 10% opening intervals.
EQUAL PERCENTAGE inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
100	4	3,2	6,4	11	16	22	32	48	74	106	160	51
100/1	4/1	2,2	4,5	7,8	11	16	22	34	52	74	112	51
150	6	7,2	14,5	25	36	50	72	108	166	238	360	72
150/1	6/1	5	10	18	25	35	50	76	116	166	252	72
200	8	13	26	45	64	90	128	192	294	422	640	95
200/1	8/1	9	18	32	45	63	90	135	207	297	450	95
250	10	20	40	70	100	140	200	300	460	660	1.000	117
250/1	10/1	14	28	49	70	98	140	210	322	462	700	117
300	12	29	58	101	144	202	288	432	662	950	1.440	139
300/1	12/1	20	40	71	101	141	202	303	465	667	1.010	139
350	14	39	78	137	196	274	392	588	902	1.294	1.960	164
350/1	14/1	27	55	96	137	192	274	411	630	904	1.370	164
400	16	51	102	179	256	358	512	768	1.178	1.690	2.560	191
400/1	16/1	36	72	125	179	251	358	537	823	1.181	1.790	191
FL		0,87	0,87	0,85	0,85	0,84	0,83	0,83	0,82	0,81	0,81	
Xt		0,75	0,75	0,73	0,72	0,7	0,68	0,68	0,67	0,65	0,65	

NOTE

(*) Indicated travel includes pilot travel plus main plug travel.

APPLICATIONS

Pilot plug for large size valves, 4in and above, to give tight shut-off with balanced trim at high temperature, Main applications are:

1. HP and LP Turbine Bypass
2. Steam dump.
3. Steam and water pressure reducing.
4. Liquids where flashing and cavitation do not exist.
5. High temperature service (up to 565°C)
6. Medium and large flows.
7. Tight shut-off
8. Steam throttling to atmosphere or to a condenser.
9. Isolation
10. Super-critical boiler start-up

NOISE ATTENUATION

In a closed system (not vented to the atmosphere) noise becomes airborne only by transmission through the valves and adjacent piping that contain the flowstream. The sound field in the flowstream forces these solid boundaries to vibrate, causing disturbances in the surrounding air to propagate as sound waves. Noise control techniques fall into one of two basic categories: Source treatment and Path treatment. While preventing noise at the sources is the preferred approach to noise control, it is sometimes economically or physically impractical due to particular application requirements. Path treatment is then a reasonable approach. There are also instances when source treatment alone does not provide sufficient noise reduction; path treatment is then used as a supplement.

We can analyze an example in source treatment. If we have two cages, one **STD** cage (1) and other one **LDB** cage (2) with more holes, and the flow rate is the same $(\text{Flow rate})_1 = (\text{Flow rate})_2$ and $(\text{Noise power})_1 = (\text{Noise power})_2$, then $(\text{dB})_1 = (\text{dB})_2 + K$. K value could be between 10 and 15 dBA, which is the attenuation between the **STD** cage and **LDB** cage with little sacrifice in flow capacity.

Due to noise source combining, use of multiple orifice trims, as **LDB** cage, can reduce the flow rate related noise component. The drilled **LDB** cage has been carefully engineered to reduce flow jet interaction and turbulence, thereby providing superior noise attenuation.

■ Valve capacity (Cv) values with LDB Cage

Table 3

PILOT plug with LDB cage. Cv values of the valve at 10% opening intervals.
LINEAR inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
100	4	9,7	31	53	74	96	115	135	156	176	195	51
100/1	4/1	6,8	22	37	52	67	81	94	109	123	137	51
150	6	22	70	119	167	216	260	304	352	396	440	72
150/1	6/1	16	50	84	118	152	183	214	248	279	310	72
200	8	39	125	211	296	382	460	538	624	702	780	95
200/1	8/1	27	86	146	205	265	319	373	432	486	540	95
250	10	61	194	328	462	595	717	838	972	1.094	1.215	117
250/1	10/1	43	136	230	323	417	502	587	680	765	850	117
300	12	87	280	472	665	857	1.032	1.207	1.400	1.575	1.750	139
300/1	12/1	61	196	331	465	600	723	845	980	1.102	1.225	139
350	14	119	381	643	904	1.166	1.404	1.642	1.904	2.142	2.380	164
350/1	14/1	84	267	451	635	818	985	1.152	1.336	1.503	1.670	164
400	16	156	498	840	1.182	1.524	1.835	2.146	2.488	2.799	3.110	191
400/1	16/1	109	348	587	827	1.066	1.283	1.501	1.740	1.958	2.175	191
FL	0,88	0,88	0,87	0,86	0,85	0,84	0,84	0,83	0,82	0,82		
Xt	0,77	0,77	0,76	0,74	0,72	0,71	0,71	0,69	0,67	0,67		

Table 4

PILOT plug with LDB cage. Cv values of the valve at 10% opening intervals.
EQUAL PERCENTAGE inherent characteristic curve.

SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
100	4	2,9	5,7	10	14	20	29	43	66	95	144	51
100/1	4/1	2	4	7	10	14	20	30	46	66	100	51
150	6	6,5	13	23	33	46	65	98	150	215	325	72
150/1	6/1	4,6	9,2	16	23	32	46	69	106	152	230	72
200	8	11,5	23	41	58	81	116	174	267	383	580	95
200/1	8/1	8	16	28	41	57	81	122	186	267	405	95
250	10	18	36	63	90	126	180	270	414	594	900	117
250/1	10/1	12,5	25	44	63	88	126	189	290	416	630	117
300	12	26	52	91	130	182	260	390	598	858	1.300	139
300/1	12/1	18	36	64	91	127	182	273	419	601	910	139
350	14	35	70	123	176	246	352	528	810	1.162	1.760	164
350/1	14/1	25	49	86	123	172	246	369	566	812	1.230	164
400	16	46	92	161	230	322	460	690	1.058	1.518	2.300	191
400/1	16/1	32	64	113	161	225	322	483	741	1.063	1.610	191
FL[1]	0,88	0,88	0,87	0,86	0,85	0,84	0,84	0,83	0,82	0,82		
FL[2]	0,77	0,77	0,76	0,74	0,72	0,71	0,71	0,69	0,67	0,67		

When pressure drops ratio ($x=\Delta P/P1$) reaches some values close to 0.5 there will be sonic conditions with the associated vibration and noise, in gas or steam applications.

In liquid service, when downstream pressure approaches vapour pressure at fluid temperature, cavitation will appear, with noise increase and damage to the valve components. This will happen whenever the cavitation index $x_F=(P1-P2)/\Delta P$ reaches the valve FL2 value.

Our approach to both problems, either gases (sonic conditions) or liquids (cavitation), is based on the "source treatment" principle: this is to suppress the source of the problem, which is the high pressure drop.

With our multicylinder cage the fluid goes through a stepped pressure reduction process, the number of steps being as large as necessary to keep pressure drop under critical values.

We have the technology to calculate, design and manufacture the valve internals best suited for every set of conditions. We calculate, for every particular application,

- the number of steps necessary to avoid critical conditions at any stage,
- the partial pressure drops at every stage,
- the Cv value of every cylinder

to achieve a non critical pressure profile.

This is equivalent to say that xT and FL values of every valve will be as high as required by the given conditions.

In small Cv, small size valves, the same results are obtained by our Multistep design.

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Manufacturing Range

■ Gate

Standards	Sizes	Features Design - Materials	
ANSI B16.34 API 600 API 6D BS - 1414	- 72" ANSI 150 - 64" ANSI 300 - 48" ANSI 600/900 - 36" ANSI 1500/2500 - 24" ANSI 4500	Bolted bonnet Pressure seal Cast and forged Solid Wedge Flexible	
API 6A	2-1/16" to 7-1/16" class 2000 2-1/16" to 7-1/16" class 3000 2-1/16" to 9" class 5000 1-13/16" to 7-1/16" class 10000 1-13/16" to 5-1/8" class 15000	Split Wedge Parallel Slide Through conduit Special Designs Double Block and Bleed	

■ Globe

Standards	Sizes	Features Design - Materials	
ANSI B16-34 BS-1873	- 48" ANSI 150/300 - 36" ANSI 600/900 - 24" ANSI 1500/2500 - 12" ANSI 4500	Bolted Bonnet Pressure seal Cast and forged Zero steam leakage Non return "Y" pattern globe Bellows seal globe Stop check globe Angle globe valve	

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■ Control

Standards	Sizes	Features Design - Materials	
ANSI B16.34	- 16" ANSI 150/2500 - 4" ANSI 4500	Cage guided globe Top guided globe Angle type 3 - Way type Butterfly type	

■ Check

Standards	Sizes	Features Design - Materials	
API 6D BS-1868 ANSI B16-34	- 64" ANSI 150 / 300 - 48" ANSI 600/900 - 36" ANSI 1500/2500 - 24" ANSI 4500	Bolted bonnet Pressure seal Cast and forged Piston check Tilting disc Swing check Emergency assisted Duo Check	
API 6A	2-1/16" to 11" class 2000 2-1/16" to 11" class - 3000 2-1/16" to 11" class - 5000 1-13/16" to 7-1/16" class 10000 1-13/16" to 4-1/16" class 15000		

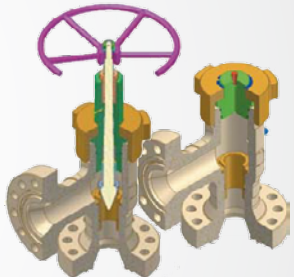
■ Ball

Standards	Sizes	Features Design - Materials	
API 6D	- 56" ANSI 150 to 900 - 36" ANSI 1500 / 2500	Floating type Trunnion mounted Top Entry and Side Entry design 3-Way Metal to Metal or Soft Seated Bolted or fully welded design 2 PCS and 3 PCS design	
API 6A	2-1/16" to 7-1/16" class 2000 2-1/16" to 7-1/16" class 3000 2-1/16" to 9" class 5000 1-13/16" to 7-1/16" class 10000 1-13/16" to 5-1/8" class 15000		

■ Butterfly

Standards	Sizes	Features Design - Materials	
AWWA C-504	40" - 120" CLASS 25 A up to 250 A	Rubber lined Check Butterfly Single piece disc	
BS - 3952	3" - 40" ANSI 250		

■ Choke

Standards	Sizes	Features Design - Materials	
API 6A	2-1/16" - 7-1/16" - 2000 2-1/16" - 7-1/16" - 3000 1-13/16" - 7-1/16" - 5000 1-13/16" - 7-1/16" - 10000	Positive Adjustable	



Polígono Empresarium
c/ Romero, 6
50720 Zaragoza (Spain)
Tel. +34 976 45 49 40
Fax. +34 976 45 48 40

ringo@ringospain.com
www.ringospain.com