

### **HISTORY of BALL VALVES as CONTROL VALVES**

PARCOL S.p.A. has been founded in 1954 in Canegrate, a small town at the edge of Milano area.

Quickly grown as a leader in Valves and Control Valves for severe services applications, especially oriented to Energy sector and Steam conditioning systems, PARCOL has been acquired in 2019 by KOSO, after 65 years of activity.

Another Italian company, SEVEN, with important experience in producing On-Off Ball valves, was already owned by KOSO. SEVEN and PARCOL have been joined together as unique Factory, now located in the historical headquarter of PARCOL, close to Milano.



Before the acquisition, Parcol was already producing Control ball valves combining the large experience in severe service globe control valve trims to an improved design of ball valves. Valves were produced in collaboration with another Italian Company (not part of KOSO Group), specialized in on-off ball valves.

Each valve was developed optimizing the design according to application needs. After SEVEN-PARCOL fusion, the original series of trims for ball valves have been quickly developed and embedded in KOSO design: the concept of Control has been therefore applied to original ball valves using an higher level of technology aimed to solve extremely advanced applications. An extended series of ball trims, including low-noise and anti-cavitation features has been realized.

### **FLUIDS**

Each fluid such as Water, Steam, Oil, Methane, Liquefied Natural Gas (LNG), Oxygen, Nitrogen, MDEA, ... has its own characteristics and its own range of temperature and pressures. KOSO Parcol Ball valves are engineered to withstand any kind of challenging and severe process or ambient conditions.

### **FEATURES**

Trunnion, Floating, Metal, Soft-Seated, Two or Three-pieces body construction, Single or Double-Seated, Side entry, Top entry, Double Block and Bleed, Extended bonnet, ... are just few example of most common Ball valves characteristics. The combination of these features, together with the accurate selection of materials and mechanical couplings, deeply influences the global result in product and control performances.

### **MATERIALS**

Materials selection is fundamental to grant full compatibility with most aggressive fluids and to withstand erosion and corrosion or to grant the capability to sustain thermal gradients and high temperatures especially reducing frictions and wearing process.

### **TRIM**

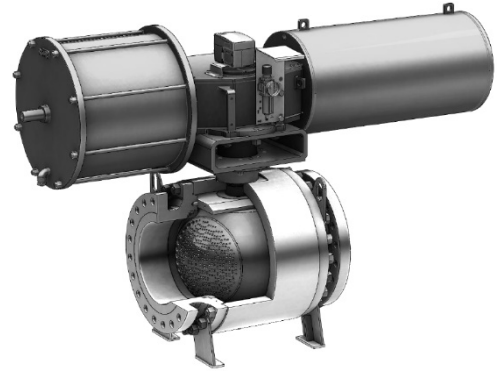
Each trim can be installed both in On-Off and Control Bodies. Some characteristics of sealing will change. Differently from many of our competitors, we install the trim internally to the ball, when the request of accuracy is high. This refined design allows superior performance compared to common downstream fixed resistor.

*"Differences are in details"*

### SPECIAL CARE for SPECIAL UNCONVENTIONAL BALL VALVES

KOSO Parcol uses also in standard on-off Ball valve design the same attention and care that puts in any other advanced and critical systems. This is the secret of great and long lasting performances along the years for our Ball Valves.

Starting our journey from our original design, we should mention 7TSE (Trunnion side-entry) ball valve which original design is coming from Seven experience. Here below a general overview of all other "ball products".



## ON-OFF WORLD

### SHUTOFF, INCHING and MANUAL BALL VALVES FAMILY

Manual valve, three pieces, floating and trunnion, soft and metal seat from 2" to 48" ANSI 150# to 2500#.

**7TSE** : Trunnion SIDE entry ball valve, available in both metal-to-metal and soft seated

**7TTE** : Trunnion TOP entry ball valve, available in both metal-to-metal and soft seated

**7DBB** : Double block and bleed, based on single or double ball configuration

**700** : small manual valves, forged or casted supplied for completion of supply packages

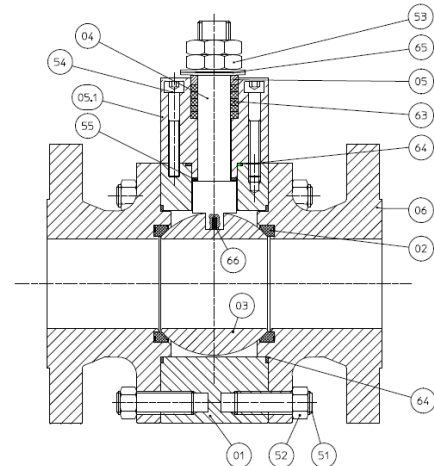


**Common features** such as API Design, Fire Safe, or SPE/DPE seats configuration...

**Special and customized design** including wetted parts cladding, advanced cladding for seats and ball, ...

**713** : three-way "T" "L" and "Y" ball valve also available with electrical and steam jacket for crystallizing fluids.

**750** : floating ball for general on-off service. Not recommended for Control applications.



*Floating soft ball valve*

## ON-OFF METAL & SOFT SEATED 2 or 3-PIECES TRUNNION BALL

### DESIGN STANDARD:

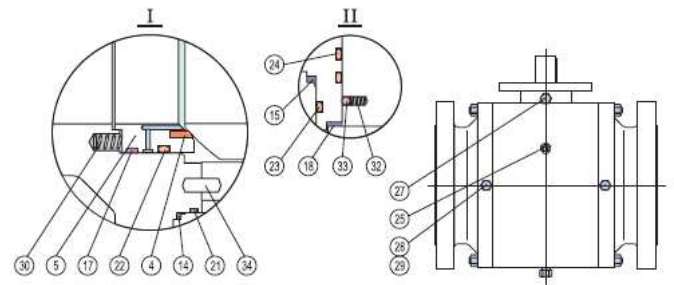
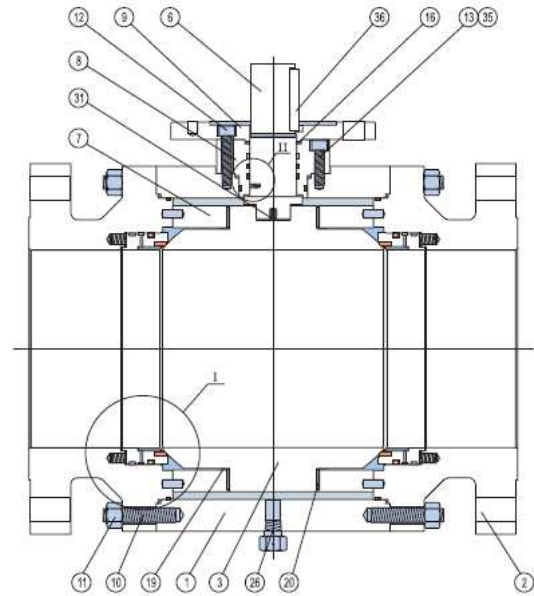
- Design: API 6D / ASME B16.34 / ISO 14313
- Face to face: API 6D / ASME B16.10
- End Connections: ASME B16.5 / ASME B16.25

### CERTIFICATION:

- PED: 2014/68/EU
- ATEX 94/9/EC
- Fugitive emission: ISO 15848-1 BH/CH CO1
- SIL: IEC 61508 (SIL2, SIL3 Capable)

### DESIGN FEATURE:

- 3-pieces bolted body
- Fire Safe design API 607 / 6FA
- Blowout-proof ball seat and stem construction
- Standard ASME Materials and NACE, EN and other materials available on request
- High Performance Sealing
- Packing with live loading available
- Double block and Bleed function available
- Self-relief on excessive cavity pressure
- Antistatic device
- Locking device
- Low operative torques
- Leakage Class up to IEC 60534-4 Cl.VI and API 508 Rate A



*Conventional Manual Ball valve for general application*

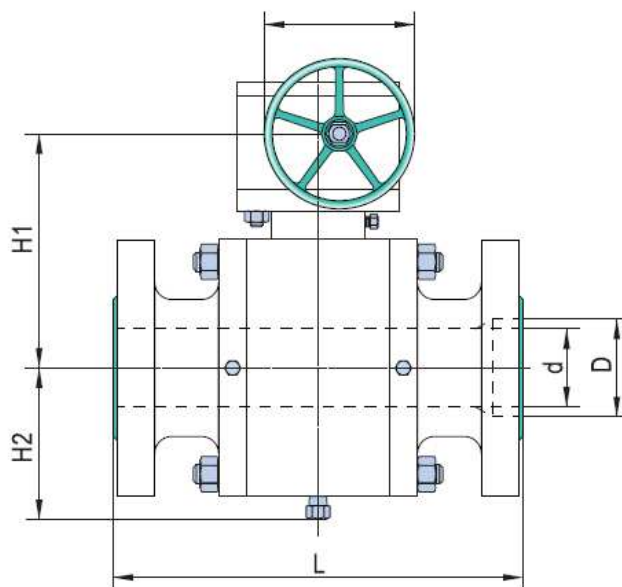
## FACE-TO-FACE DIMENSION for STANDARD DESIGN

### Full Bore - Class 150

Size in	D mm	L mm	H1 mm	H2 mm	W mm	Weight Kg
2	51	178	155	85	350	30
3	76	203	191	110	400	60
4	102	229	211	130	450	92
6	152	394	231	160	*305	190
8	203	457	282	235	*406	345
10	254	533	336	290	*406	495
12	305	610	373	315	*406	705
14	337	686	413	345	*406	859
16	387	762	457	383	*600	1020
18	438	864	501	435	*600	1440
20	489	914	551	495	*600	1918
22	540	991	600	555	*600	2352
24	591	1067	635	590	*700	2803

### Full Bore - Class 300

Size in	D mm	L mm	H1 mm	H2 mm	W mm	Weight Kg
2	51	216	155	85	400	31
3	76	283	191	110	450	69
4	102	305	211	130	500	110
6	152	403	229	160	*305	211
8	203	502	291	235	*406	376
10	254	568	340	290	*406	540
12	305	648	375	315	*500	763
14	337	762	417	345	*600	900
16	387	838	466	400	*600	1300
18	438	914	506	440	*600	1715
20	489	991	563	495	*600	2090
22	540	1092	605	560	*700	2220
24	591	1143	684	590	*760	2890



### Full Bore - Class 600

Size in	D mm	L mm	H1 mm	H2 mm	W mm	Weight Kg
2	51	292	155	85	400	45
3	76	356	193	112	500	80
4	102	432	239	140	700	150
6	152	559	266	175	*406	248
8	203	660	310	250	*406	438
10	254	787	354	290	*600	701
12	305	838	411	345	*600	855
14	337	889	435	370	*600	1230
16	387	991	493	420	*600	1535
18	438	1092	544	462	*700	2135
20	489	1194	629	515	*760	2640
22	540	1295	683	570	*800	3370
24	591	1397	728	610	*800	3960
	686	1549	810	695	*800	6060
	737	1651	863	735	*800	6690
	781	1778	900	775	*800	7825
	832	1930	940	820	*800	8460

### Full Bore - Class 1500

Size in	D mm	L mm	H1 mm	H2 mm	W mm	Weight Kg
2	51	368	178	100	450	60
3	76	470	226	130	700	115
4	102	546	241	162	*406	194
6	146	705	319	255	*600	580
8	194	832	345	280	*600	752
10	241	991	411	345	*600	1195
12	289	1130	478	405	*600	1970
14	318	1257	517	435	*700	2250
16	362	1384	599	485	*760	2760
18	407	1537	663	545	*800	3646
20	457	1664	695	580	*800	4497
24	534	2045	842	730	*900	7151

### Full Bore - Class 900

Size in	D mm	L mm	H1 mm	H2 mm	W mm	Weight Kg
2	51	368	178	100	450	52
3	76	381	221	125	600	87
4	102	457	215	150	*305	160
6	152	610	268	215	*406	385
8	203	737	324	260	*600	560
10	254	838	371	305	*600	820
12	305	965	425	360	*600	1125
14	324	1029	463	390	*600	1610
16	375	1130	513	440	*710	2010
18	425	1219	614	500	*760	2810
20	473	1321	644	530	*760	3460
24	572	1549	745	630	*800	5497
	667	1753	830	720	*800	10202
	714	1880	880	755	*800	11442
	810	2159	970	850	*900	17462

### Full Bore - Class 2500

Size in	D mm	L(RTJ) mm	H1 mm	H2 mm	W mm	Weight Kg
2	44	454	214	118	700	90
3	64	584	216	150	*406	200
4	89	683	265	180	*406	385
6	133	927	371	305	*600	778
8	181	1038	426	360	*600	1352
10	225	1292	463	390	*710	2137
12	267	1445	550	465	*760	3267

## CONTROL WORLD

### 4-4000 Valve Series: TRUNNION 2 or 3-Way CONTROL BALL VALVES

Metal Seated trunnion ball valves with special trim design defined and customized according to process conditions and customer requirements.

Low-noise, Anti-cavitation and multistage standard trim design to cover most common services and applications. Two or Three-way for mixing/diverting applications.

For advanced services and specific design, our technical department can provide customized solutions and trim designs thanks to the large experience granted by studies to offer to our Customers definitive solutions along more than 60 years of PARCOL's activity.



*Steam jacketed Three-way Control ball valve for Urea*

## ADVANTAGES OF BALL VALVE (vs GLOBE)

Main advantages of a Control Ball Valve, compared to a Globe Valve are:

- Lower weight of bigger valve size
- Higher rated capacity
- Better and longer lasting seat sealing properties



*Big Low-Noise Control ball valve for Natural Gas ready to be shipped*

### 4-4001 (Typically for Control / Inching / Manual services)

Control ball valve derived from original on-off design but implemented with specific upgrades to grant best controllability and smooth operation.

Normally supplied with a single metallic seat SPE/DPE to reduce frictions and with a classic full or reduced bore ball design, this valve can be used in not-critical applications as trimmer for flow or pressure fine control.

It can be supplied with soft or metal to metal seat depending on fluid characteristics and operating temperatures. Metal-seated ball valves are however recommended for Control application.



*Full Bore Control Ball Valve*



*KOSO Parcol Production Facility*

## 4-4000 CONTROL BALL VALVE FAMILY

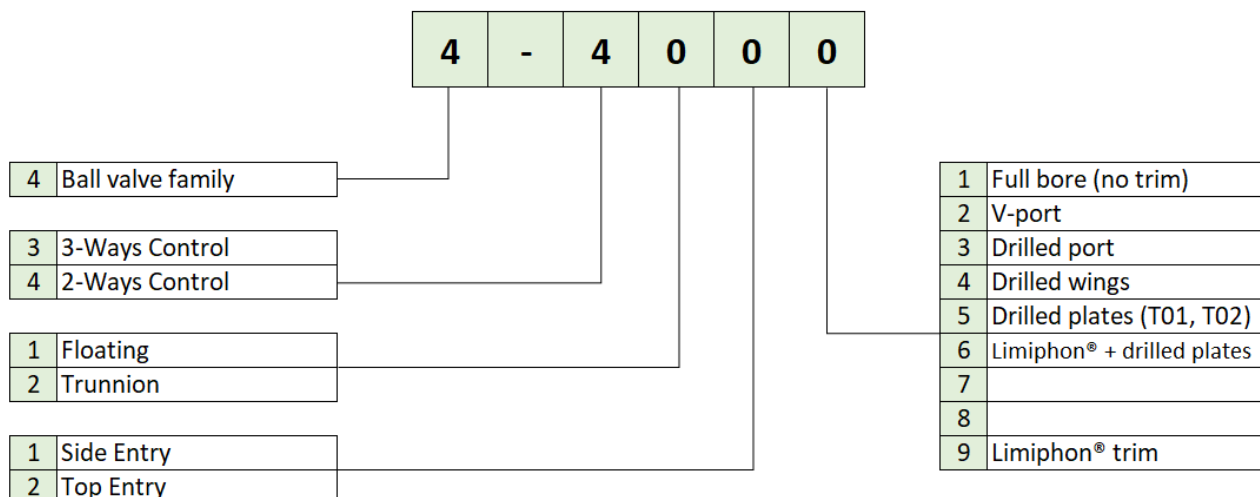
A full range of technical solutions associated with ball valve design has been implemented over the years to address specific needs of our customers. This has resulted in ball valves with anticavitation trims and low-noise cartridges, carefully tailored to process requirements.

All the most common solutions can be found within our standard special valves, but in case of need the design is flexible and can be adapted to specific requirements.

Very often the selection of a ball control valve, even for severe service, is the best choice. The greater flow capacity compared, for example, to a globe valve of the same size, together with the enormous rangeability that inherently characterizes this particular design, makes it the winning choice.

Moreover, the ability to handle even significant pressure drops should not be forgotten, thanks to the various trims used and the natural predisposition to lower sensitivity in case of dirty fluids.

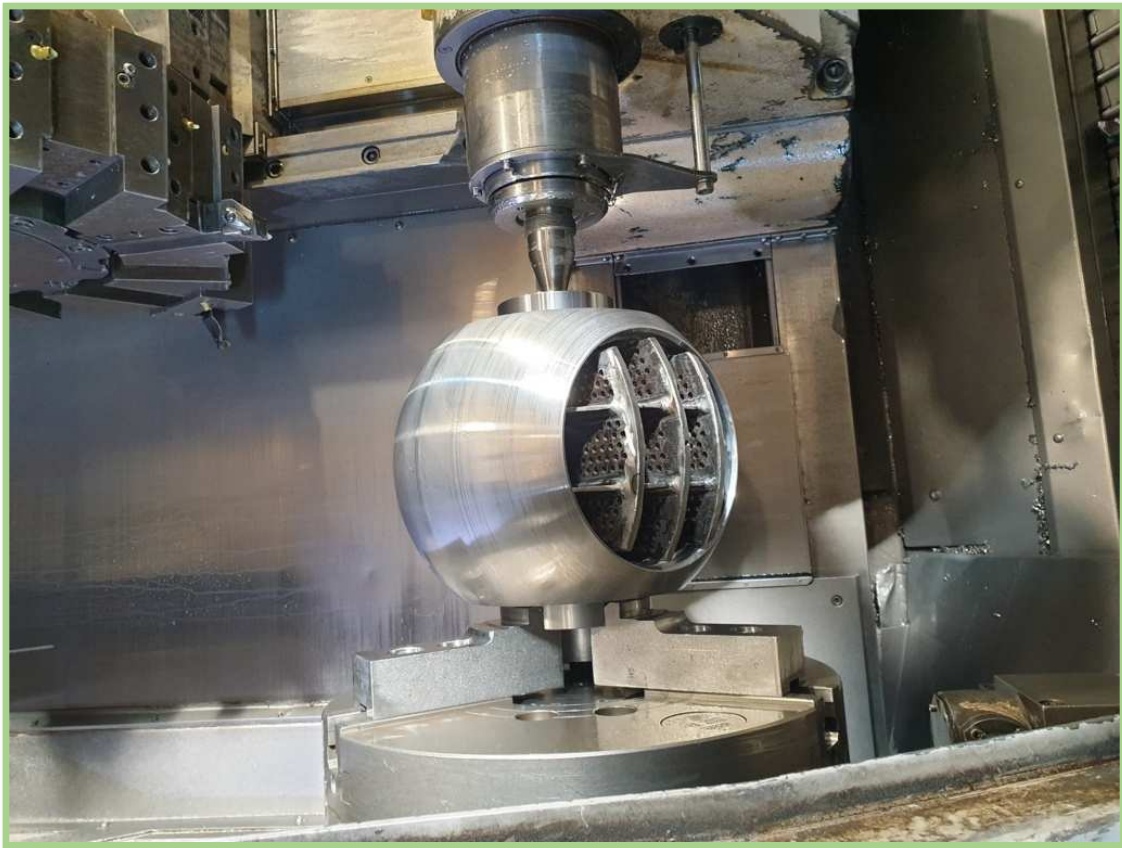
### PRODUCT CODING



	4-4001	4-4002	4-4003	4-4004	4-4005	4-4006	4-4009
Rated capacity	◆◆◆◆◆	◆◆◆◆◆	◆◆	◆◆◆	◆◆◆	◆◆	Customized
Range-ability	◆	◆	◆◆	◆◆◆◆	◆◆	◆◆◆◆	◆◆◆◆◆ Customized
Anti-Cavitation	No	No	◆◆	◆◆	◆◆◆◆	◆◆◆◆	◆◆◆◆◆ Customized
Noise reduction	No	No	◆◆◆	◆◆	◆◆◆◆	◆◆◆◆	◆◆◆◆◆
Compatibility with dirty fluids	◆◆◆◆◆	◆◆◆◆◆	◆	◆◆	◆◆◆	◆◆	◆
Optimal working range	10% - 70%	10% - 70%	5% - 90%	5% - 70%	10%-70%	5% - 70%	5% - 90%

## PRODUCT RANGE

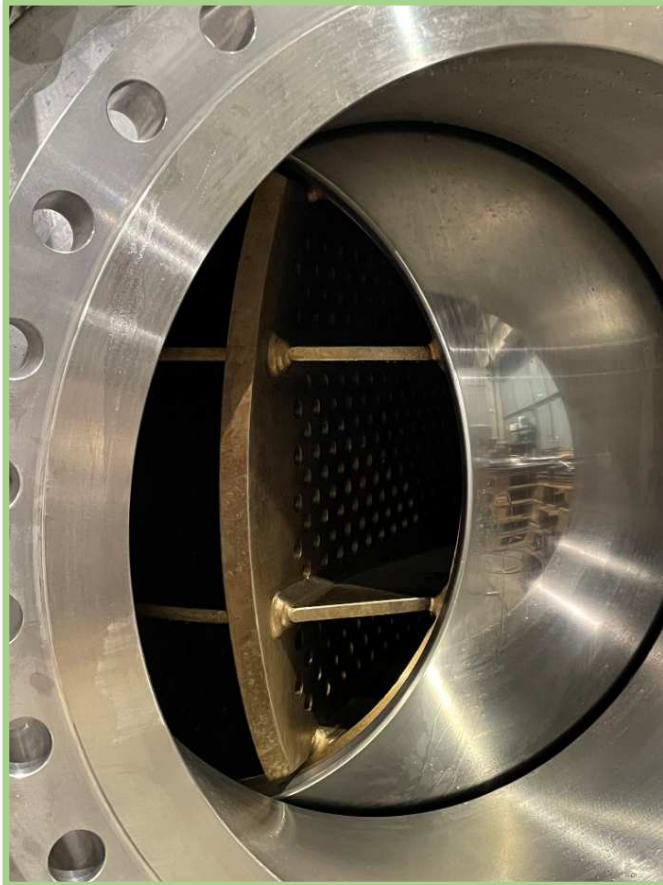
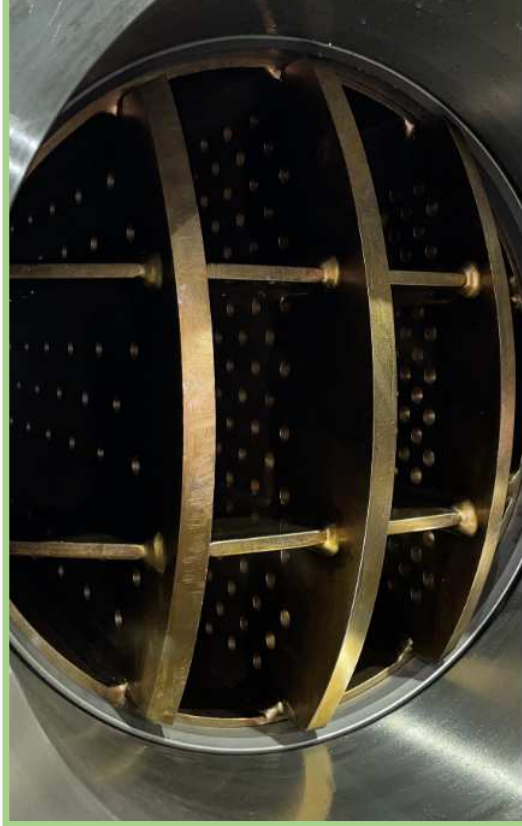
	ANSI 150-600	ANSI 900	ANSI 1500	ANSI 2500
<b>4-4001</b> Full port	2" to 48"	2" to 36"	2" to 24"	2" to 18"
<b>4-4002</b> V- port	2" to 48"	2" to 36"	2" to 24"	2" to 18"
<b>4-4003</b> Drilled port	2" to 48"	2" to 36"	2" to 24"	2" to 18"
<b>4-4004</b> Drilled wings	4" to 48"	4" to 36"	4" to 24"	4" to 18"
<b>4-4005</b> Perforated plates	6" to 48"	6" to 36"	6" to 24"	6" to 18"
<b>4-4006</b> Limi-cage	6" to 48"	6" to 36"	6" to 24"	6" to 18"
<b>4-4009</b> Limi-ball	2" to 48"	2" to 36"	2" to 24"	2" to 18"



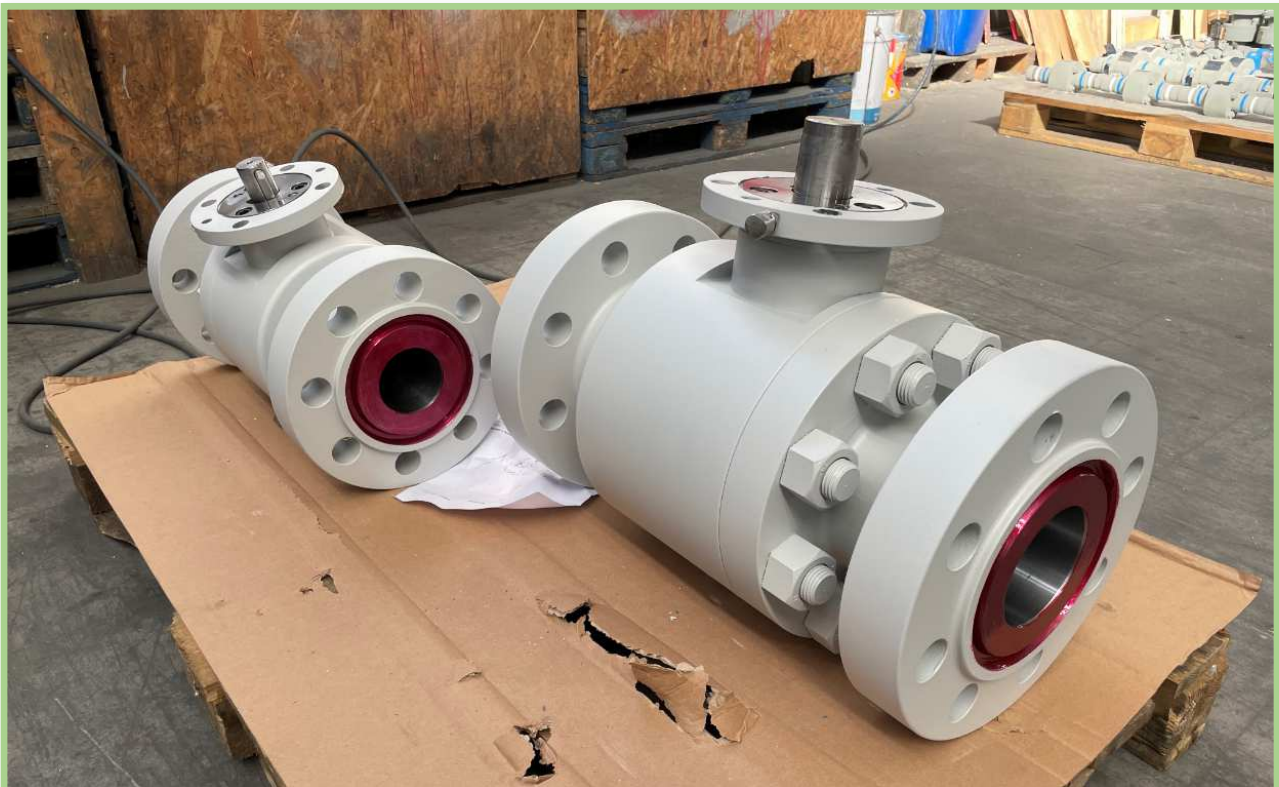
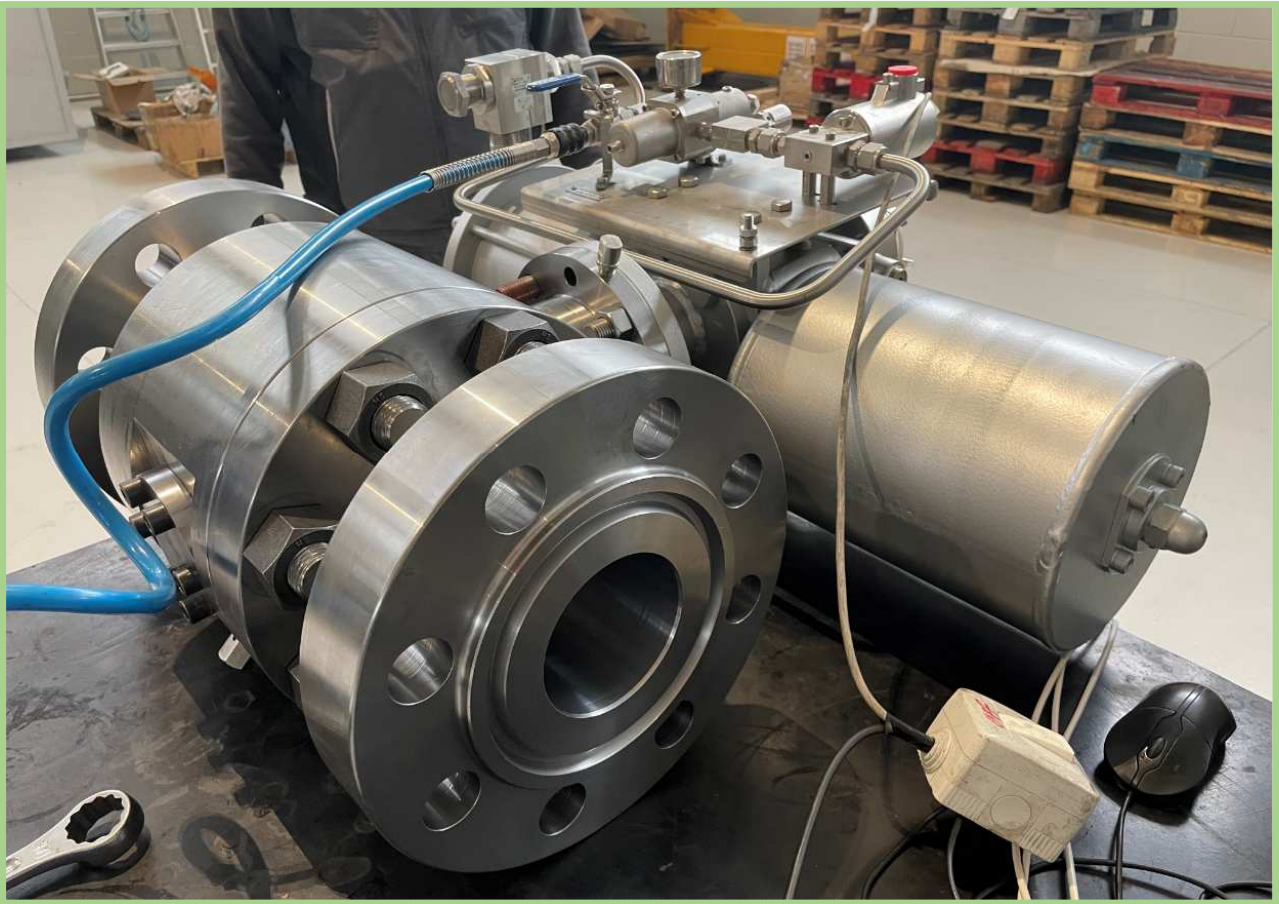
*Control ball with anti-cavitation trim refining.*



**32" 300# 4-4216 CONTROL BALL VALVES FOR OIL & GAS APPLICATION (5.0 MPa of pressure drop)**



## ESDV BALL VALVE (EMERGENCY QUICK CLOSING in less than 0.21 s)



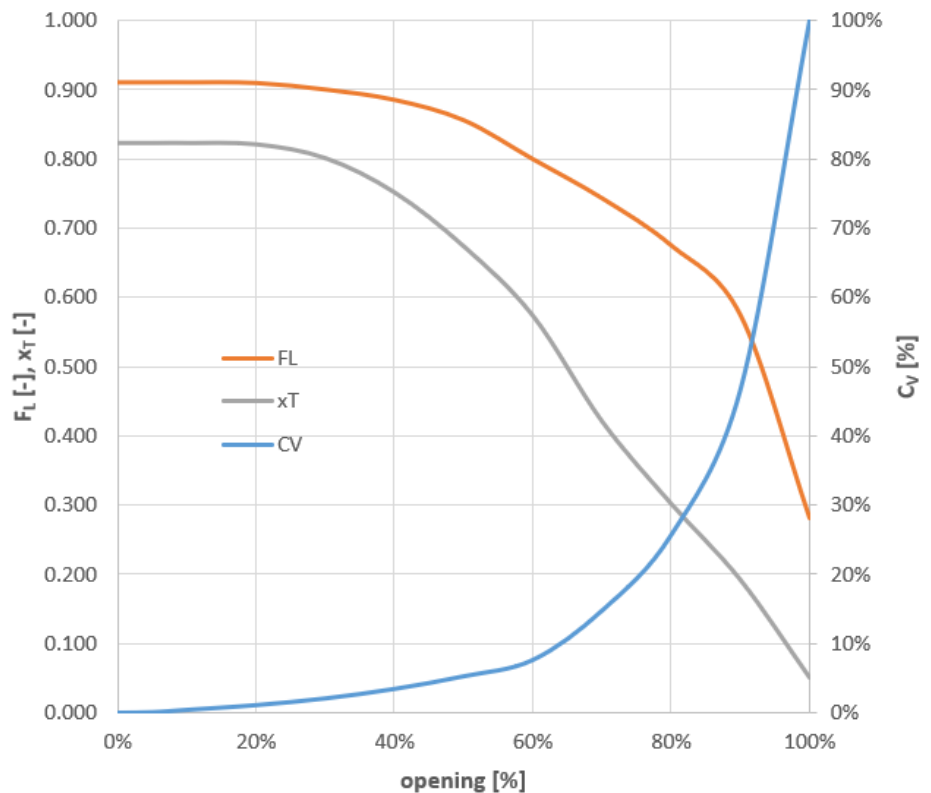
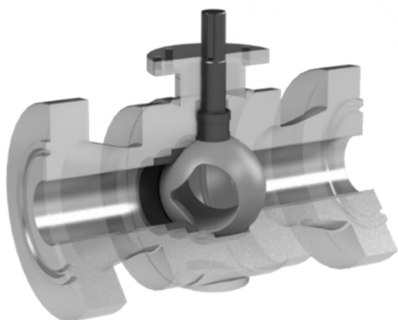
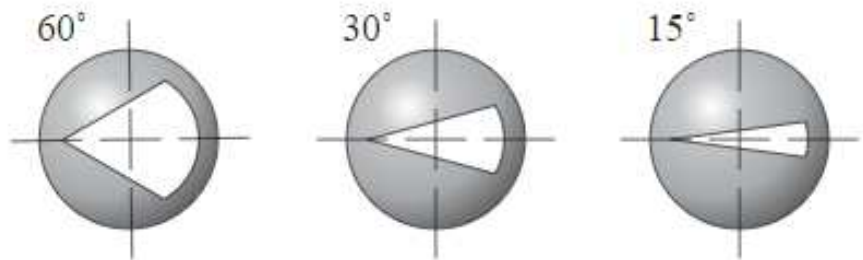
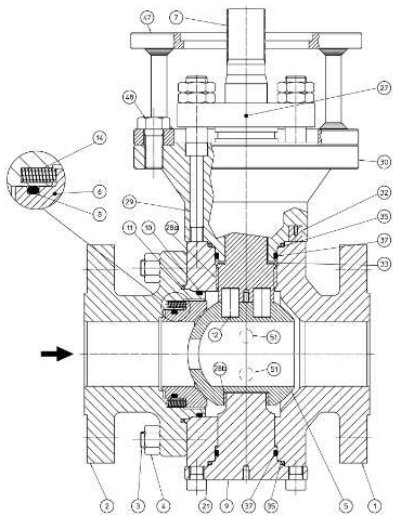
## 4-4002 : V-PORT BALL VALVE TRIM

Improved rangeability thanks to the V-shaped ball. The small “v” end that opens first improves throttling at reduced working angles dramatically extending valve rangeability and controllability.

Customized “v” shape can realize tailor made characteristic flow.

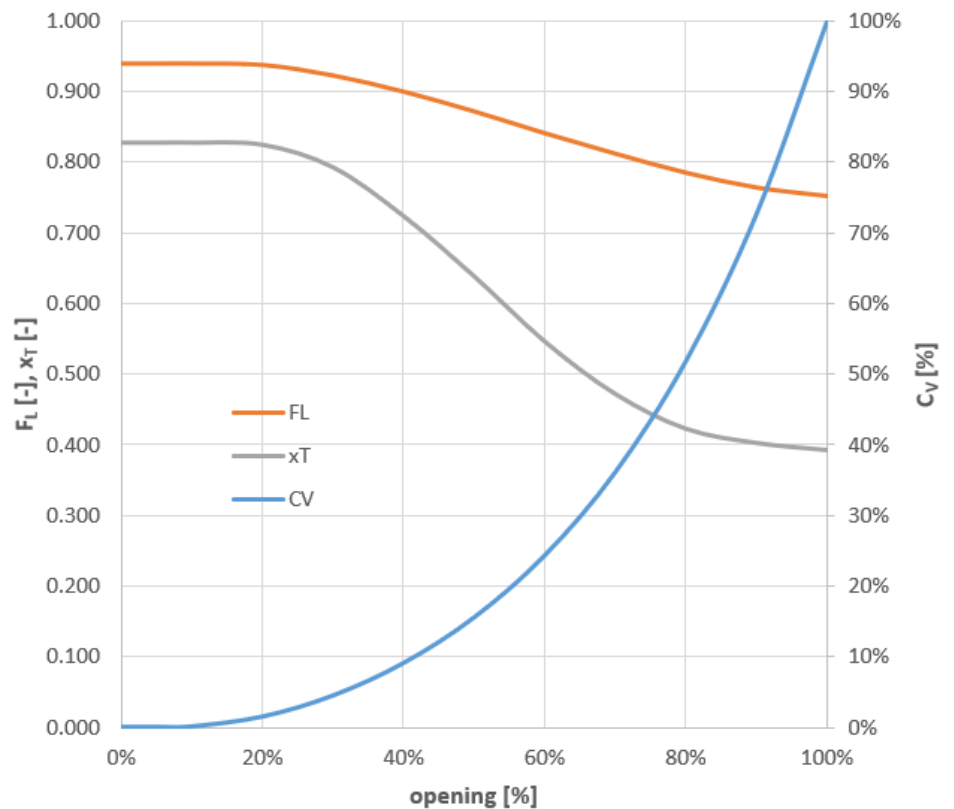
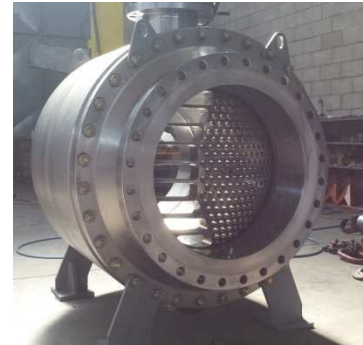
This trim can be recommended when improved throttling characteristics are necessary maintaining negligible pressure drops in fully open position. This trim shall be used when Noise and Cavitation are not expected.

Recommended also for medium or low dirty and erosive fluids, even including slugs and slurries thanks to self-cleaning inherent design.



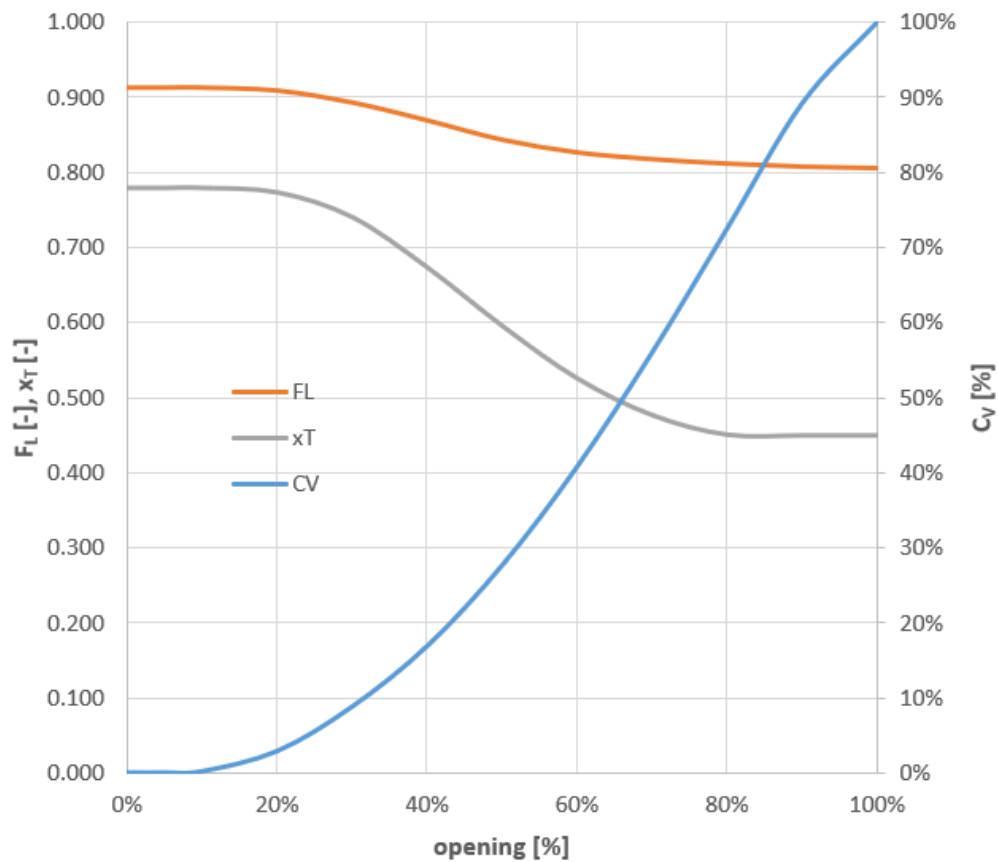
## 4-4003 : SINGLE STAGE, GENERAL PURPOSE

- Single stage for general purpose
- Variable drilling pattern along the travel
- Variable performances at different valve openings
- Equal-percentage characteristic curve (ST-E)
- Very high flow capacity considering performance at smallest opening
- Suggested for application involving liquids at low or intermediate pressure drop ( $\Delta P$ )
- Suitable for dirty fluids
- Self-cleaning design



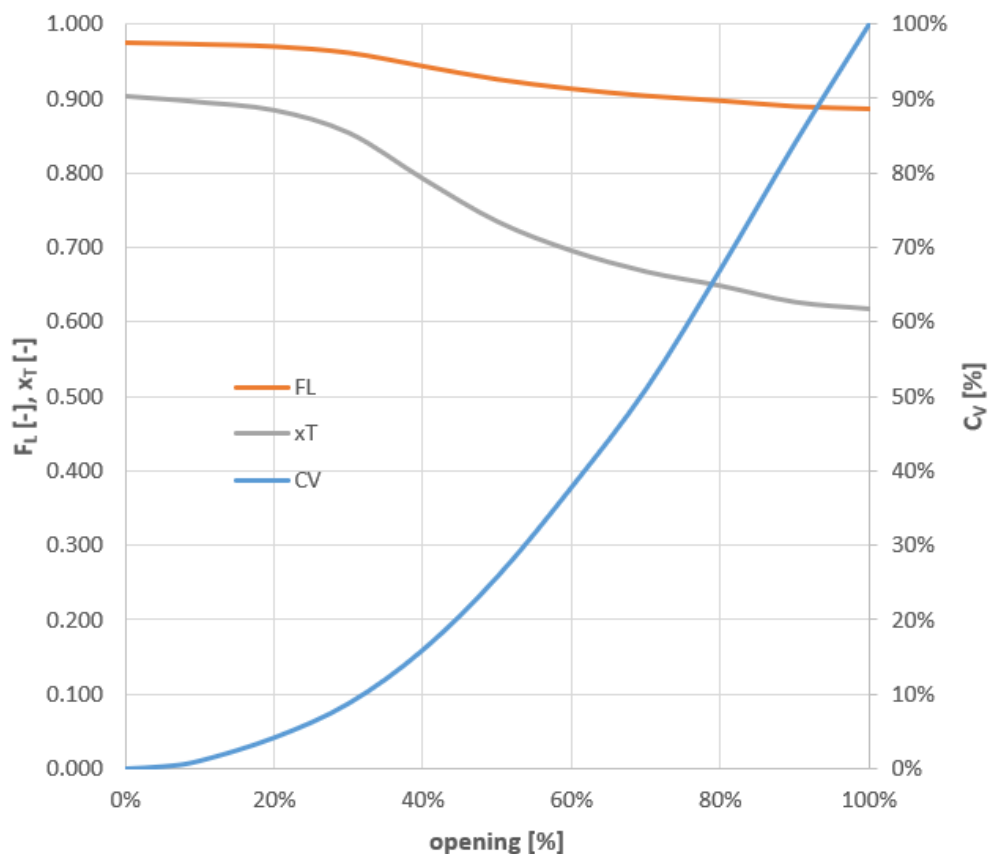
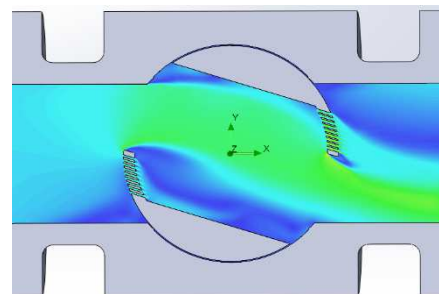
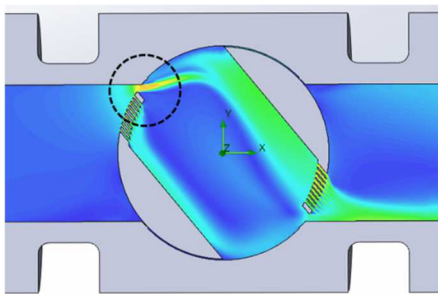
### 4-4003 : LN-L LOW NOISE

- Single-stage formed by a single spherical drilled surface. Available also in double stage configuration.
- Drilling pattern and holes distribution for best Controllability and Low Noise (LN) performance characterized by very low  $F_d$ .
- Standard, Linear, Equal% or customized characteristic curves.



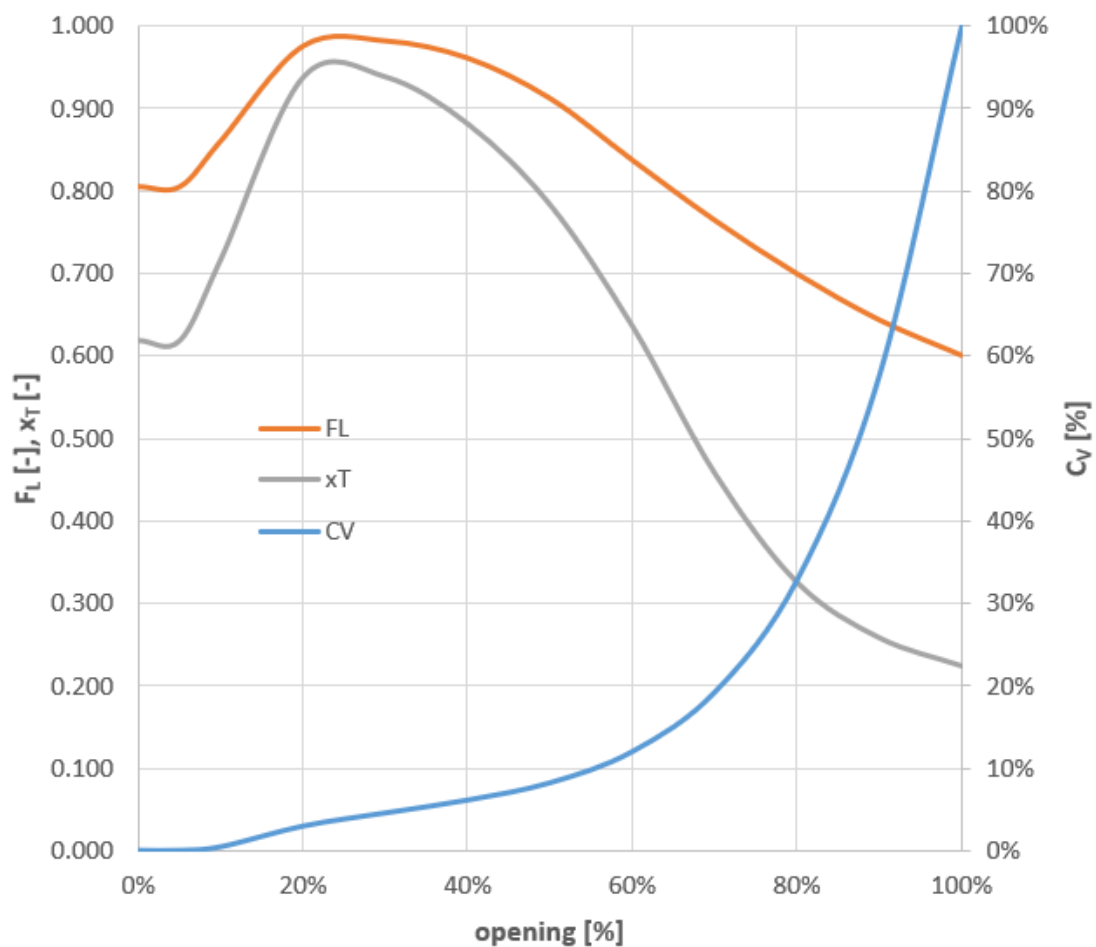
### 4-4004 : LN-L / LN-E - LOW NOISE, LINEAR or EQUAL%

- Double drilled baffles for two-stage pressure reduction and Linear or Modified Linear characteristic flow
- Baffles extension and cut can be customized on actual process data to ensure suitable flow coefficients and improve global trim rangeability and efficiency
- Suitable for service on liquids with medium pressure drops at small opening angles



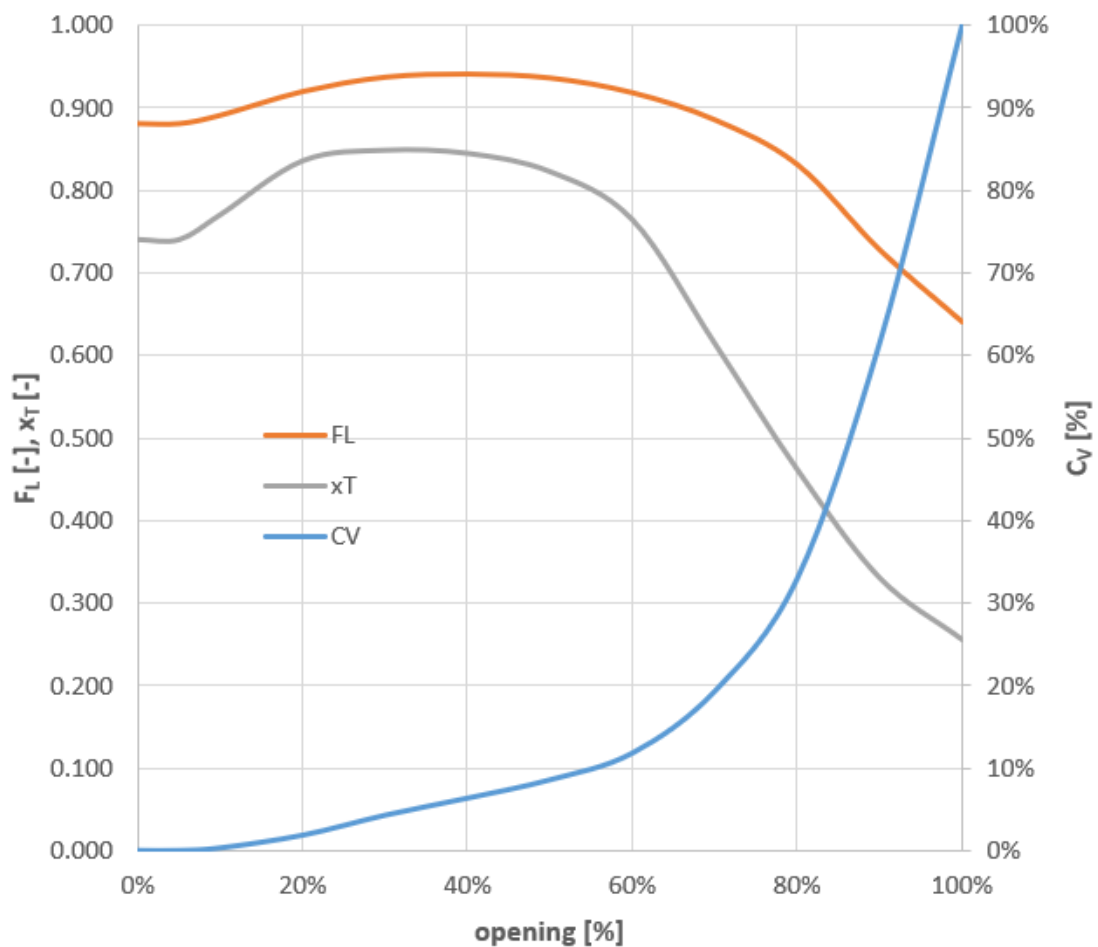
### 4-4005 T01 : ASYMETRICAL DRILLED PLATES WITH EXPASION ON BALL

- Multi-stage, multi-path, asymmetrical design with outlet expansion
- High performances in a good range of openings
- Very good values of maximum capacity (Cv) in fully open position
- Typically used for gas flow applications
  - Anti-surge, Compressor control, Blowdown and Venting (with downstream drilled plate or different additional silencer)



## 4-4005 T02 : SYMETRICAL DRILLED PLATES

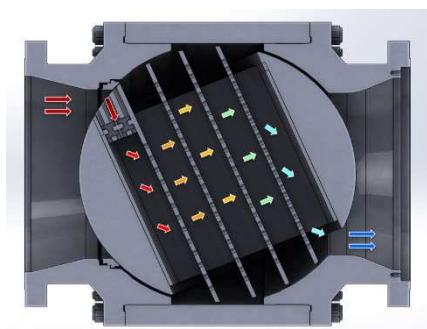
- Multi-stage, multi-path realized by parallel, symmetrical, and equally spaced drilled plates
- High performances in a good range of openings
- Very good values of maximum capacity (Cv) in fully open position
- Typically used for gas flow applications
  - Anti-surge, Compressor control, Blowdown and Venting (with downstream drilled plate or different additional silencer)





### 4-4006 : DRILLED PLATES with THROTTLING BAFFLE

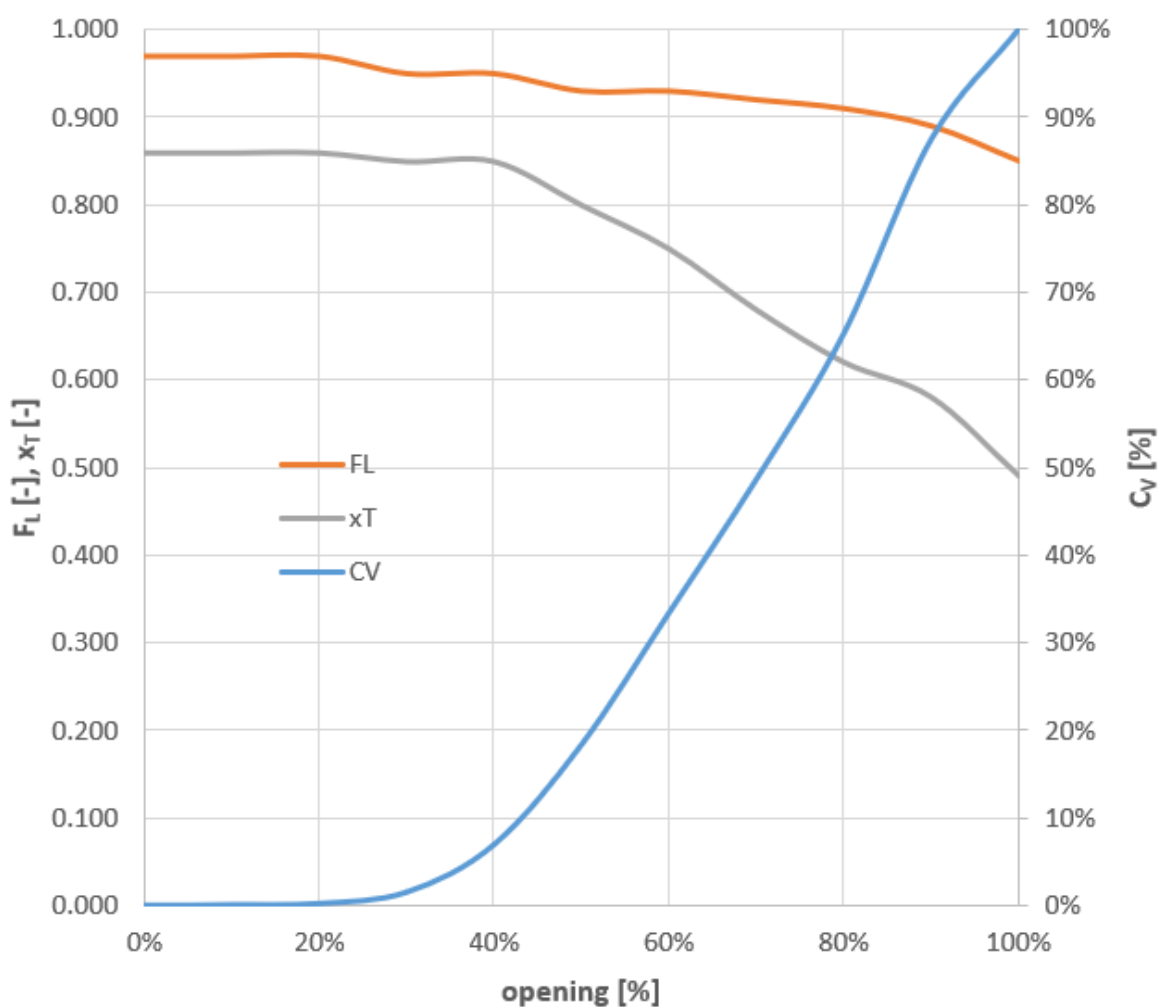
- Improved version of 4-4005 valve series including partializing baffle for increased throttling at the beginning of stroke
- Suitable when it is necessary to ensure a smooth control from very small valve opening together with a great prevention of noise and cavitation



### BAFFLES OPTIONS

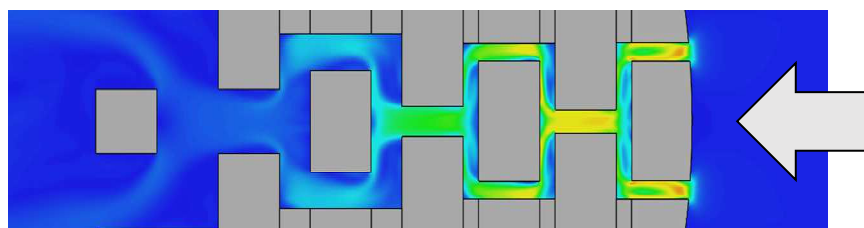
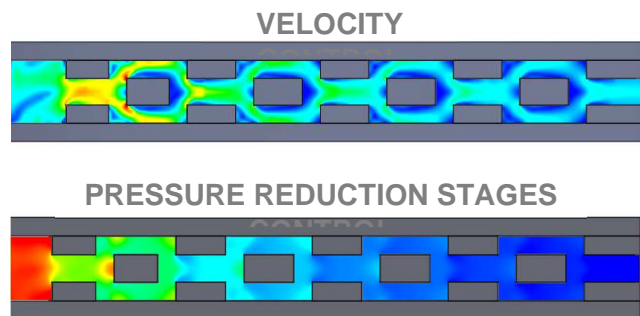
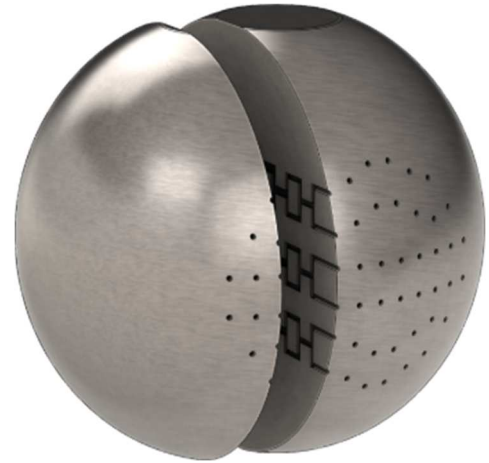
Standard drilled baffle can be replaced with Limiphon stack:

- Suitable when it is necessary to ensure the best control from very small valve opening together with state-of-art about prevention of noise and cavitation



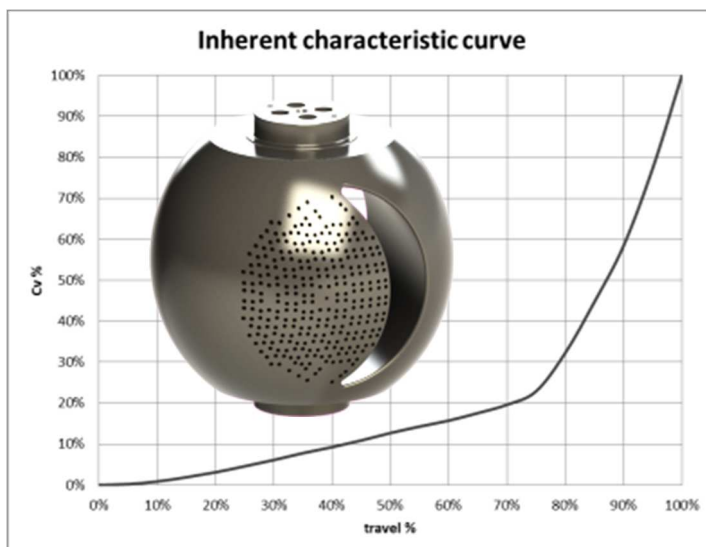
### 4-4009 : LIMIPHON® MULTISTAGE MULTISTEP / MULTIPATH

- Limiphon is a Multi-step Multi-path trim for most severe process conditions, due to its high  $F_L$  and  $X_T$  values, suitable for noise and cavitation prevention both with compressible and incompressible fluids.
- Flow Velocity and Pressure drop easily controlled, step by step, for any kind of clean fluid.
- No risk of trim erosion due to limited velocity and kinetic energy under control stage by stage by proprietary design of the stack.
- No vibrations along the travel even in case of severe pressure reduction
- In Limiphon® trim, the Expansion of compressible fluids, due to pressure reduction, is followed by an accurate sizing of the series of passing areas
- Its Patented Diverging-Converging Labyrinth channels ensure additional energy dissipation due to interaction of colliding flows at each converging section. Labyrinth efficiency increases and the specific effect of any direction changes amplifies the energy dissipation of the fluid



### 4-4009 VAR : LIMIPHON® VARISTEP

- Limiphon is a Multi-step Multi-path trim for most severe process conditions, due to its high  $F_L$  values, suitable for noise and cavitation prevention both with compressible and incompressible fluids
- Flow Velocity and Pressure drop easily controlled, step by step, for any kind of clean fluid
- No risk of trim erosion due to proven limits of velocity (and kinetic energy)
- Accurate noise prediction and lower specific generated noise
- No vibrations along the travel even in case of severe pressure reduction
- The number of stages presented to the fluid is variable along the stroke: it will be very high at very low openings, where the highest pressure drop is expected and will be reduced in intermediate positions, where pressure drop is reduced as well.
- In Limiphon trim, the Expansion of compressible fluids, due to pressure reduction, is followed by an accurate sizing of the series of passing areas
- Its Patented Diverging-Converging Labyrinth channels ensure additional energy dissipation due to interaction of colliding flows at each converging section. Labyrinth efficiency increases and the specific effect of any direction changes amplifies the energy dissipation of the fluid



## 4-4009 VAR : LIMIPHON® VARISTEP

- Fluid dynamic performances
  - number of stages
  - expansion factor
  - expansion shape
  - Characteristic Curve
  - extension of Limiphon trim within the ball
  - labyrinth type at each valve opening
    - Modulating precision
  - number and position of labyrinths
  - Rangeability
- Materials and hard-facings



## APPLICATIONS and SERVICES for 4-4009 VAR : LIMIPHON® BALL VALVE

- Pump Recycle
- Feed Water
- Gas to Flare



## CONTROL BALL METAL SEATED 2 or 3-PIECES TRUNNION BALL

### DESIGN STANDARD:

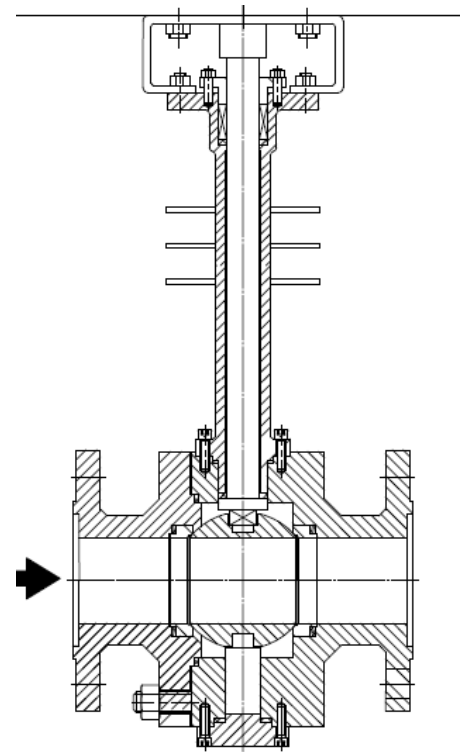
- Design: API 6D / ASME B16.34 / ISO 14313
- Face to face: API 6D / ASME B16.10
- End Connections: ASME B16.5 / ASME B16.25

### CERTIFICATION:

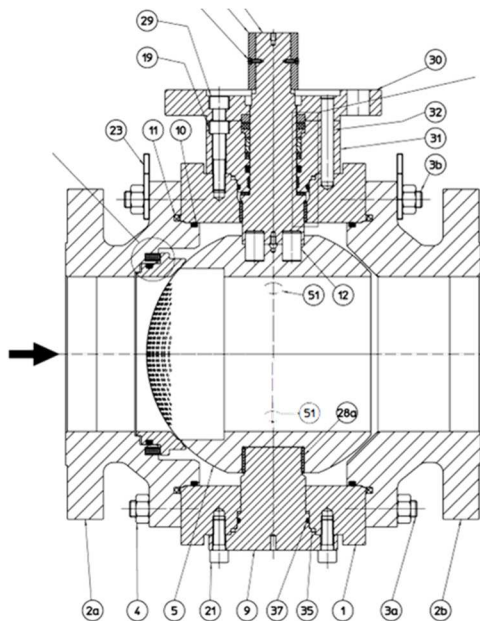
- PED: 2014/68/EU
- ATEX 94/9/EC
- Fugitive emission: ISO 15848-1 BH/CH CO1
- TA-LUFT Packing
- SIL: IEC 61508 (SIL2, SIL3 Capable)

### DESIGN FEATURE:

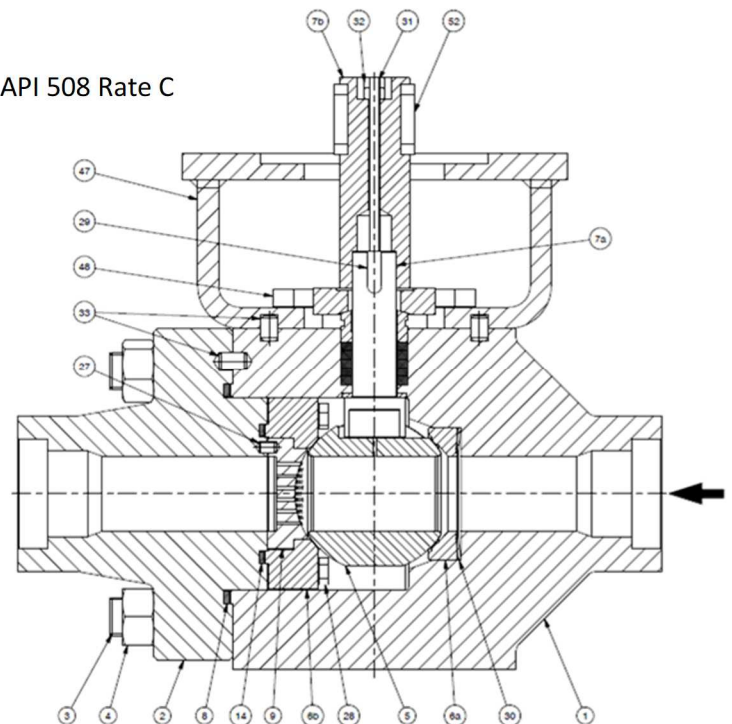
- 3-pieces or 2-pieces bolted body
- Single seat for reduced friction and operating torques
- Double seat available for DBB-1 and DBB-2 optional functions (Double-Block and Bleed).
- Fire Safe design API 607 / 6FA
- Blowout-proof ball seat and stem construction
- Standard ASME Materials and NACE, EN and other materials available on request
- High Performance Sealing
- Packing with live loading available
- Antistatic device
- Locking device
- Leakage Class up to IEC 60534-4 Cl.V and API 508 Rate C



*Cryogenic Trunnion Ball Valve*



*Low-Noise Control Ball with Limiphon® Trim*



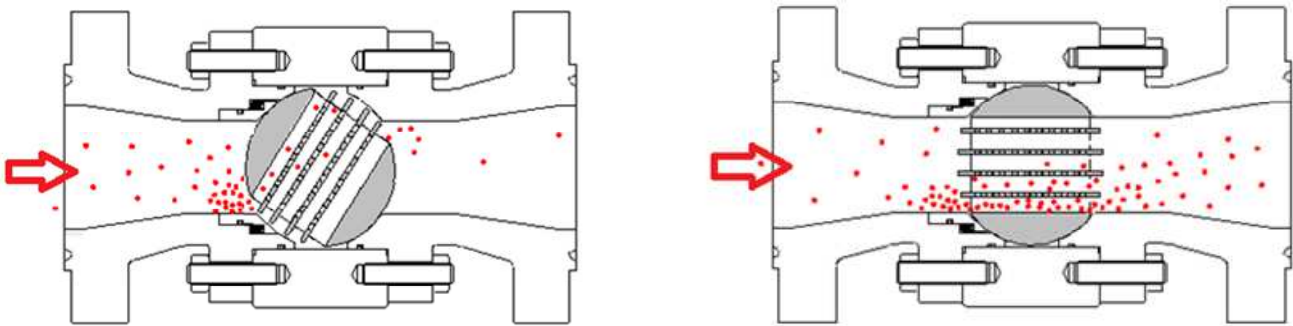
*High Temperature Control Ball valve*

## SPECIAL FEATURES:

- SELF CLEANING Design
- Advanced SEAT PROTECTION design
- DIRTY FLUIDS applications
- Fully CUSTOMIZED DESIGN

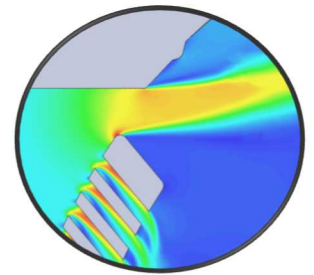
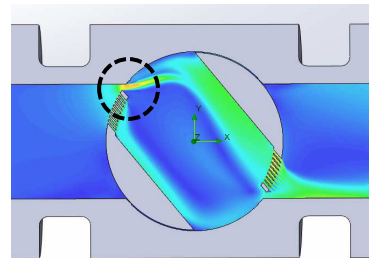
## SELF CLEANING

This special design allows to clean even multistage trims from debris just fully opening the valve.



## SEAT PROTECTION

Seat is protected by flow especially at the very beginning of opening thanks to this special design where the sealing surfaces are in a "shadow-zone" where fluid cannot damage them.



*Seat protected from direct flow impingement*

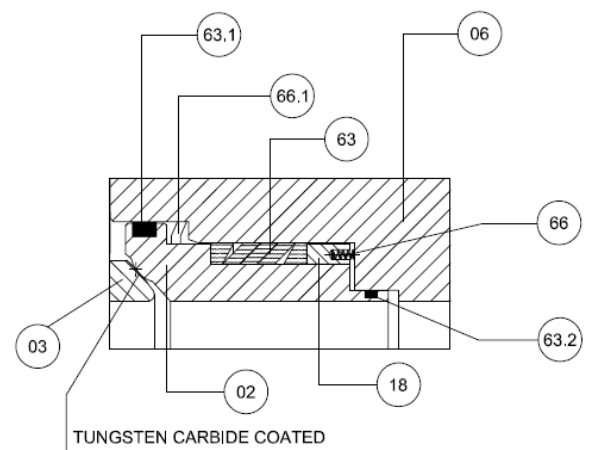
## DIRTY FLUIDS and SOLIDS

Special design for dirty fluids by means of protecting scrapers (63.1 and 63.2) on upstream/downstream section of valve seats (02).

Double spring system (66 and 66.1) to improve seat recovering before and after pressurization.

Main seat gaskets with special design to reduce frictions whit low pressure drops and increasing sealing properties when the valve is pressurized.

Metal seats sealing surfaces are hardened to improve resistance to impingement and scratches due to solid particles.



### Cv TABLES for CONTROL VALVES 4-4001-2 SERIES

4-4001 – STANDARD BALL VALVE (Cv) – up to 600#												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
2	0	5	11	18	29	47	72	104	162	245	313	<b>360</b>
3	0	16	31	52	83	135	207	300	466	704	900	<b>1035</b>
4	0	29	58	97	156	253	389	564	875	1323	1692	<b>1945</b>
6	0	70	139	232	371	603	927	1344	2086	3152	4032	<b>4635</b>
8	0	132	264	439	703	1142	1757	2548	3954	5974	7644	<b>8786</b>
10	0	214	428	714	1142	1856	2856	4141	6426	9710	12424	<b>14280</b>
12	0	328	656	1093	1748	2841	4370	6337	9833	14858	19010	<b>21850</b>
14	0	362	723	1205	1928	3133	4820	6989	10845	16388	20967	<b>24100</b>
16	0	493	986	1643	2628	4271	6570	9527	14783	22338	28580	<b>32850</b>
18	0	658	1316	2193	3508	5701	8770	12717	19733	29818	38150	<b>43850</b>
20	0	847	1694	2823	4517	7340	11292	16373	25407	38393	49120	<b>56460</b>
24	0	1219	2438	4064	6502	10566	16256	23571	36576	55270	70714	<b>81280</b>
FL	0.780	0.780	0.780	0.832	0.884	0.894	0.874	0.829	0.775	0.706	0.637	0.580
XT	0.500	0.500	0.500	0.653	0.723	0.727	0.677	0.581	0.462	0.352	0.259	0.180
XFZ	0.417	0.417	0.417	0.456	0.477	0.458	0.401	0.326	0.252	0.184	0.115	0.085

4-4002 – V-PORT (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
2	0.0	0.0	0.0	0.5	2.8	6.8	13.5	23.8	41.0	67.7	115.3	<b>210.0</b>
3	0.0	0.0	0.0	2.4	8.3	18.3	34.1	58.5	98.8	158.8	266.6	<b>475.0</b>
4	0.0	0.0	0.0	4.0	14.7	32.5	61.2	105.4	178.5	287.8	484.1	<b>865.0</b>
6	0.0	0.0	0.0	13.1	39.6	82.5	149.5	252.5	420.9	666.2	1108.8	<b>1950</b>
8	0.0	0.0	0.9	27.3	76.9	156.2	278.4	465.9	771.1	1210.6	2004.6	<b>3500</b>
10	0.0	0.0	10.7	58.1	142.4	274.7	473.2	777.7	1266.0	1954.3	3200.1	<b>5500</b>
12	0.0	0.0	0.0	36.8	127.2	277.1	515.8	883.4	1490.4	2390.5	4010.0	<b>7135</b>
14	0.0	0.0	18.1	100.9	248.7	480.7	829.0	1363.4	2221.0	3430.7	5620.0	<b>9665</b>
16	0.0	0.0	21.4	129.6	324.2	630.1	1090.9	1797.9	2934.4	4541.4	7449.5	<b>12835</b>
18	0.0	0.0	15.6	139.0	366.9	727.6	1276.6	2119.3	3481.7	5424.2	8937.3	<b>15495</b>
20	0.0	0.0	6.5	151.8	425.1	861.3	1532.8	2563.7	4240.0	6651.6	11009.3	<b>19210</b>
24	0.0	0.0	86.8	367.0	846.0	1591.2	2694.9	4387.3	7078.5	10834.4	17632.0	<b>30050</b>
FL	0.780	0.780	0.780	0.832	0.884	0.894	0.874	0.829	0.775	0.706	0.637	0.580
XT	0.500	0.500	0.500	0.653	0.723	0.727	0.677	0.581	0.462	0.352	0.259	0.180
XFZ	0.417	0.417	0.417	0.456	0.477	0.458	0.401	0.326	0.252	0.184	0.115	0.085

### Cv TABLES for CONTROL VALVES 4-4003 SERIES

4-4003 ST-L – DRILLED BALL LINEAR (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
2	0.0	0.0	0.0	0.1	1.0	2.7	5.5	9.5	15.0	22.5	32.9	<b>47</b>
3	0.0	0.0	0.0	0.6	3.1	7.5	14.0	23.1	35.6	52.7	75.7	<b>106</b>
4	0.0	0.0	0.0	0.9	5.4	13.4	25.3	41.9	64.8	96.0	138.2	<b>195</b>
6	0.0	0.0	0.0	4.7	16.8	36.3	64.1	102.1	153.7	223.1	315.5	<b>438</b>
8	0.0	0.0	0.0	8.4	30.2	65.2	115.0	183.4	276.0	400.5	566.4	<b>785</b>
10	0.0	0.0	1.0	18.1	55.2	112.1	191.9	300.3	445.9	640.1	897.1	<b>1234</b>
12	0.0	0.0	1.2	25.5	78.6	160.7	275.8	432.5	643.0	923.9	1296.1	<b>1784</b>
14	0.0	0.0	1.5	31.4	96.3	196.1	336.1	526.5	782.3	1123.5	1575.4	<b>2168</b>
16	0.0	0.0	2.6	43.6	130.6	263.9	450.5	703.7	1043.6	1496.5	2095.7	<b>2881</b>
18	0.0	0.0	2.7	53.6	164.0	334.2	572.8	897.2	1333.1	1914.7	2684.8	<b>3695</b>
20	0.0	0.0	2.4	63.0	198.8	409.6	706.3	1110.4	1654.2	2380.8	3344.3	<b>4610</b>
24	0.0	0.0	4.6	96.4	297.2	607.2	1042.3	1634.0	2429.5	3491.3	4897.6	<b>6742</b>
FL	0.940	0.940	0.940	0.940	0.926	0.904	0.876	0.844	0.814	0.787	0.765	0.752
XT	0.827	0.827	0.827	0.826	0.800	0.735	0.648	0.555	0.477	0.425	0.403	0.393
XFZ	0.804	0.804	0.804	0.804	0.794	0.750	0.696	0.638	0.584	0.540	0.513	0.511

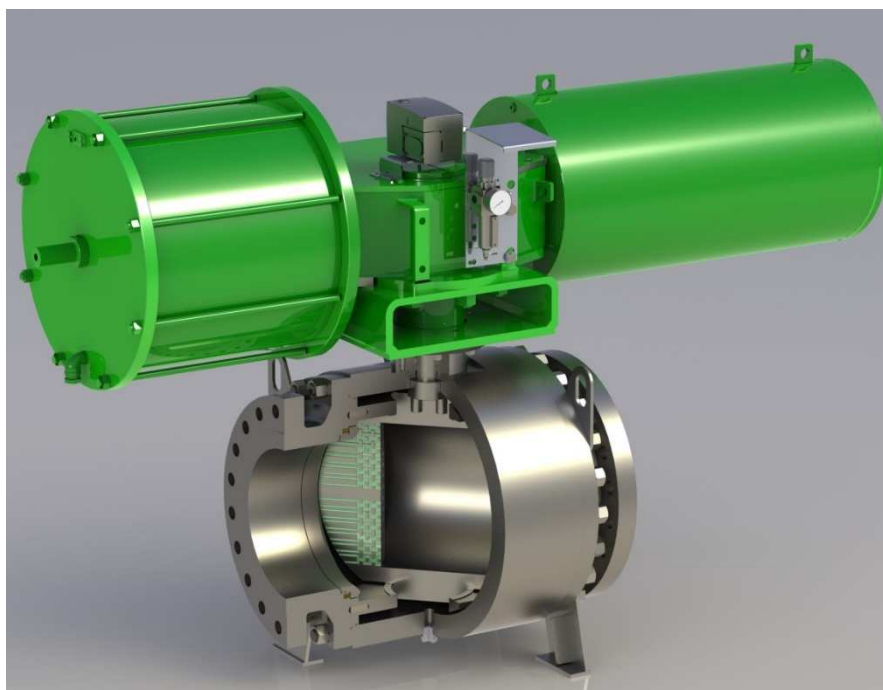
4-4003 ST-E – DRILLED BALL EQUALPERCENTAGE (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
2	0.0	0.0	0.0	0.1	1.4	3.9	7.9	13.5	21.4	32.2	47.0	<b>67.0</b>
3	0.0	0.0	0.0	0.8	4.4	10.7	20.0	33.0	50.9	75.3	108.1	<b>152.0</b>
4	0.0	0.0	0.0	1.3	7.7	19.2	36.1	59.9	92.6	137.1	197.4	<b>278.0</b>
6	0.0	0.0	0.0	6.7	24.0	51.9	91.5	145.9	219.6	318.7	450.7	<b>625.0</b>
8	0.0	0.0	0.0	12.0	43.1	93.1	164.3	262.0	394.3	572.1	809.1	<b>1122</b>
10	0.0	0.0	1.4	25.9	78.8	160.1	274.1	429.0	637.0	914.4	1281.6	<b>1763</b>
12	0.0	0.0	1.7	36.4	112.3	229.5	394.0	617.8	918.5	1319.9	1851.6	<b>2549</b>
14	0.0	0.0	2.2	44.9	137.5	280.1	480.1	752.1	1117.5	1605.0	2250.5	<b>3097</b>
16	0.0	0.0	3.7	62.3	186.6	377.0	643.5	1005.3	1490.8	2137.9	2993.8	<b>4115</b>
18	0.0	0.0	3.8	76.6	234.3	477.4	818.3	1281.7	1904.4	2735.3	3835.4	<b>5278</b>
20	0.0	0.0	3.4	90.0	284.0	585.2	1009.0	1586.3	2363.1	3401.2	4777.6	<b>6585</b>
24	0.0	0.0	6.5	137.7	424.5	867.4	1489.0	2334.3	3470.7	4987.5	6996.6	<b>9632</b>
FL	0.940	0.940	0.940	0.940	0.926	0.904	0.876	0.844	0.814	0.787	0.765	0.752
XT	0.827	0.827	0.827	0.826	0.800	0.735	0.648	0.555	0.477	0.425	0.403	0.393
XFZ	0.804	0.804	0.804	0.804	0.794	0.750	0.696	0.638	0.584	0.540	0.513	0.511



## Cv TABLES for CONTROL VALVES 4-4003 SERIES

4-4003 LN-L – DRILLED BALL - LOW NOISE LINEAR (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
2	0.0	0.0	0.0	0.1	1.3	4.2	8.7	14.5	21.5	29.1	35.6	<b>40.0</b>
3	0.0	0.0	0.0	1.1	5.1	12.6	23.1	36.6	52.3	70.0	86.8	<b>97.0</b>
4	0.0	0.0	0.0	1.7	8.9	22.8	42.0	66.7	96.1	128.9	160.7	<b>181.0</b>
6	0.0	0.0	0.0	7.6	30.9	65.5	110.7	167.4	233.5	305.8	378.9	<b>422.0</b>
8	0.0	0.0	0.0	13.0	55.3	115.6	197.3	299.1	417.2	546.5	676.0	<b>760.0</b>
10	0.0	0.0	2.1	34.1	104.6	200.6	328.4	484.6	665.4	861.8	1059.6	<b>1188</b>
12	0.0	0.0	0.0	27.4	121.9	256.8	440.3	668.9	934.5	1225.3	1518.7	<b>1710</b>
14	0.0	0.0	0.0	32.4	141.0	301.9	511.6	774.9	1081.7	1418.3	1760.3	<b>1977</b>
16	0.0	0.0	5.0	84.2	254.2	487.2	783.7	1157.0	1583.7	2059.2	2524.5	<b>2829</b>
18	0.0	0.0	0.0	19.1	134.2	365.9	690.7	1114.1	1616.1	2164.5	2726.1	<b>3113</b>
20	0.0	0.0	5.4	125.3	388.6	759.3	1248.5	1849.1	2541.9	3303.4	4051.4	<b>4569</b>
24	0.0	0.0	2.1	104.8	457.3	951.4	1616.0	2453.4	3420.2	4479.1	5544.2	<b>6282</b>
FL	0.913	0.913	0.913	0.911	0.896	0.872	0.846	0.827	0.817	0.811	0.807	0.805
XT	0.780	0.780	0.780	0.777	0.750	0.685	0.605	0.533	0.480	0.451	0.450	0.450
XFZ	0.777	0.777	0.777	0.775	0.749	0.704	0.658	0.628	0.599	0.582	0.575	0.572

**Note:** Also available as Equal%



**4-4009 Limiphon® Ball valve – Customized multi-stage / Multi-Path trim for low-noise and ant cavitation services.**

## Cv TABLES for CONTROL VALVES 4-4005 SERIES

4-4005 T01 – DRILLED PLATES MULTISTAGE WITH BALL EXPANSION (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
6	0.0	0.0	1.1	28.6	47.6	65.0	87.6	127.7	205.2	354.5	631.0	1110
8	0.0	0.0	2.0	51.5	85.6	116.9	157.4	229.4	368.9	637.2	1134.2	1995
10	0.0	0.0	13.8	92.6	142.6	191.5	257.5	376.5	602.6	1030.2	1809.6	3140
12	0.0	0.0	18.6	132.7	205.4	275.9	371.3	542.7	869.0	1487.1	2615.6	4545
14	0.0	0.0	23.2	158.6	244.4	328.6	441.3	645.8	1033.7	1767.9	3107.0	5395
16	0.0	0.0	34.5	214.8	328.4	439.7	591.3	865.1	1383.8	2363.9	4145.7	7185
18	0.0	0.0	39.8	272.0	419.0	563.3	756.7	1107.2	1772.3	3031.2	5327.1	9250
20	0.0	0.0	40.5	332.1	518.3	698.8	939.5	1373.4	2200.6	3770.7	6644.7	11570
24	0.0	0.0	69.6	495.8	767.5	1030.7	1387.3	2027.4	3246.6	5555.9	9772.0	16980
FL	0.805	0.805	0.859	0.976	0.982	0.962	0.913	0.837	0.765	0.699	0.643	0.600
XT	0.619	0.619	0.714	0.938	0.938	0.881	0.783	0.637	0.458	0.326	0.259	0.225
XFZ	0.393	0.393	0.477	0.629	0.614	0.554	0.479	0.392	0.315	0.257	0.226	0.176

4-4005 T02 – DRILLED PLATES MULTISTAGE (Cv)												
DN / %Opening	0	5	10	20	30	40	50	60	70	80	90	100
6	0.0	0.0	0.9	17.1	45.5	72.3	97.4	135.4	219.5	380.3	719.1	1185
8	0.0	0.0	1.5	30.7	81.7	129.9	175.1	243.3	394.6	683.6	1292	2130
10	0.0	0.0	10.4	62.0	143.2	212.4	286.8	395.5	647.2	1104.6	2061	3350
12	0.0	0.0	13.9	87.7	205.0	306.0	413.1	570.1	932.2	1593.4	2977	4845
14	0.0	0.0	17.4	106.5	247.3	367.9	496.8	685.3	1121.1	1914.9	3575	5815
16	0.0	0.0	26.0	146.8	334.3	492.8	665.6	917.3	1502.3	2560.6	4772	7745
18	0.0	0.0	29.8	182.1	422.9	629.3	849.6	1172.1	1917.4	3275.0	6115	9945
20	0.0	0.0	31.3	216.8	517.5	780.0	1052.7	1454.2	2375.0	4068.3	7616	12420
24	0.0	0.0	52.4	329.4	770.3	1149.7	1552.2	2142.1	3502.7	5987.1	11186	18205
FL	0.880	0.880	0.882	0.914	0.934	0.940	0.937	0.920	0.888	0.834	0.730	0.640
XT	0.740	0.740	0.746	0.827	0.848	0.846	0.827	0.773	0.629	0.469	0.333	0.256
XFZ	0.470	0.470	0.478	0.561	0.559	0.534	0.507	0.474	0.427	0.368	0.291	0.200

## MATERIALS for PRESSURE CONTAINMENT PARTS

Some examples of Standard material selection and combination

T Range		CARBON	LOW TEMP	INOX	DUPLEX	NACE CARBON	NACE SS
		-29 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C
ITEM	PART NAME						
1	BODY (1)	SA 105	SA 350 LF2 cl.1	SA 182 F316	SA 182 F51 (6)	SA 350 LF2 cl.1 22HRC max	SA 182 F316 22HRC max
2	CLOSURE	SA 105	SA 350 LF2 cl.1	SA 182 F316	SA 182 F51 (6)	SA 350 LF2 cl.1 22HRC max	SA 182 F316 22HRC max
3	BOLT	SA 193 B7	SA 320 L7	SA 320 L7 (5)	SA 193 B7	SA 320 L7M	SA 320 L7M (5)
4	NUT	SA 194 2H	SA 194 7	SA 194 7 (5)	SA 194 2H	SA 194 7M	SA 194 7M (5)
9	BALL SUPPORT (2)	EN 10025 S355 J2	EN 10025 S355 J2	A 240 316	A 240 S31803	A 516 70 22HRC max	A 240 316 22HRC max
10	GASKET	O-RING or LIP-SEAL (4)					
11	FIRE SAFE GASKET	FLEXIBLE GRAPHITE					
13	SCREW	SA 193 B7	SA 320 L7	SA 320 L7 (5)	SA 193 B7	SA 320 L7M	SA 320 L7M (5)
18	BOTTOM FLANGE (2)	SA 105	SA 350 LF2 cl.1	SA 182 F316	SA 182 F51	SA 350 LF2 cl.1 22HRC max	SA 182 F316 22HRC max
19	SCREW	SA 193 B7	SA 320 L7	SA 320 L7 (5)	SA 193 B7	SA 320 L7M	SA 320 L7M (5)
20	PIN (2)	A 322 4140	A 322 4140	A 564 630 H1150	A 479 XM-19 H	A 322 4140	A 564 630 H1150M
21	PIN	AISI 304	AISI 304	AISI 304	AISI 304	AISI 304	AISI 304
23	LIFTING LUG	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2
24	VALVE SUPPORT	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2
27	WASHER (2)	CARBON STEEL + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES	INCONEL 625 + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES
28	BEARING	CARBON STEEL + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES	INCONEL 625 + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES
29	SCREW	SA 193 B7	SA 320 L7	SA 320 L7 (5)	SA 193 B7	SA 320 L7M	SA 320 L7M (5)
30	OPERTOR FLANGE (3)	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2	EN 10025 S355 J2
31	BODY COVER	SA 105	SA 350 LF2 cl.1	SA 182 F316	SA 182 F51	SA 350 LF2 cl.1 22HRC max	SA 182 F316 22HRC max
32	PIN	A 322 4140	A 322 4140	A 564 630 H1150	A 479 XM-19 H	A 322 4140	A 564 630 H1150M
33	WASHER	CARBON STEEL + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES	INCONEL 625 + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES
34	BEARING	CARBON STEEL + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES	INCONEL 625 + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES
35	FIRE SAFE GASKET	FLEXIBLE GRAPHITE					
37	GASKET	O-RING or LIP-SEAL (4)					
39	BEARING (2)	CARBON STEEL + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES	INCONEL 625 + PTFE FIBRES	CARBON STEEL + PTFE FIBRES	AISI 316L + PTFE FIBRES
48	SCREW	SA 193 B7	SA 193 B7	SA 193 B7	SA 193 B7	SA 193 B7	SA 193 B7
50	YOKE	A 516 70	A 516 70	A 516 70	A 516 70	A 516 70	A 516 70
51	DRAIN / VENT PLUG	AISI 304	AISI 304	AISI 304	AISI 304	AISI 304	AISI 304

## MATERIALS for TRIMS

TRIM CLASS		13Cr ALLOY	STAINLESS STEEL				NACE	
		01	02	03	04	05	06	
Temperature range		-29 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	-46 / + 200 °C	
ITEM	PART NAME							
5	BALL	A 182 F6a cl.2	A 182 F316 (11)	A 182 F51 (12)	A 182 F53 (13)	A 182 F6a cl.2 22HRC max	A 182 F316 22HRC max	
5A	CAGE (14)	A 240 410	A 240 316 (15)	A 240 S31803	A 240 S32550	A 240 410 22HRC max	A 240 316 22HRC max (15)	
6	SEAT	A 182 F6a cl.2	A 182 F316	A 182 F51	A 182 F53	A 182 F6a cl.2 22HRC max	A 182 F316 22HRC max	
7	STEM	A 564 630 H1150	A 564 630 H1150	A 479 S31803	A 479 S32550	A 564 630 H1150M	A 564 630 H1150M	
8	GASKET	O-RING or LIP-SEAL (4)						
12	STEM PIN	A 564 630 H1150	A 564 630 H1150	A 479 S31803	A 479 S32550	A 564 630 H1150M	A 564 630 H1150M	
14	SPRING	INCONEL X-750				INCONEL 718		
17	LOWER TRUNNION (2)	A 182 F6a cl.2	A 182 F316	A 479 S31803	A 479 S32550	A 182 F316 22HRC max	A 182 F6a cl.2 22HRC max	
47	TONGUE	A 564 630 H1150	A 479 S41500	A 479 S31803	A 479 S32550	A 564 630 H1150M	A 564 630 H1150M	

## METAL SEAT TREATMENTS

SEALING CODE	Ni-SiC Nickel-Silicon Carbide	TCC Tungsten Carbide	CCC Chromium Carbide
TYPE	Metal	metal	metal
Temperature range	-46°C / + 450°C	-46 / + 190 °C	-46 / + 400 °C
Thickness	Up to 0.05 mm	Up to 0.40 mm	Up to 0.40 mm
Hardness	Up to 1200 HV	Up to 1200 HV	Up to 1100 HV
Max IEC 60534 leakage class	V	V (16)	V (16)
Max ISO 5208 leak rate	C	C	C
<b>PART NAME</b>			
Ball/Seat Coating	Nickel Plating	Tungsten carbide	Chromium carbide
Treatment	Auto-catalytic Reaction (bath)	Thermal spray process	Thermal spray process



### NOTES:

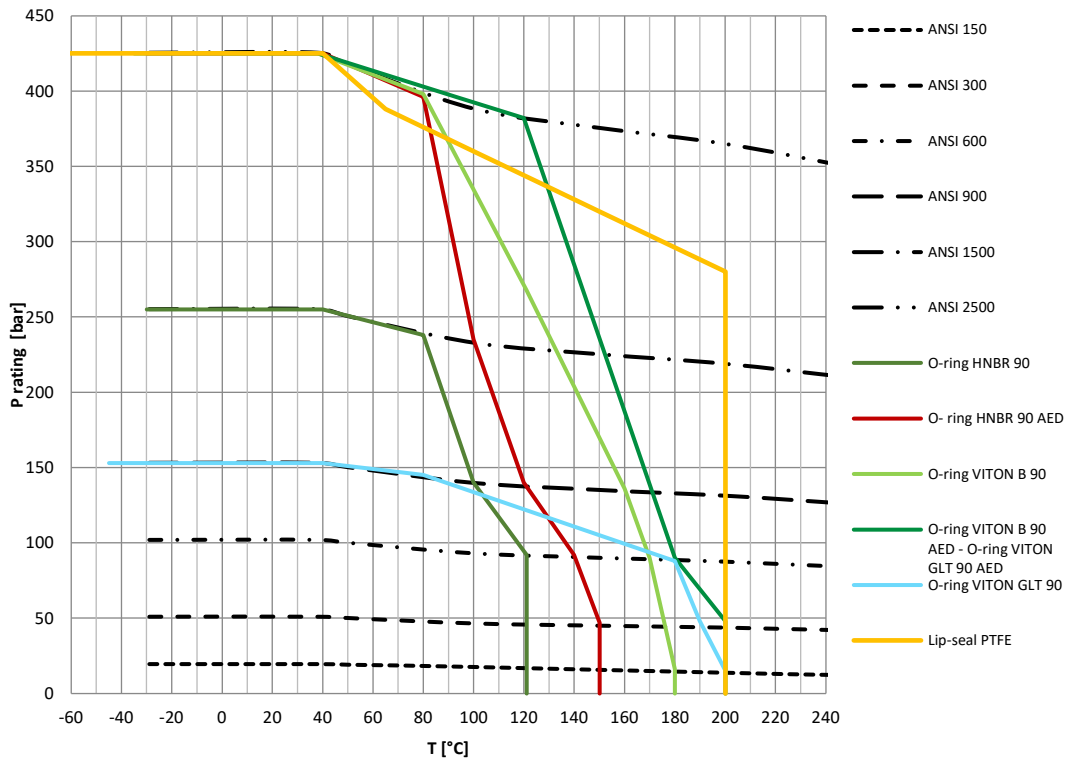
- (1) See body design table: primary body design (flanged body + 1 closure) or split body design (body + 2 closures).
- (2) See trunnion design table: (9), (20) and (27) applicable for support plates design, (17), (18) and (39) applicable for internal trunnion.
- (3) Applicable in case of V-pack.
- (4) See gasket chart for pressure-temperature limitations.
- (5) SA 193 B8M cl.2 and SA 194 8M available as alternative.
- (6) SA 105 + INC 625 overlay as alternative, to be evaluated over DN 20".
- (11) A351 CF3M centrifugally spun as alternative for ANSI 150 and 300, to be evaluated over DN 20".
- (12) A890 4A centrifugally spun as alternative as alternative for ANSI 150 and 300, to be evaluated over DN 20".
- (13) A890 5A centrifugally spun as alternative as alternative for ANSI 150 and 300, to be evaluated over DN 20".
- (14) Applicable for 4-4215 series; for all the other models the trim is made of the same material of the ball.
- (15) Material available up to 5 bar of max operative pressure drop.  
Otherwise consider A693 630 H1150M.
- (16) Class VI available up to DN 10" with extensive lapping activity.

## MAST TABLE

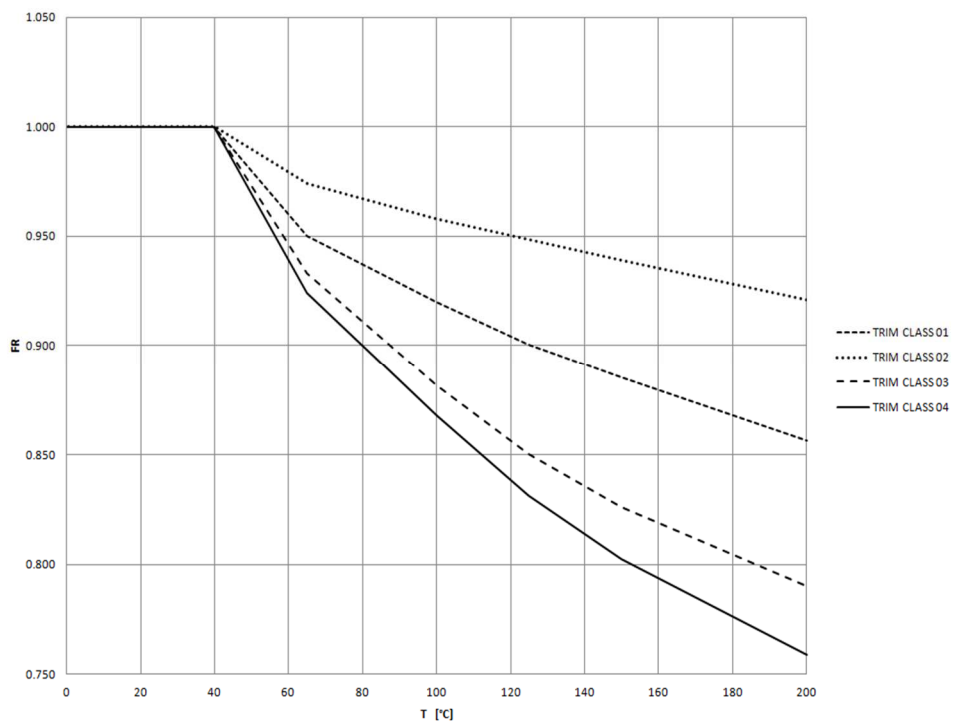
MAST [Nm] at ambient Temp.		RATING		
TRIM CLASS (22)	DN	ANSI 150	ANSI 300	ANSI 600
01	2"	678	678	957
02		582	582	821
03		420	420	592
04		517	517	730
01	3"	1334	1334	1673
02		1144	1144	1435
03		825	825	1035
04		1017	1017	1276
01	4"	1334	1334	2153
02		1144	1144	1847
03		825	825	1333
04		1017	1017	1642
01	6"	4516	4516	7438
02		3874	3874	6380
03		2795	2795	4603
04		3443	3443	5671
01	8"	12456	12456	13590
02		10684	10684	11657
03		7708	7708	8409
04		9497	9497	10362
01	10"	12456	12456	17687
02		10684	10684	15171
03		7708	7708	10945
04		9497	9497	13485
01	12"	16408	16408	24011
02		14074	14074	20595
03		10153	10153	14857
04		12510	12510	18307
01	14"	24011	24011	35253
02		20595	20595	30238
03		14857	14857	21814
04		18307	18307	26878
01	16"	28407	28407	68058
02		24366	24366	58375
03		17578	17578	42113
04		21658	21658	51889
01	18"	39425	39425	89603
02		33816	33816	76856
03		24395	24395	55445
04		30058	30058	68316
01	20"	68058	68058	106160
02		58375	58375	91057
03		42113	42113	65690
04		51889	51889	80940
01	24"	89603	89603	145096
02		76856	76856	124454
03		55455	55455	89783
04		68316	68316	110626



## GASKET CHART



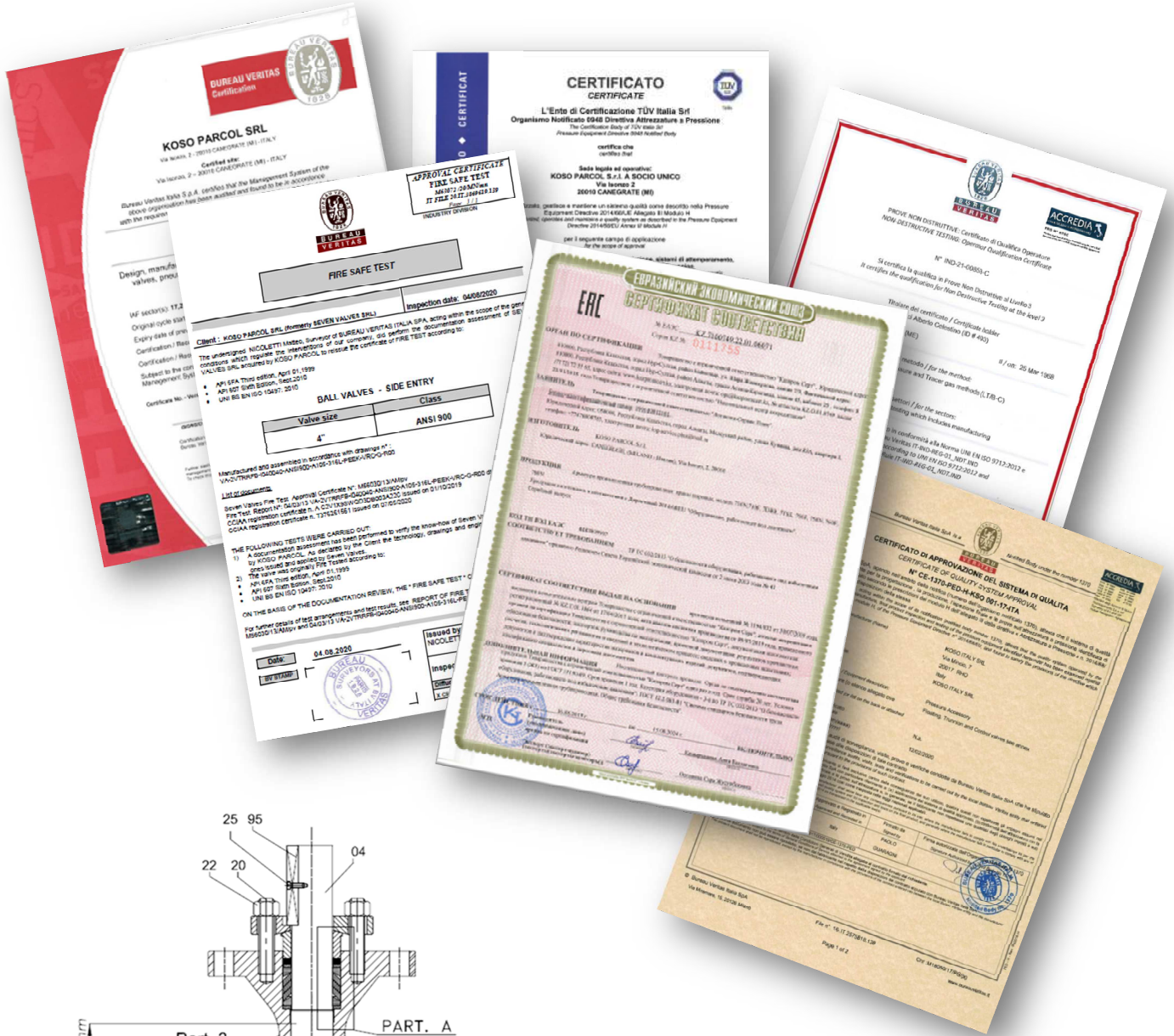
## MAST vs TEMPERATURE REDUCTION FACTOR



## ACTUATORS

Type	Pneumatic ball valves	Electric ball valves	Electro-hydraulic ball valves
<b>Speed</b>	Typically fast / medium dynamic	Typically slow / very low dynamic	High speed and dynamic achievable
<b>Stiffness</b>	Low, due to gas compressibility at low	High due to mechanical transmission geometry	High due to hydraulic oil incompressibility
<b>Accuracy</b>	Precision issues (without positioner) could be caused only by air leaks and pressure fluctuations.	Valve positioning is extremely accurate if the actuator is well selected. Accurate electrical signals result in accurate valve positioning.	Valve positioning is extremely accurate if hydraulic system and actuator are well designed.
<b>Energy consumption</b>	Consumed energy is due to air compression system. (Could be high)	Lower energy consumption compared to compressed air system energy (electric motor).	Energy consumption is related to stroking time, pressure and oil volume (generally limited).
<b>Cost</b>	Lower initial cost, higher operating cost.	Higher initial cost, lower operating cost.	Moderate initial cost (only actuator), lower operating cost.
<b>Fail-safe</b>	Easier and cheap.	Complex and Expensive.	Generally easy or not too complex with affordable costs.
<b>Size/torque range</b>	lower torque-to-size ratio.	higher torque-to-size ratio.	Actuators are very small but HPU can be big depending on oil volume and pressures/flow
<b>Operating conditions</b>	Can operate in moderate pressure and temperature conditions (including ATEX)	Can operate in moderate pressure and temperature conditions (standard design, including ATEX)	Can operate properly with high temperature and pressure (including ATEX)
<b>Maintainability</b>	Simple mechanism, limited number of components, easy to maintain.	Complex mechanism that sometimes requires a skilled technician	Complex mechanism that sometimes requires a skilled technician
<b>Life span</b>	Life span is variable with operating but generally not extremely long.	More complex components but still easy to maintain. Typical life span is quite long.	The actuator is simple, the hydraulic unit is extremely complex. Life-span is generally very long.
<b>Electromagnetic interference</b>	No disturbances considering only the actuator.	May experience signal disturbances only if not properly designed	May experience signal disturbances only if not properly designed
<b>Modulating control</b>	Recommended for modulating and control service	Very efficient for modulation and control	Extremely efficient for modulation and control
<b>Weight</b>	Lightweight	Generally heavier than pneumatic	Actuators are light. HPU can be very big depending on Power and oil volume.

## CERTIFICATES



## MAIN CERTIFICATIONS

- ISO 9001
- PED
- SIL3 Capable
- ATEX
- FIRE SAFE DESIGN
- TR CU 032, 012, 010
- FUGITIVE EMISSION / TA-LUFT