Control Valves

SMART IN FLOW CONTROL

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 of 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 thesting 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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QUALITY

Ringo Válvulas is totally committed to Quality, and a smooth integration of all departments with the Quality Assurance and Quality Procedures.

Ringo Válvulas is qualified to ISO 9001, ISO 14001, OSHAS 18001, SA 8000, PED, ATEX, TUV AD-2000 HPO & WO, EN-ISO 3834-2 and Functional Safety Management system (SIL) among others.

This guarantees that all our products are designed, manufactured and delivered in accordance with the most strict customer requirements. By this we achieve our main goal "to offer a high quality product and service to ensure a high degree of satisfaction and fidelity of our customers".

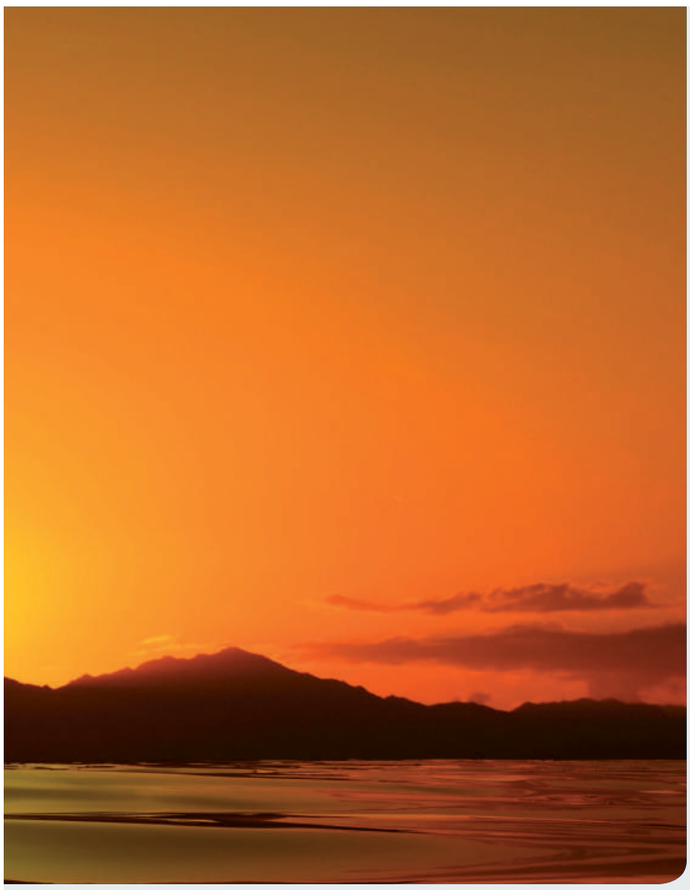
MARKETS

Our valves are used in many different applications such as Nuclear Power Plants, Conventional Power Plants, Oil & Gas, upstream and downstream offshore, chemical, petrochemical, cryogenic, etc.

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.



OUR INTERNATIONAL ACREDITATIONS:

ISO 9001

ISO 14001

OHSAS 18001

CE stamp holder
PED 2019/68/EU

ATEX stamp holder

EAC

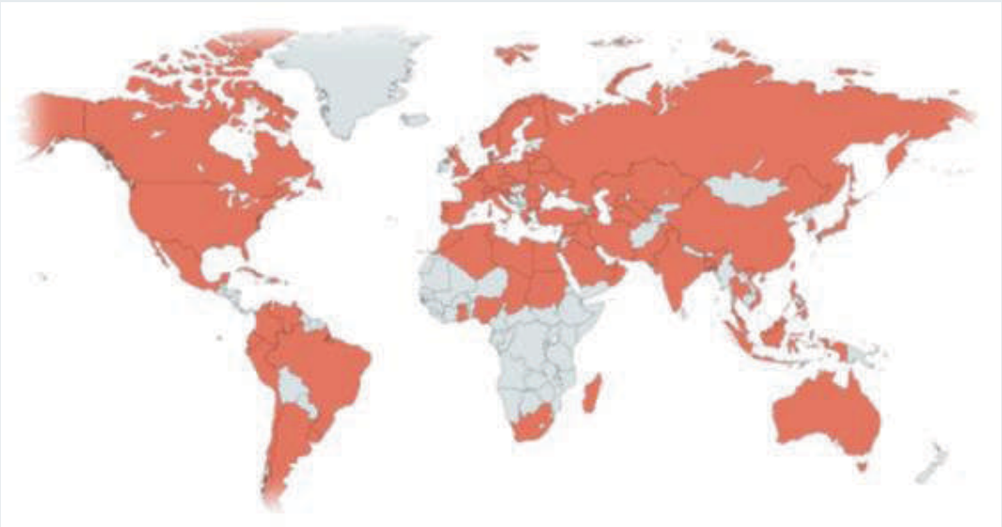
N

NPT

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

Inspection Type Certificate
issued by KIWA INSPECTA
nuclear

ISCIR Cetificate of
authorization



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.

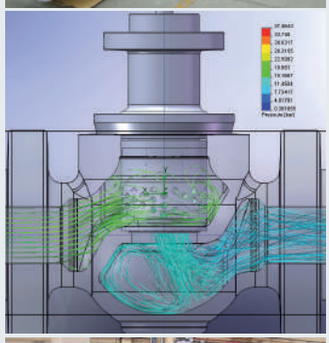
Ringo valvulas control valves have been designed to be operated by pneumatic, electric or electro-hydraulic actuators, including any type of accessories, at request, and accepting any type of control signals. When electric actuators / accessories are used all type of protections can be provided, including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



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.

Sealing of body-bonnet joint is achieved by spiral wound 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" to 2"	DN20 to DN50	150# to 2.500#	PN10 to PN400	SW, BW, FLG
	3" to 16"	DN250 to DN400	150# to 2.500#	PN10 to PN400	BW, FLG
Forged globe, angle and three-way	3/4 to 2"	DN20 to DN50	150# to 2.500#	PN10 to PN400	SW, BW
	3" to 16''	DN250 to DN400	150# to 2.500#	PN10 to 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. Nº	ASTM	DIN NAME	DIN MAT. Nº
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	GS16Cr-Mo19.10	1.7379
Stainless steel	A182 F316	X5CrNiMo18.10	1.4401	A351 CF8M	GXCrNi-Mo18.10	1.4408

MATERIAL	FORGED	CAST
Duplex steel	A 182 F44	A 351-CK3MCuN
	A 182 F51	A 890 Gr. 4A CD3MN
Super Duplex steel	A 182 F53	A 890 Gr. 5A CE3MN
	A 182 F55	A 890 Gr. 6A CD3MW-CuN
Inconel 625	B564-N06625	A494-CW6MC

*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. Higher hardness in trims with Stellite® overlay.

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

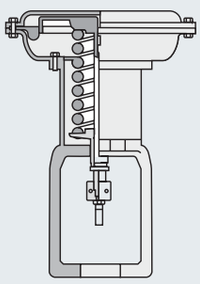
RINGO VALVULAS control valves can be operated by any type of actuators, at customer request. When pneumatic actuators are requested we use our well proved, stiff and versatile RV 300 model.

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

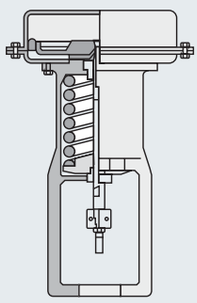
Standard materials are WCB cast steel yoke, stamped steel for cover and base plates, reinforced Buna, Neoprene, EPDM, etc, diaphragm. All parts are protected against rust and corrosion.

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

We use positioners and accessories from all major manufacturers providing the latest technology for smart instrumentation with diagnostic capabilities as well as partial stroke testing.



SIDE MOUNTED HAND WHEEL

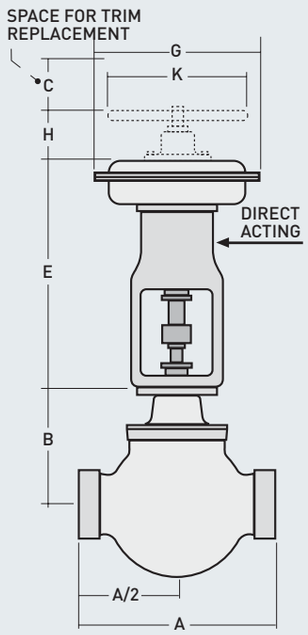


TOP MOUNTED HAND WHEEL

Maximum thrust in N.

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	13.630*					5.450*				
350	645 cm^2	29.550	22.720*				13.640	9.090*			
380	1.032 cm^2	50.910	43.640	36.360*			25.450	18.180	10.900*		
390	1.032 cm^2	53.820	52.730	50.910	47.270	36.360*	30.980	25.600	20.220	14.840	9.450*

Valve dimensions

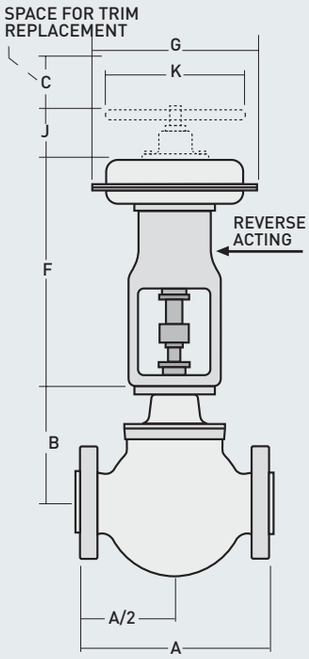


A | BW / SW / Threaded body Lenght

	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#	187	187	222	254	318	368	508	543	752	819	851	1.108
900# 1.500#	194	197	235	292	318	368	508	610	762	914	1.257	1.422
2.500#	216	216	260	318	381	406	610	762	1.016	1.118	On request	On request

A | RF Length

	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#	184	184	222	254	298	352	451	543	673	737	889	1.016
300#	194	197	235	267	318	368	473	568	708	775	927	1.057
600#	206	210	251	286	337	394	508	610	752	819	972	1.108
900#	273	273	333	340	441	464	600	781	864	1.016	1.257	1.422
1.500#	273	273	333	340	460	483	692	838	991	1.130	1.257	1.422
2.500#	308	318	359	400	498	575	819	1.022	1.270	1.321	On request	On request



A | RTJ Length

	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
600#	206	210	251	289	340	397	511	613	755	822	975	1.111
900#	273	273	333	343	444	467	603	784	867	1.019	1.267	1.432
1.500#	273	273	333	343	463	486	698	848	1.001	1.146	1.276	1.444
2.500#	308	318	362	403	504	585	832	1.038	1.038	1.343	On request	On request

B | Pipe center-yoke Height

	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#	193	193	197	217	277	324	390	448	534	581	640	688
300#	193	193	197	217	277	324	390	448	534	581	640	688
600#	193	193	197	217	277	324	387	439	571	600	640	683
900#	220	220	241	253	308	313	369	423	613	616	590	670
1.500#	220	220	241	253	308	313	421	452	613	577	653	750
2.500#	255	255	275	293	327	369	439	540	683	771	882	991

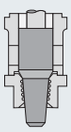
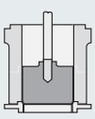
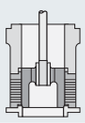
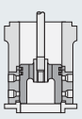
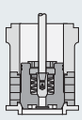
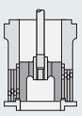
C | Space for trim replacement

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
100	100	100	100	125	150	200	250	350	400	450	500

Operator dimensions

	Direct actuator height	Reverse actuator height	Diaphragm Ø	Top handwheel Ø	Direct top handwheel height	Reverse top handwheel height
	E	F	G	K	H	J
330	434	447	292	250	169	231
350	690	705	384	500	283	388
380	709	809	457	500	283	405
390	864	931	457	500	402	569

Trim types

TRIM TYPE	TRIM CHARACTERISTIC	ANSI B16.104-76 RATED SEAT LEAKAGE	TEMPERA-TURE 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.	06
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.	07
USS / STD™ o LDB™ 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.	08
BSS / STD™ or LDB™ 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.	09
		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 (deaeratorlevel control, drain services,etc.). • Condensed recirculation systems.	10
		Class II	550 °C		
PILOT Plug / STD™ or LDB™ 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.	11
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.	12
		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

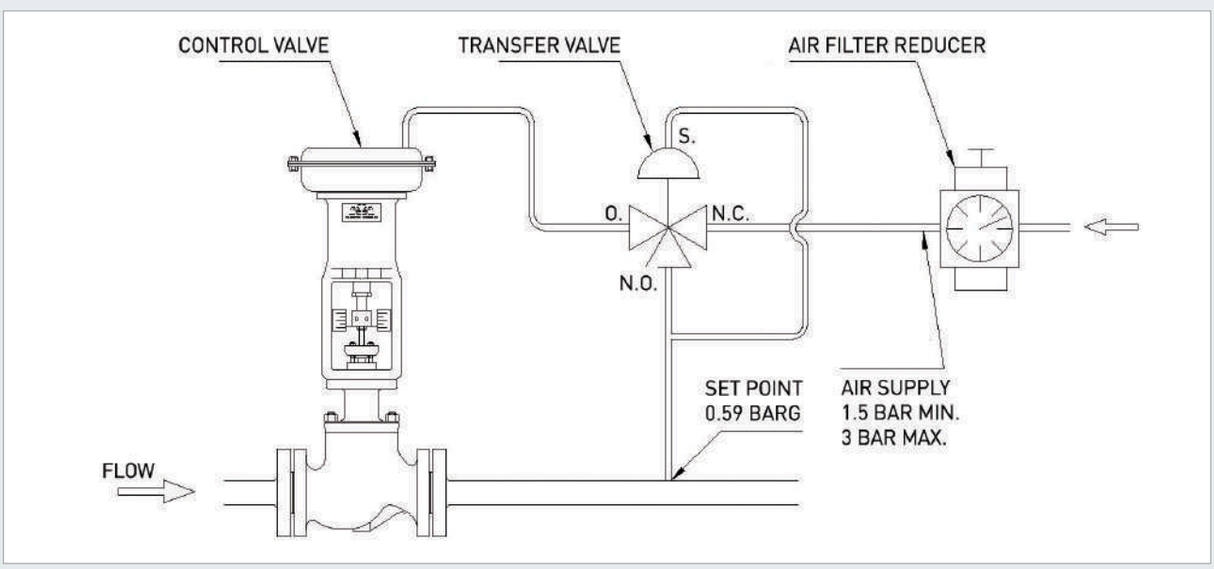
Other Ringo control valves

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 spring will tend to compensate the deviation.

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



CHOKE VALVES

Our choke valves have been developed to cope with high pressure drop applications on liquid, gas or multiphase fluids for oil and gas wells.

They are used in production, gaslift-topside and water injection applications.
Special designs include low noise or anti-cavitation features.
Materials are selected to withstand erosion.
Interchangeable beans allow the use of the same valve at different conditions.

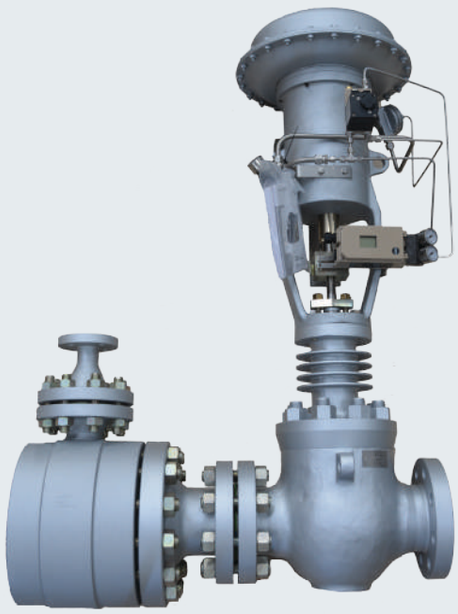
DESUPERHEATERS

The function of reducing pressure is separated from the cooling function, thus avoiding thermal expansion problems.
We can offer complete packages.

a) Desuperheater stations, including water control valve and spray or Venturi type desuperheater.

b) Pressure reduction and desuperheating stations including steam pressure reducing valve and water valve associated with desuperheaters.

c) First class desuperheaters, either spray or Venturi type, carefully selected and sized, combine with control valves to offer highest rangeability and accurate control of temperature.



BALL VALVES

A major problem encountered, when using ball valves for control applications, was their high recovery characteristic, which is to say low Fl values.
The result was, with high even medium pressure losses, cavitation and noise.
Our LDB ball valves overcome these problems, and give excellent control characteristic.
A segmented plate combined with multidrilled plates inside the ball to give cavitation suppression and noise reduction.
Different characteristics are offered.

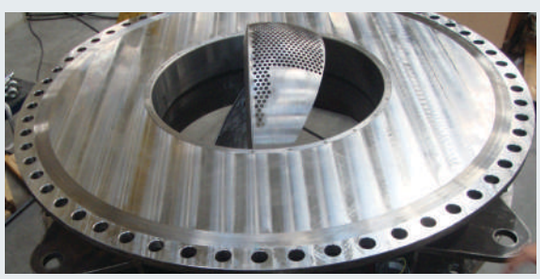
BUTTERFLY VALVES

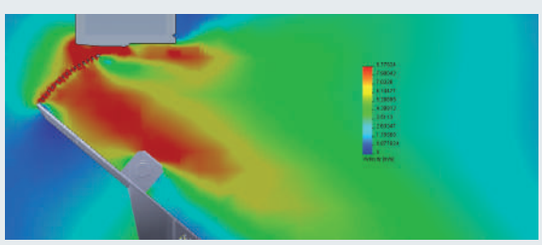
When very large flow rates combine with low to medium pressure conditions, a characterized butterfly valve is a convenient solution, both technically and price wise.

Valve disc is modified to match the required Cv value and curve characteristic. With the addition of conditioning baffles, the dynamic torque acting on the disc is reduced and smooth operation is achieved.

As an added feature, noise reduction of up to 20 dB(A) can be achieved.

Tight shut off requirement can also be met.





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

Electric actuators

When electrical actuators are requested ROTORK, BERNARD , 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. SIZING AND SELECTION

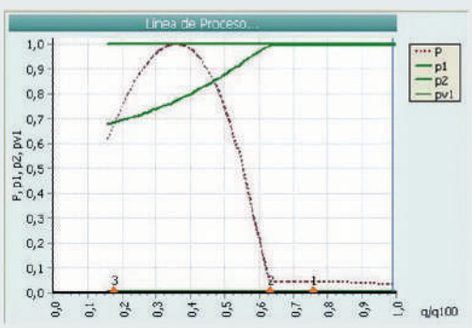
RV has specific control valve calculation software which is CONVAL™. It calculates the flow properties based on client process specification, and select from the Ringo Valvulas database the control valve which is the most accurate for this process (size, pressure class, and trim type).

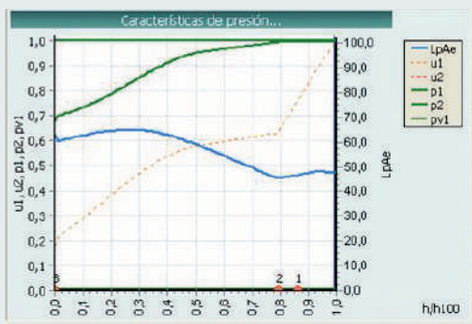
Some of the possible parameters which can be calculated with this program are:

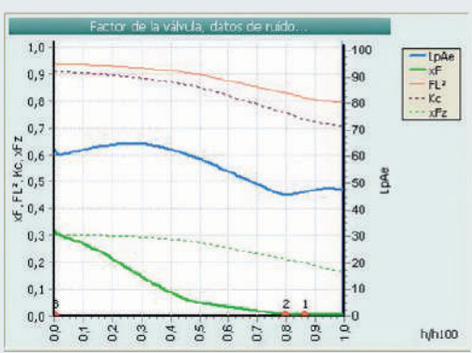
- Cv calculation and % of travel for the different operation points
- Fluid properties and state in the operation conditions
- Noise level
- Fluid velocities
- Power loss inside the valve
- Two-phase fluid conditions if it is required
- Actuator forces
- Internal valve parameters

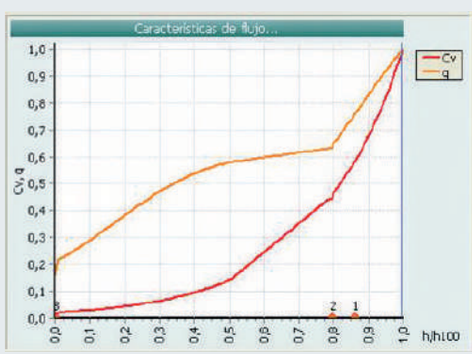
This software permits export of the calculation results to Ringo Valvulas datasheet format.

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









Noise reduction special designs

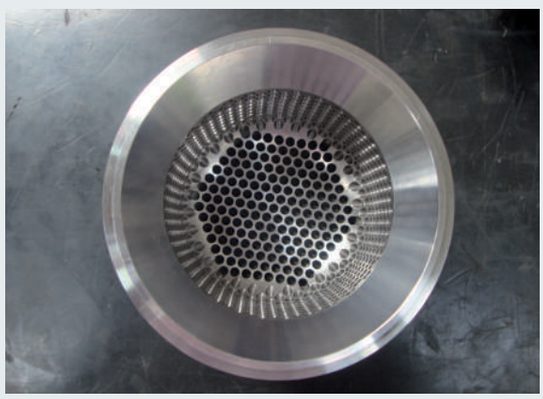
Large, medium size valve in gas or steam service, may give unacceptable noise levels, even if multistage cages are used, and sonic conditions avoided.

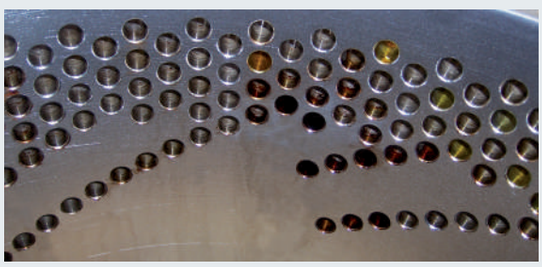
The answer to the problem is the increased number of holes of flow passages with the reduction of jet-diameters, and reduction of Fd factor. Depending on the size of the valve and the number of stage additional reductions, up to 25 dB(A) can be obtained. Again here, engineering programs let us to know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

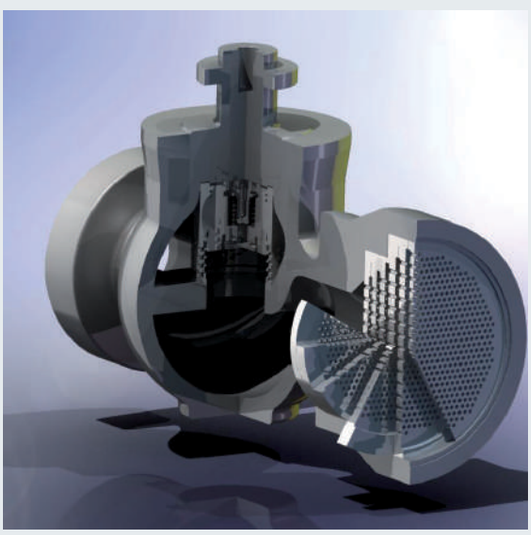
When high pressure drops applications in gas or steam recommend the outlet pipe to be larger than inlet pipe, a good recommendation is to have one or more diffuser plates downstream the valve to match the pipe size. The combination of valve and baffles, diffusers or multihole plates, when correctly calculated,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

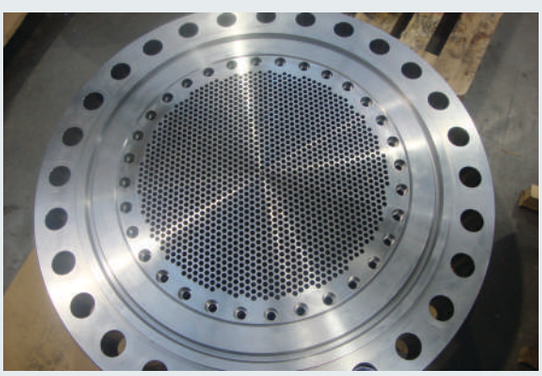
- Reduce the velocity of gas/ steam at valve outlet
- Allows the use of smaller size valves,
- Reduces the valve and baffle overall noise levels
- Reduces noise and vibration transmitted by the downstream pipe

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









In-line diffuser plates silencer water type.

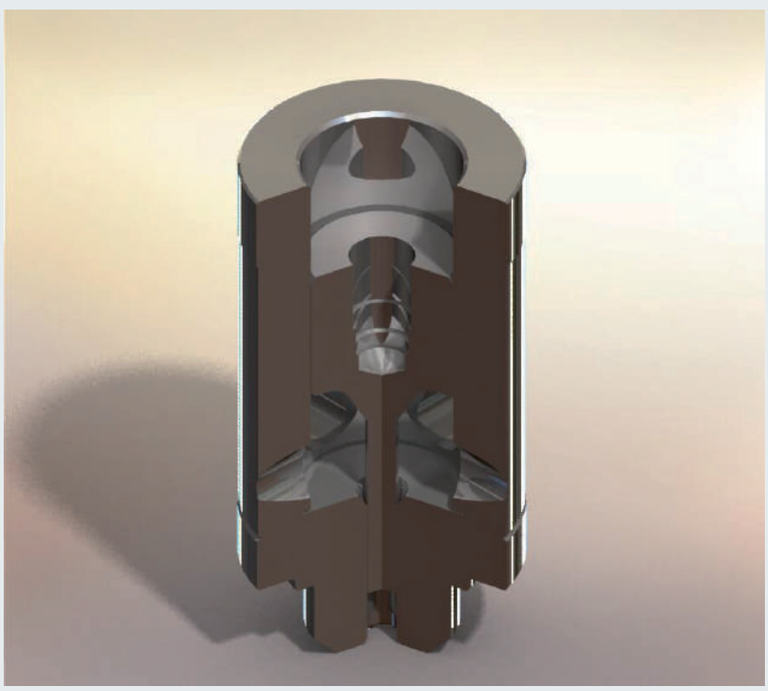
06. MINIFLOW

SMALL FLOW VALVES

A complete series of Miniflow fluted plugs have been developed to cover the need of controlling small to very small flow rates combined with medium to high pressure drop applications.

Offered Cv values range from 3.84 to 0.02 covering most common applications.
Control characteristic can be linear or equal percentage.
Comparatively large strokes assure smooth, accurate control of small flows, and good rangeability.
High Fl, xT values offer protection against cavitation and additional noise reduction.
All plugs and seats are interchangeable within every valve body size.
Also the same internals can be used with all body ratings of the same size.

SIZE	Relative opening h										TRAVEL (mm)
	CV10	CV20	CV30	CV40	CV50	CV60	CV70	CV80	CV90	CV100	
0	0,0009	0,0019	0,0032	0,0046	0,0070	0,0094	0,0123	0,0153	0,0182	0,0200	26
1	0,0013	0,0029	0,0048	0,0070	0,0106	0,0141	0,0185	0,0229	0,0273	0,0300	26
2	0,0026	0,0058	0,0095	0,0139	0,0212	0,0282	0,0370	0,0459	0,0547	0,0600	26
3	0,0053	0,0116	0,0190	0,0290	0,0423	0,0565	0,0741	0,0920	0,1094	0,1200	26
4	0,0105	0,0233	0,0381	0,0558	0,0847	0,1129	0,1482	0,1835	0,2188	0,2400	26
5	0,0212	0,0466	0,0762	0,1115	0,1694	0,2260	0,2965	0,3670	0,4376	0,4800	26
6	0,0423	0,0932	0,1525	0,2230	0,3388	0,4518	0,5929	0,7341	0,8753	0,9600	26
7	0,0847	0,1863	0,3049	0,4461	0,6776	0,9035	1,1859	1,4682	1,7506	1,9200	26
8	0,1698	0,3737	0,6115	0,8945	1,3590	1,8118	2,3780	2,9441	3,5100	3,8500	26



07. MULTISTEP™ TRIM

DESIGN

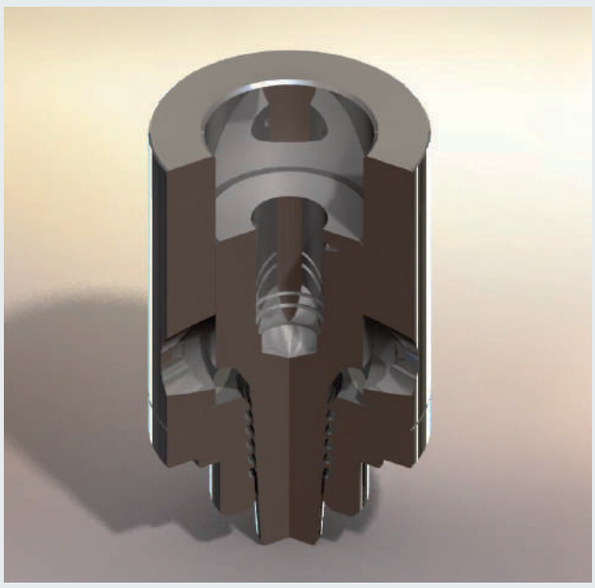
Specially designed for low and medium flows combined with medium to high pressure drops. Also recommended when high rangeability is required.
With this outstanding design the total pressure drop across the valve is splitted in several smaller, decreasing pressure drops.
In this way erosion or cavitation, 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 is deacreasing values of individual pressure steps. The number of steps is constant whichever the position of the plug, thus being effective at low as well 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 his position surface of seat ring and plug are subject to erosion and cavitation. Cavitation will occur when the liquid pressure falls down to or bellow the vapour pressure; at which point small bubbles are formed. When the pressure is recovered the bubbles will implode and cause shock waves that can cause severe damage of the trim and body. Our Multistep design minimizes these problems.
Multistep Trim features a series of labyrinth grooves, machined into the seat ring along its throttling surface. This serie 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 exist. 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 applicacion 420 or 440 hardenend steels are used.
Stellited 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 primarly 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 as well as steam or liquids.
Differential pressure ranges up to and including 300 bar.
Rangeability is good as 80 to 1.

Valve capacity (Cv) values

Table 1

EQUAL PERCENTAGE inherent charasteristic 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	0,82	0,81	0,80	0,78	0,76

08. USS/STD™ O LDB™ CAGE

DESIGN

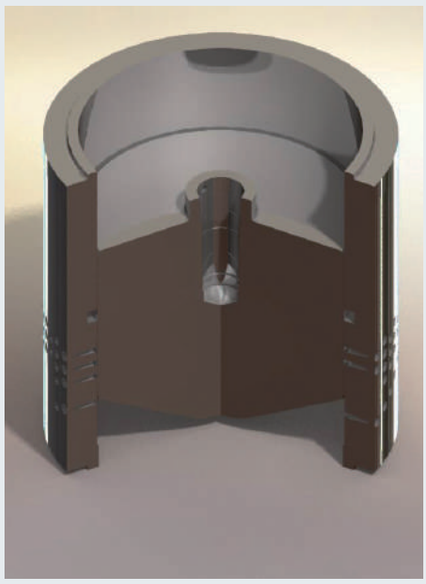
STD cage is a hole pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.
LDB cages maintain the same philosophy as STD cages with excellent features in noise reduction.
STD cage and LDB cage can be used with unbalanced plug over 250ºC giving excellent solutions. Flow is going up through seat ring and out of cage.
Hole pattern design reduces the number of pieces for reduced trims and also provides excellent rangeability for reduced trims instead of reducing 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.

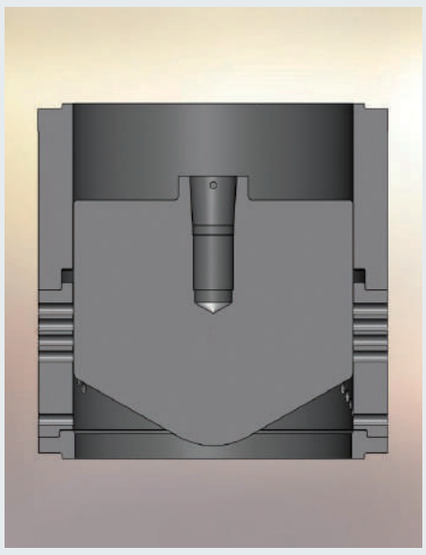
Rated seat leakage is class IV as standard. Class VI is also available.
LDB trim offer some of the advantages of the multistage trims. LDB cage reduces the damaging effects of flashing and cavitation when using compressible and non-compressible fluids



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 exceeding 250ºC.
Alternative to Balanced Single Seat (BSS) when temperature exceeds 250ºC. (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.

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 contro, 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 (dB)1 = (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.

Cierre caracterizado

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

Caja STD

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 charasteristic 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

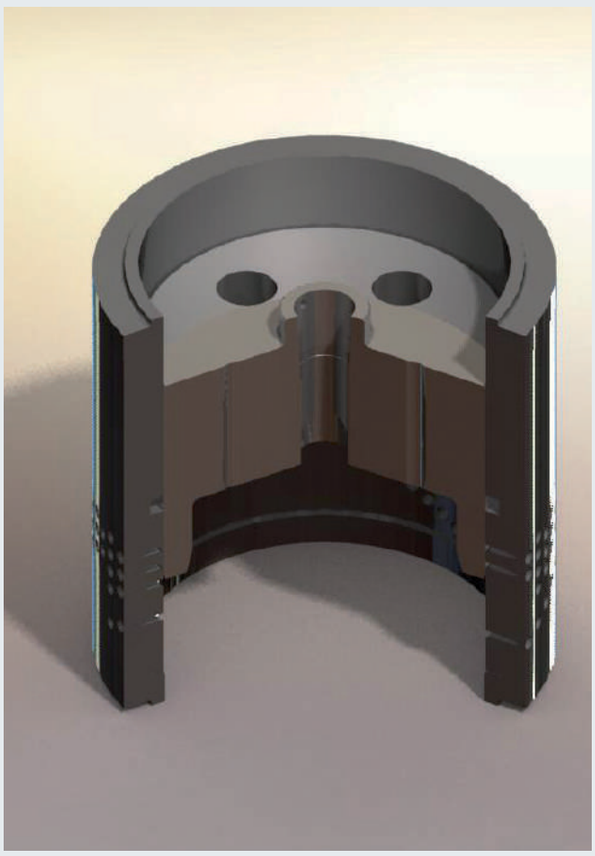
SIZE		Relative opening h										TRAVEL (mm)
DN	INCH	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
50	2	0,72	1,4	2,5	3,6	5	7	11	17	24	36	20
50/1	2\1	0,5	1	1,7	2,5	4	5	8	12	17	25	20
80	3	1,6	3,2	5,6	8	12	16	24	37	53	81	32
80/1	3\1	1,1	2,2	4	5,6	8	12	17	26	37	57	32
100	4	2,9	5,7	10	14	20	29	43	66	95	144	45
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

09. BSS/STD™ & LDB™ CAGE

DESIGN

STD cage is a hole pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.
LDB cages mantain 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 reduces the number of pieces for reduced trims and also provides excellent rangeability for reduced trims instead of reducing the travel.
Spacing between holes is carefully controlled to eliminate jet interaction and higher resultant noise levels.

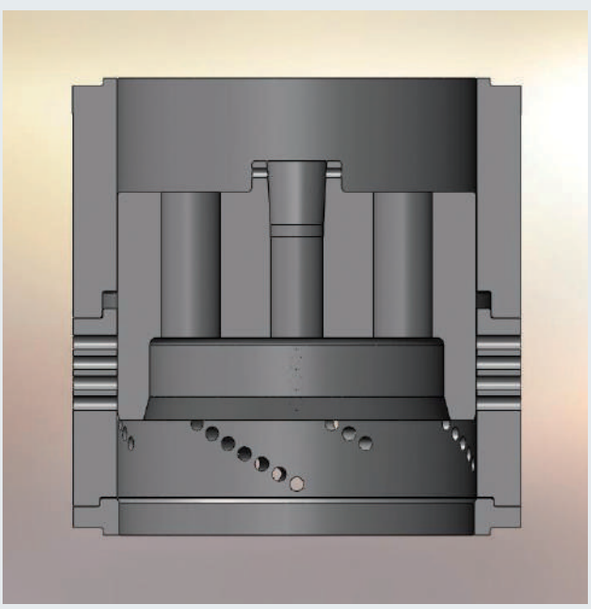


PERFORMANCE

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 an 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 reduces the damaging effects of flashing and cavitation when using compressible and non-compressible fluids.
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, 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 premitting use of smaller, less expensive actuators while mantaining 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 thight 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 trough 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 (Flow rate)1= (Flow rate)2 and (Noise power)1= (Noise power)2, then (dB)1=(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

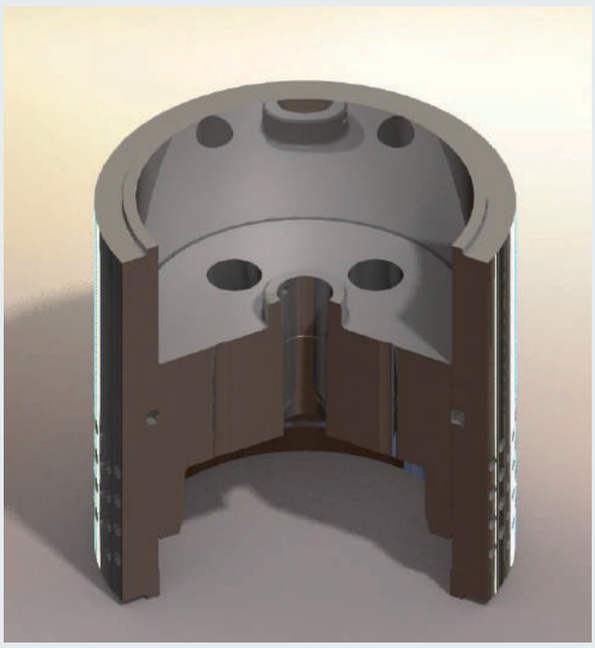
The Cavless trim consists of a cage which has, double drilled, a serie of timed radial holes which provides a nozzle effect. Each nozzle is diametrically opposed by an identical nozzle.
Using a balanced plug it acts as a control device which covers and uncovers those holes, thus controlling the flow fluid.
The design can control the location of the vena-contracta and therefore control the location where cavitation occurs. When the plug is throtling 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 reduce 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 exist.
The Cavless trim with balanced plug, for cavitation service, utilizes a cage guided design with "U" cup seal for thight 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 material selection.
The cage guided balanced plug provides for stable operation during valve throtting, in addition to tight shut-off capability.
Our standard Caveless 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 IV according ANSI B16. 104.
Rangeability is good as 25 to1.
Direction of flow from over the seat for cavitating applications and from under the seat for flashing applications.

Valve capacity (Cv) values

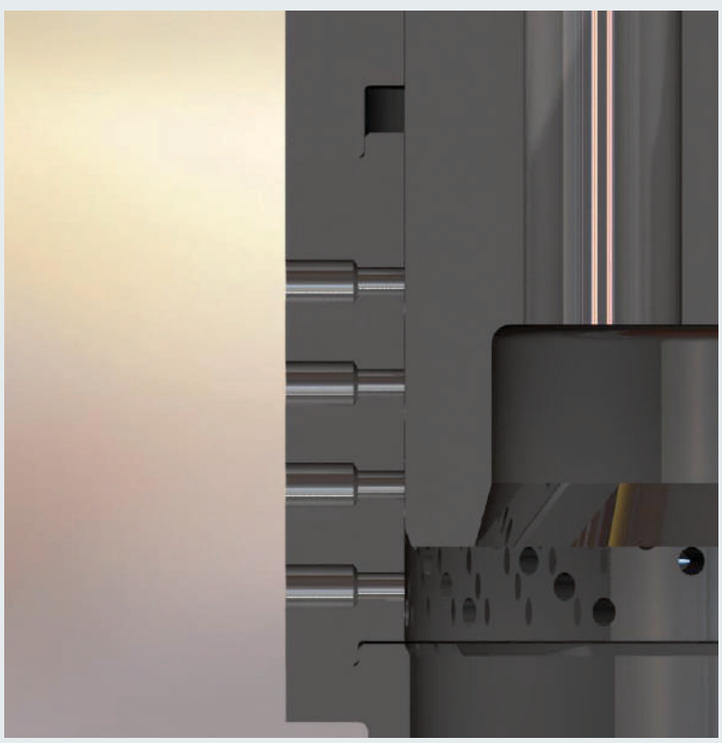
Table 1

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)



11. PILOT™/STD™ & LDB™ CAGE

DESIGN

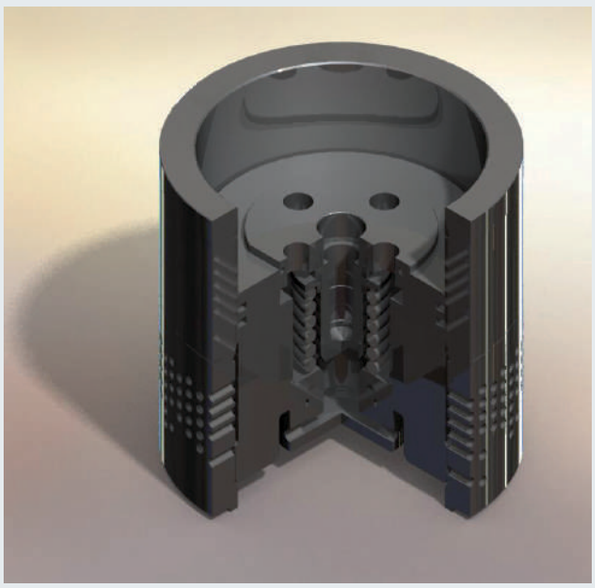
Pilot plug is specially designed for large size valves, 4in and above, to give tight shut-off with balanced trim at high temperature.
Pilot plug permits minimum actuator size when tight shut-off is required.
Pilot plug can be combined with STD and LDB cages with excellent solutions.
STD cage is a hold pattern drilled cage. It provides excellent rangeability for control valves with low cost cage design thus reducing trim prices.
LDB cages mantain the same philosophy as STD cages with excellent features in noise reduction.
Hole pattern design reduces the number of pieces for reduced trims and also provides excellent rangeability for reduced trims instead of reducing 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 or 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.

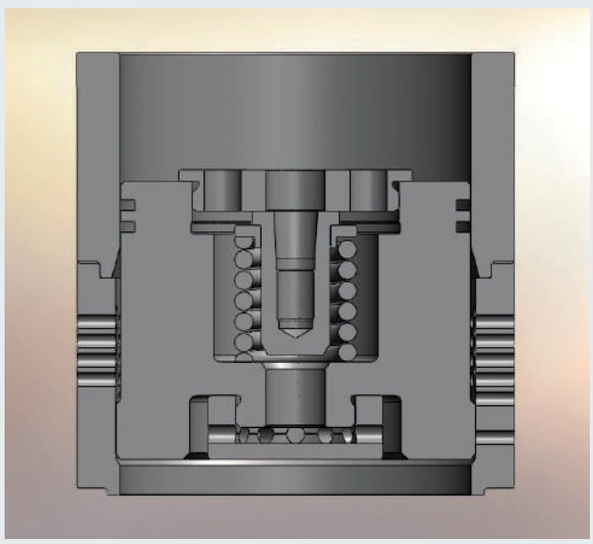
The cage guided balanced plug provides for stable operation during valve throttling, in addition to tight shut-off capability.



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, ally steel, stainless steel and others.



APPLICATIONS

Pilot plug for large size valves, 4in and above, to give thight 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 trough 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 (Flow rate)1= (Flow rate)2 and (Noise power)1= (Noise power)2, then (dB)1=(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 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.

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

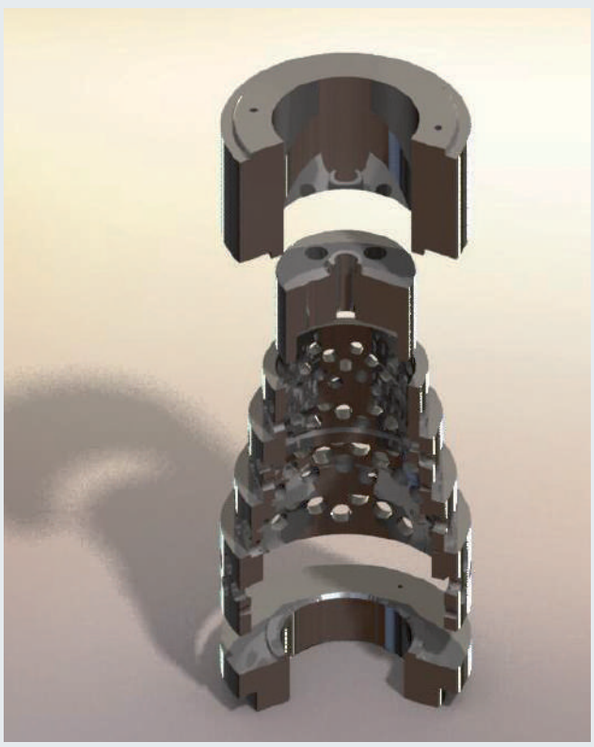
FL(1)	0,88	0,88	0,87	0,86	0,85	0,84	0,84	0,83	0,82	0,82
FL(2)	0,77	0,77	0,76	0,74	0,72	0,71	0,71	0,69	0,67	0,67

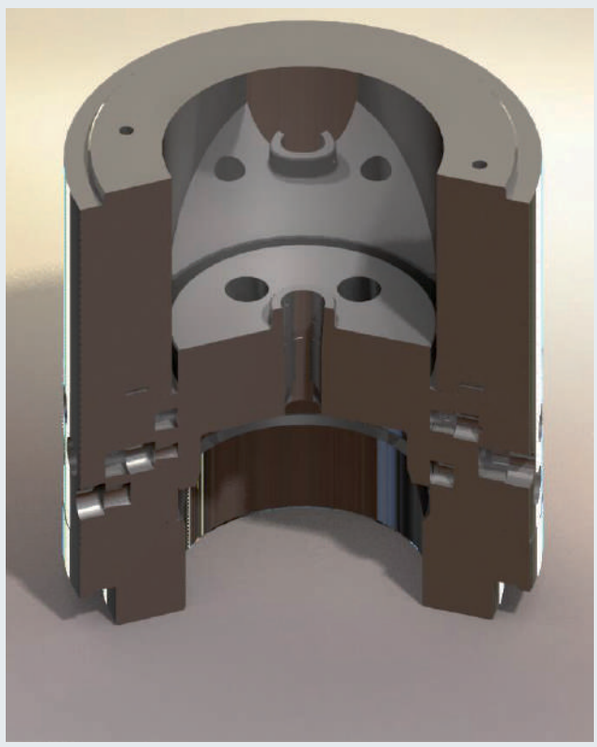
12. MULTICYL/BSS™ PLUG: MULTISTAGE VALVES

When pressure drops ratio (x=ΔP/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 xF=(P1-P2)/ ΔP 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.





13. MANUFACTURING RANGE

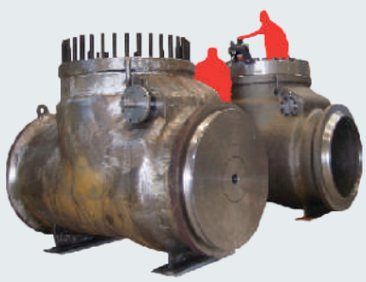
Gate

Standards	Sizes	Features Design - Materials	
ANSI B16.34 API 600 API 6D BS - 1414	1/2"-72" 150# 1/2"-64" 300# 1/2"-48" 600# 1/2"-42" 900# 1/2"-36" 1500# 1/2"-30" 2500# 1/2"-24" 4500#	Types: Wedge Gate/ through conduit / Double expanding Construction: Bolted bonnet / Pressure seal Disc type: Solid / Flexible/ Split /Parallel slide Standard features: OS&Y / Backseat Optional features: Lantern ring Equalizer Locking device Stem extension Leak-Off & Packing Expulsor Low emission packing Non rising stem Bellows seal gate Materials: Cast and forged Operation: Manual / MOV / AOV / HOV / Electrohydraulic	
API 6A	2-1/16"- 7 1/16" 2000 psi 2-1/16"- 7 1/16" 3000 psi 2-1/16"- 9" 5000 psi 1-13/16"- 7 1/16" 10000 psi 1-13/16"- 5-1/8" 15000 psi 1-13/16"- 3-1/16" 20000 psi		

Globe

Standards	Sizes	Features Design - Materials	
ANSI B16.34 BS 1873	1/2″-48″ 150#-300# 1/2″-42″ 600# 1/2″-36″ 900# 1/2″-30″ 1500# 1/2″-24″ 2500# 1/2″-12″ 4500#	Types: Straight pattern / Y pattern / Angle pattern / 3-Way / Stop check Construction: Bolted bonnet / Pressure seal Disc type: Flat / Parabolic / Needle Standard features: OS&Y / Backseat Optional features: Lantern ring Leak-Off & Packing Expulsor Locking device Stem extension Low emission packing Bellows seal Zero stem leakage Materials: Cast and forged Operation: Manual / MOV / AOV / HOV / Electrohydraulic	

Check

Standards	Sizes	Features Design - Materials	
ANSI B16.34 API 6D BS 1868	1/2"-72" 150# 1/2"-64" 300# 1/2"-56" 600# 1/2"-48" 900# 1/2"-36" 1500# 1/2"-30" 2500# 1/2"-24" 4500#	Types: Swing check / Dual plate / Tilting Disc / Piston check / Ball check / Single Disc / Axial check Construction: Bolted bonnet / Pressure seal Wafer / Lug / Double flanged Optional features: Position indicator Locking device Emergency assisted valves Dumpered valves Materials: Cast and forged	
API 6A	2-1/16"- 11" 2000 psi 2-1/16"- 11" 3000 psi 2-1/16"- 11" 5000 psi 1-13/16"- 7 1/16" 10000 psi 1-13/16"- 4 1/16" 15000 psi 1-13/16"- 3-1/16" 20000 psi		

Butterfly (on-off and control)

Standards	Sizes	Features Design - Materials	
AWWA C-504	40"-120" CLASS 25A-250A	Types: Concentric Double eccentric Triple eccentric Seats: Soft / Metal Seated Construction: Wafer / Lug / Double flanged Materials: Cast and forged Optional features: Control butterfly valves Operation: Manual / MOV / AOV / HOV / Electrohydraulic	
BS - 3952	3"-40" ANSI 600#		

■ Ball (on-off and control)

Standards	Sizes	Features Design - Materials	
ANSI B16.34 API 6D	1/2"-60" 150#-600# 1/2"-56" 900# 1/2"-48" 1500# 1/2"-30" 2500#	Types: Trunnion Mounted / Floating Construction: Side entry Split body: 2 or 3 pieces Fully welded Top entry Non contact Ball Valve Seats: Soft / Metal Seated Standard features Trunnion: Bidirectional Flow Trunnion Design for low torque Automatic cavity pressure relief Double block & bleed Anti-blow out stem Grease fittings, drain and vent Antistatic device Fire safe Optional features: Double piston effect Seat with scrapper Locking device Stem extension Low emission packing Live loaded packing 3-Way ball valves Control ball valves High temperature service Materials: Cast and forged Operation: Manual / MOV / AOV / HOV / Electrohydraulic	
API 6A	2-1/16"- 7 1/16" 2000 psi 2-1/16"- 7 1/16" 3000 psi 2-1/16"- 7 1/16" 5000 psi 1-13/16"-7 1/16" 10000 psi 1-13/16"-5-1/8" 15000 psi 1-13/16"-3-1/8" 20000 psi		

Choke

Standards	Sizes	Features Design - Materials	
API 6A	Customized up to 20000 psi	Types: Positive, Adjustable and Control Materials: Cast and forged Operation: Pneumatic diaphragm Pneumatic piston Hydraulic piston Electrohydraulic	

Axial flow valves (on-off control)

Standards	Sizes	Features Design - Materials	
ASME B16.34	4"-48" 150#-900# 4"-24" 1500#	Types: One piece body Trim type: STD / LDB / DobDrill / DobCage Materials: Cast Operation: Manual Pneumatic Hydraulic Electric Electrohydraulic	

Globe control - cage guided

Standards	Sizes	Features Design - Materials	
ANSI B16.34	1/2″-36″ 150#-300# 1/2″-30″ 600# 1/2″-28″ 900 1/2″-24″1500# 1/2″-20″ 2500# 1/2″-12″ 4500#	Types: Straight pattern / Y pattern / Angle / 3-Way / Bellows seal Construction: Bolted bonnet / Pressure seal Trim type: Mini flow / Multistep / USS STD / USS LDB BSS STD / BSS LDB Pilot / Multicylinder / Cascade Standard features: OS&Y / Backseat Optional features: Lantern ring Leak-Off & Packing Expulsor Double packing Stem extension Low emission packing Bellows sealed control globe Materials: Cast and forged Operation: Pneumatic diaphragm / Pneumatic piston / Hydraulic piston / Electric Electrohydraulic	

SAMSON

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N NPT

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