

VSU SERIES 3-5403 PRESSURE SAFETY RELIEF VALVES



Parcol 3-5483 tested on air (above) and on water (left).
[Laboratories of Fluid-dynamics of turbomachines, Energy Department, Politecnico di Milano, Italy]

The new series VSU 3-5403 universal pressure safety relief valves represents the third step in evolution of the first series 3-5401 dated 1989. The new series geometry is moulded by demanding experimental tests campaign supported by CFD and FEM analyses. Experimental tests, both on compressible (air) and incompressible (water) fluids, with and without back pressure, were performed according to PED requirements (standard ISO 4126-1 and working draft ISO 4126-11).

With respect to previous series VSU 3-5402, the new series still provides high quality overpressure protection *with the same valve* on gas, steam, vapour, liquid and two-phase mixtures services and, in addition, *offers dramatic improvement* of discharge flow rates under back pressure conditions.

Features and benefits

- PED marking
- full nozzle design, threaded at top, ensures better nozzle/body alignment
- internal body shape, design and dimensions are particularly studied to reduce built-up back pressure and to avoid damages to balanced bellows during fluid discharge
- excellent body drain for any application
- orifice areas fully meet the interchangeability criteria as per standard API 526.

Options

On request all valves can be equipped with soft-seal, sealing surface washing, nozzle and/or body washing and/or jacketing, lifting lever and test gag. Auxiliary balanced piston and/or bellows protection can be supplied on balanced bellows valves.

Also available on request:

- ATEX marking
- special materials (included compliance to standard NACE MR0175)
- valve sizing according to standard API 520 Part I (using API 520 coefficients and API 526 effective discharge areas)

VSU SERIES 3-5403 PRESSURE SAFETY RELIEF VALVES

Universal Safety Relief Valves Series 3-5403 are basically designed and manufactured in two versions:

- model 3-5433, conventional type;
- model 3-5483, balanced bellows type.

The conventional type valves are suitable for applications with low built-up back pressure (also in combination with constant superimposed back pressure) while balanced bellows types are specifically designed for high demanding back pressures applications.

When back pressure is present at valve outlet it is well known that discharge capacity can be dramatically influenced and correct valve selection shall be done.

Back pressure can be built-up and/or superimposed (constant, variable or both).

The *built-up back pressure* is the increase in pressure at valve outlet as a result of the opening of the safety valve itself.

The discharge coefficients for 3-5433 type conventional valve with built-up back pressure are given in figure 1.

The discharge coefficients for 3-5483 type valve with balancing bellows and built-up back pressure are the same shown in figure 2 for superimposed back pressure.

The *superimposed back pressure* is the static pressure at the outlet of a pressure relief valve at the time it is required to operate. It is the result of pressure in the discharge system coming from other sources and may be constant or variable.

When back pressure is constant and the safety relief valve is not provided with balanced bellows, it is necessary to decrease the set pressure value of the same amount of back pressure.

When back pressure is variable a 3-5483 type valve with balancing bellows shall be used: the discharge coefficients as function of back pressure are given in figure 2.

The balanced bellows also avoids that highly corrosive, fouling and toxic fluids or high viscous liquids come in contact with sliding parts, spring and bonnet, ensuring longer trouble-free valve life.

Two versions are available for bonnet: open and closed (tight) type. Open bonnet is normally used for valves discharging clean, no toxic fluids (i.e. air and steam) to atmosphere and when the discharge temperature exceeds the temperature limits for spring with closed bonnet. In case of bellows and closed bonnet, this last one is vented to atmosphere through a suitable screwed hole in order to guarantee a correct bellows operation.

TECHNICAL DATA

Model 3-5433 Conventional type

Service	Gas	Liquid	Alternate discharge	Gas/liquid mixture
overpressure (1)	10%	10%	10%	10%
K(2) (3)	0.967	0.751	0.967 / 0.751	(5)
max back pressure (4)	21%	14%	21% / 14%	(5)

Model 3-5483 Balanced bellows type

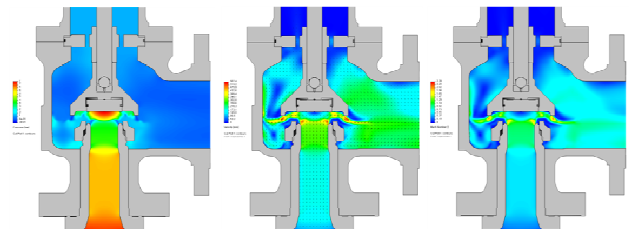
Service	Gas	Liquid	Alternate discharge	Gas/liquid mixture
overpressure (1)	10%	10%	10%	10%
K(2) (3)	0.980	0.789	0.980 / 0.789	(5)
max back pressure (4)	65%	60%	65% / 60%	(5)

- (1) Minimum value = 0.1 bar according to standard ISO 4126-1
- (2) Coefficients of discharge K_D for gas and K_L for liquid (corresponds to K_D of standard ISO 4126-1)
- (3) Value without back pressure. For corrected K values with back pressure refer to figures 1 and 2
- (4) Evaluated as ratio between back pressure and relieving pressure (absolute values for gas; gauge values for liquid)
- (5) According to standard API 520 Part I, Annex C

Blowdown values are within the limits of standards ISO 4126-1 and API 520.
 Minimum set pressures are 0.5 bar for conventional type valves and 1 bar for balanced bellows types.

ORIFICES TABLE

orifice type	flow diameter mm	flow area cm ²	thrust diameter mm	thrust area cm ²	valve minimum lift	
					3-5433 mm	3-5483 mm
F	17	2.27	17.2	2.32	7.5	8.9
G	23.5	4.34	24.3	4.64	10.3	12.3
H	27.7	6.03	28.5	6.38	12.5	14.3
J	36.3	10.3	37.5	11.0	16.1	18.5
K	41.7	13.7	43.5	14.9	18.5	21.3
L	51.9	21.2	54	22.9	23.0	26.5
M	58.2	26.6	60.5	28.7	25.8	29.7
N	63.9	32.1	66.5	34.7	28.3	32.6
P	77.6	47.3	79	49.0	34.4	39.5
Q	102	81.7	105	86.6	45.2	52.0
R	123	118.8	125	122.7	54.6	62.7
T	157	193.6	159	198.6	69.6	80.0



Pressure, velocity and Mach contours in a conventional safety valve during discharge simulation.

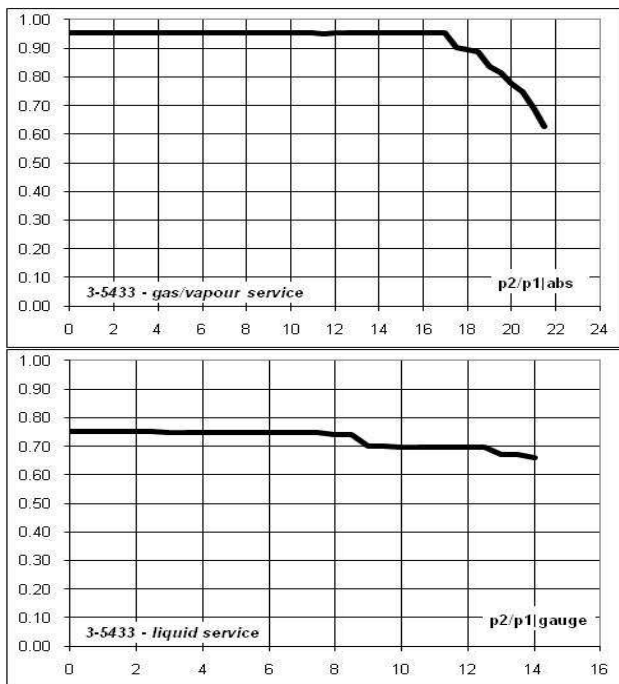


Fig. 1 – Model 3-5433 – K_D and K_L versus built-up back pressure

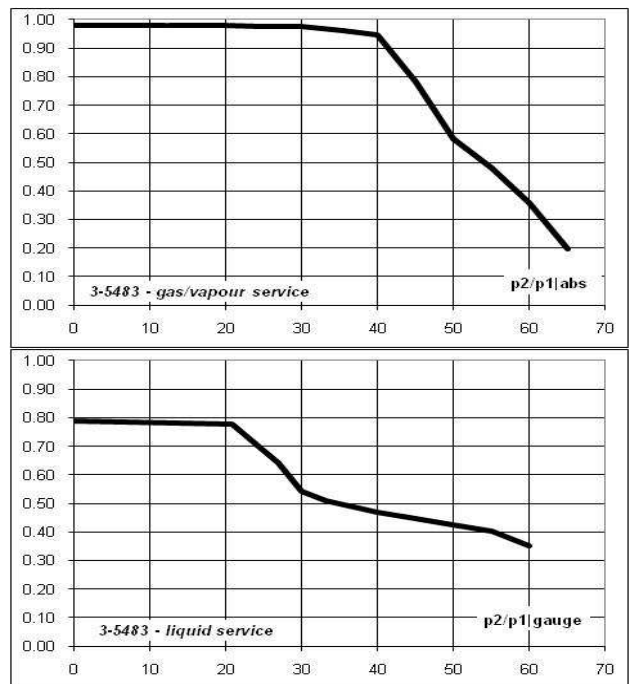
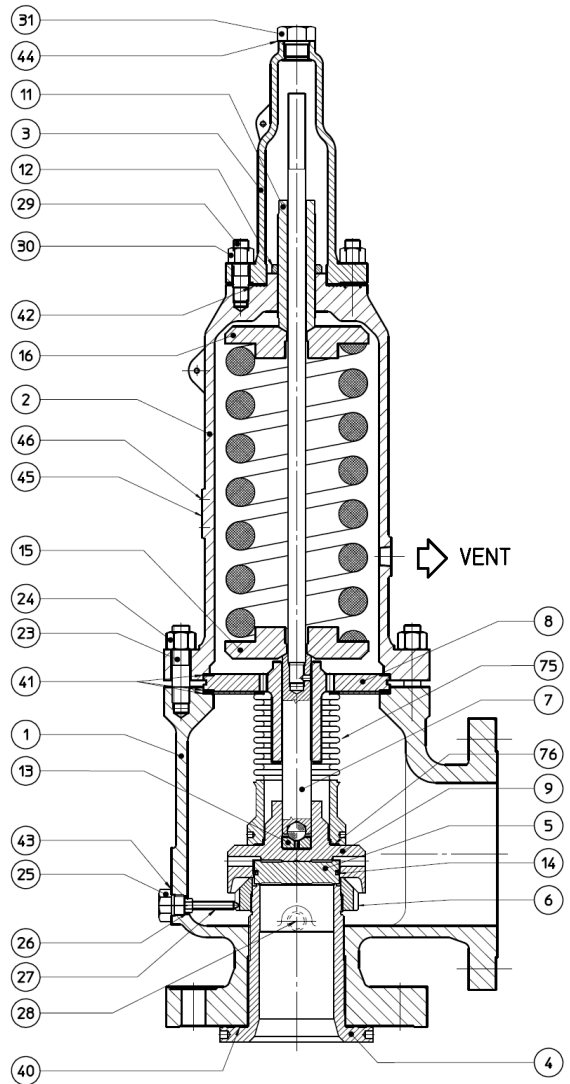
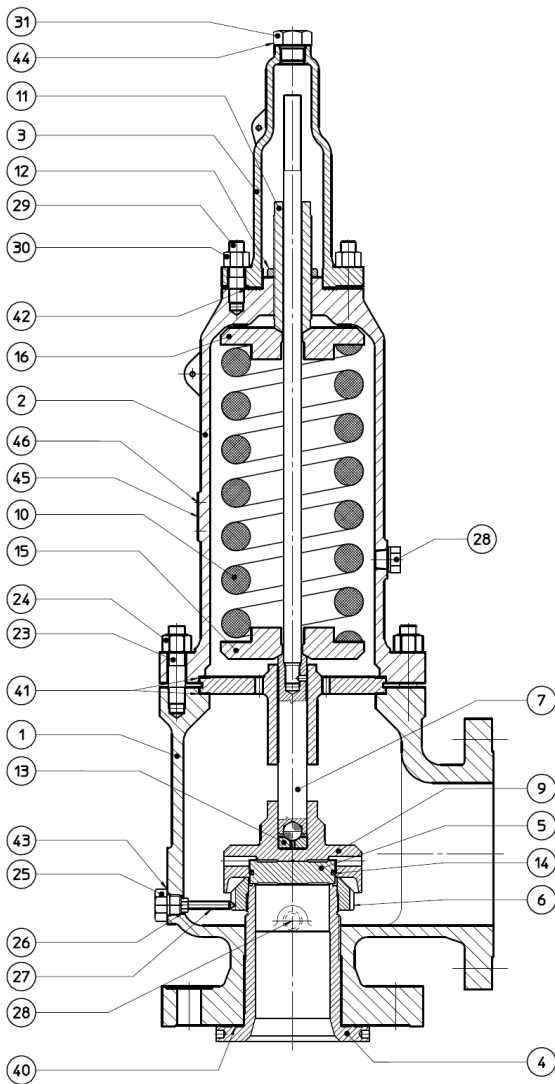


Fig. 2 – Model 3-5483 – K_D and K_L versus superimposed and built-up back pressure

3-5433 CONVENTIONAL TYPE

3-5483 BALANCED BELLOWS TYPE



Item	Part name
1	Body
2	Tight bonnet
3	Cap
4	Nozzle
5	Disc
6	Adjusting ring
7	Stem assembly
8	Guide
9	Disc holder
10	Spring
11	Adjusting screw
12	Lock nut

Item	Part name
13	Pivoting bush
14	Retaining ring
15	Lower spring seat
16	Upper spring seat
23	Body stud
24	Nut
25	Plug
26	Nut
27	Adjusting ring set screw
28	Plug (not shown on body)
29	Bonnet stud
30	Nut

Item	Part name
31	Plug
40	Gasket
41	Gasket
42	Gasket
43	Gasket
44	Gasket
45	Name plate (not shown)
46	Name plate rivet (not shown)
48	Auxiliary piston
75	Bellows
76	Bellows gasket

MAIN FEATURES**BODY**

Construction : cast.

Sizes and rating : see tables. Series according to standard API 526 with ANSI and EN ratings.

Connections : - flanged ANSI and EN. The nozzle raised face has a diameter matching with ANSI and EN standards but is greater in height (see table of dimensions).
 - socket welding ends in accordance with ANSI B 16.5 or screwed in accordance with ANSI B 2.1 up to size 1.1/2" x 3" included.
 - lug type, lens-type seal or other connection type according to Customer's standard available on request.

Jackets : for all valve bodies, jackets with ANSI 150 and PN 16 are available. Inlet and outlet connections are NPT female screwed. Other types are optional (socket weld, flanged).

Washing : optionally, connections are supplied for the washing of the disc and nozzle seating surfaces. Connection may be screwed or socket weld.

NOZZLE

Construction : from bar stock or cast.

Mounting : threaded and positively guided in the body.

Jackets : an inner jacket is provided for fluids which easily solidify. Connections consist of two tapped holes in the nozzle flanges which are thicker than the standard ones.

DISC

Construction : from bar stock.

Coating : Co-Cr hard facing; others on request.

Soft seal : rubber ring. Materials and limitations of use supplied on request.

BONNET

Construction : from bar stock or cast.

Realization : usually tight. Open bonnet for high temperature service or on request.

Mounting : flanged on body.

CAP

Construction : from bar stock or cast.
 Two types: plain or with lifting lever.

Mounting : the plain caps up to 2" x 3" size included are screwed on the bonnet. Other caps are flanged.

Accessories : test gag; open-valve limit switch; plumbing.

DISC HOLDER

Construction : from bar stock or cast.

Mounting : holds the disc by means of an elastic ring in the lower side; holds an hardened bush on which the ball of assembled stem pivots in the upper side.

STAINLESS STEEL BELLOWS

Construction : the upper part of the bellows is welded on a disc clamped between body and bonnet; the lower part of the bellows is welded on a ring nut screwed on the disc holder.

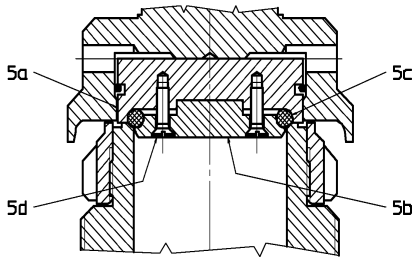
Diameters : the bellows thrust area equals the orifice thrust area listed in table.

Application limits : the maximum temperature for AISI 316L construction is 350 °C.
 The maximum pressure values are the same of standard API 526.
 Specific data are available on request.

Accessories : bellows protection device; auxiliary piston. Supplied on request for particularly heavy operating conditions.

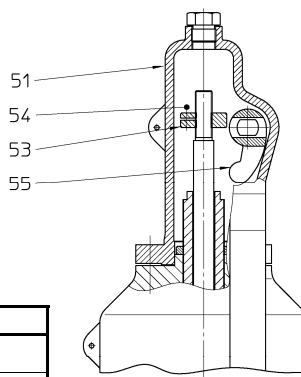
ACCESSORIES and SPARE PARTS

SOFT SEAL

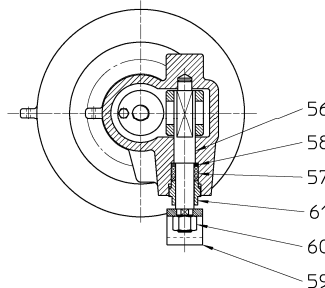


Item	Part name
5a	Disc
5b	Ring locking disc
5c	Sealing ring
5d	Screw

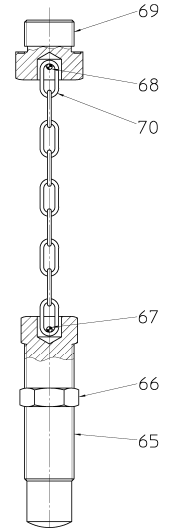
LIFTING LEVER



Item	Part name
51	Manual lift cap
53	Stop disc
54	Screw
55	Fork
56	Fork shaft
57	Packing
58	Packing end ring
59	Lever
60	Nut
61	Packing gland

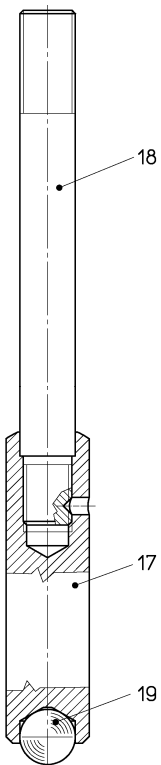


TEST GAG



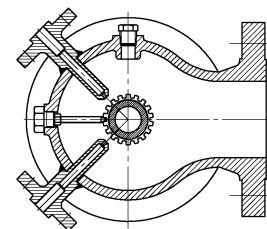
Item	Part name
65	Test gag
66	Nut
67	Dowel
68	Dowel
69	Plug
70	Chain

STEM ASSEMBLY

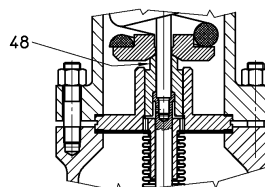


Item	Part name
17	Spindle
18	Stem
19	Ball

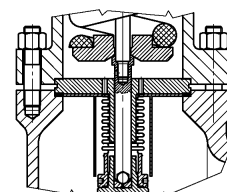
NOZZLE FLUSHING DEVICE



AUXILIARY PISTON

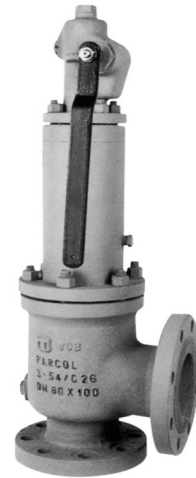


BELLOWS PROTECTION DEVICE



MATERIALS OF CONSTRUCTION

BODY BASIC CLASS	Item	Part name	A	C	D	E	F	G	H	
	1	BODY	SA 216 WCB	SA 217 WC6	SA 217 WC9	SA 217 C5	SA 352 LCB	SA 351 CF8M	SA 351 CF3M	
	4	NOZZLE								
	5	DISC	SEE 1° SUBCLASS TABLE							
	6	ADJUSTING RING	SA 351 CF3M							
	9	DISC HOLDER	S41600 HARDENED 220-280 HB					A 479 316	A 479 316L	
	14	RETAINING RING	SEE 1° SUBCLASS TABLE							
	25	PLUG	SA 479 304							SA 479 316L
	26	NUT	A 479 304							A 479 316L
27	ADJUSTING RING LOCKING SCREW	A 479 304							A 479 316L	
28	PLUG	SA 479 304							SA 479 316L	



Parcol VSU standard construction with lifting lever

BONNET BASIC CLASS	Item	Part name	A	C	D	E	F	G	
	2	BONNET	SA 216 WCB	SA 217 WC6	SA 217 WC9	SA 217 C5	SA 352 LCB	SA 351 CF8M	
	3	CAP	SA 216 WCB						SA 351 CF8M
	8	GUIDE	SEE 1° SUBCLASS TABLE						
	10	SPRING	SEE 2° SUBCLASS TABLE						
	11	ADJUSTING SCREW	S41600 HARDENED 220-280 HB					A 479 316	
	12	LOCK NUT	A 479 304						
	19	PIVOTING BUSH	SEE 1° SUBCLASS TABLE						
	15-16	SPRING SEAT	CARBON STEEL + ZINC COAT					A 479 316	
	17	PUSH ROD	S41600 HARDENED 38 HRC					A 479 XM-19	
	18	STEM	S42000 HARDENED 230-300 HB					A 479 316	
	19	BALL	S42000 HARDENED 50-55 HRC					A 479 316	
	23	BODY STUD	SA 193 B7					SA 193 B8	
	24	NUT	SA 194 4					SA 194 8	
	29	BONNET STUD	SA 193 B7					SA 193 B8	
	30	NUT	SA 194 4					SA 194 8	
	31	PLUG	SA 479 304						
	40-41	GASKETS	T<300°C INORGANIC COMPOUND / T>=300°C GRAPHITE						
	42	CAP GASKET	INORGANIC COMPOUND						
	43-44	GASKETS	A 240 316L						
	45	PLATE	A 240 304						
	46	RIVET	ALUMINIUM						
	48	PISTON	S41600 HARDENED 38 HRC					A 479 XM-19	
	51	MANUAL LIFT CAP	SA 216 WCB						SA 351 CF8M
	53	STOP DISC	CARBON STEEL + ZINC COAT					SA 479 316	
	54	SCREW	8.8 (UNIF EN 20898)					A4 ISO 3506	
	55	FORK	SA 351 CF3M						
	56	FORK SHAFT	S41600 HARDENED 220-280 HB					SA 479 316	
	57	PACKING SEALING RING	FLEXIBLE GRAPHITE						
	58	PACKING END RING	A 479 316						
	59	LEVER	CARBON STEEL + ZINC COAT						
	60	NUT	SA 194 4						
	61	PACKING GLAND	SA 479 316						
65	TEST GAG	CARBON STEEL + ZINC COAT							
66	NUT	CARBON STEEL + ZINC COAT							
67	PIN	A 240 304							
68	PIN	A 240 304							
69	PLUG	A 479 304							
70	CHAIN	NICKEL PLATED CARBON STEEL							
75	BELLOWS	A240 316L							
76	BELLOWS GASKET	T<300°C INORGANIC COMPOUND / T>=300°C GRAPHITE							
81	CENTERING RING	A 564-630 H900							
82	BALL BEARING	CHROMIUM STEEL							
83	UPPER SPRING SEAT	A 564-630 H900							



Parcol VSU with body steam jacketing

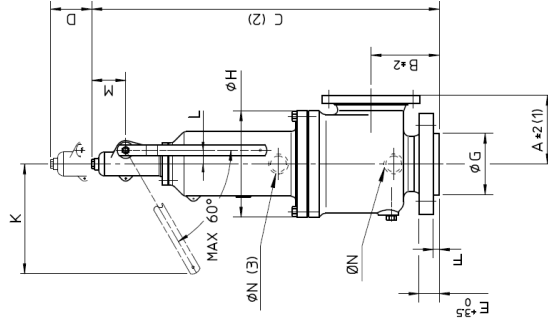
1° SUBCLASS	Item	4	5	8	13	14
	Part name	NOZZLE	DISC	GUIDE	PIVOT BUSH	RETAINING RING
	01			A 564-630 H900		
	02	SA 479 316	A 479 316			
	03		A 479 316+stellGr.6	A 564-630 H900	A 564-630 H900	
	04	SA 479 316+stellite gr.6	A 564-630 H900			
	05		A 479 316+stellGr.6			
	06		A 564-630 H1150			A 479 316
	07	SA 479 316	A 479 316			
	08		A 479 316+stellGr.6	A 479 316	S 21800 (Nitronic 60)	
	09	SA 479 316	A 564-630 H1150			
	10		A 479 316+stellite gr.6			
	11	SA 479 316 + stellite gr.6	A 479 316+stellite gr.6	Fe43B + stellGr.6	A 479 316+stellGr.6	N07750
	12	SA 479 316	A 479 316+N10276			
	13	SA 479 316 + N10276		(T<=380°C) A 479 316		
	14	SA 479 316L				
	15	SA 479 316L+HVD1	HVD1		S 21800 (Nitronic 60)	A 479 316
	16	S31050 + HVD-1		(T>380°C) A 479 316+Stell.		
17	N10276	N10276				
18	N04400 / N04405	N05500				

2° SUBCLASS	Item	10
	Part name	SPRING
	C	CARBON STEEL
	S	A 479 316
	W	TUNGSTEN STEEL
	P	A 564-630 H1025
	H	A 564-630 H1150
	Y	A 564-630 H900
L	N07750 Spring temper	
T	N07750 Triple heat treatment	

OVERALL DIMENSIONS and MASSES

DN entrata-inlet DN uscita-outlet ORIFICIO - Orifice	1 1/2"			2"			3"			4"			6"			8"		
	F	G	H	J	H	H	H	G - H	G	J	K	L	K	J	K	L	J	K
RATING ENTRATA Inlet rating	150	300	600	16	40	100	160	250	400	100	160	300	400	100	160	300	400	100
RATING USCITA Outlet rating	150	300	600	16	40	100	160	250	400	100	160	300	400	100	160	300	400	100
A	121	124	124	124	165	124	162	171	2500	150	300	600	1500	150	300	600	1500	150
B	124	140	130	136	140	130	154	156	1500	300	600	900	1500	300	600	900	1500	300
C	481	479	566	597	581	569	700	713	1500	300	600	900	1500	300	600	900	1500	300
D	110	110	130	130	160	160	160	150	1500	16	40	100	250	40	100	250	40	100
E	38	38	50	42	65	34	56	73	400	16	40	100	250	16	40	100	250	16
F	14	14	14	16	14	14	14	16	400	16	40	100	250	16	40	100	250	16
G	73	88	73	92	88	88	95	95	1500	150	300	600	1500	150	300	600	1500	150
H	136	136	160	160	160	160	196	196	1500	150	300	600	1500	150	300	600	1500	150
K	90	90	165	165	165	165	235	235	1500	150	300	600	1500	150	300	600	1500	150
L	32	32	32	32	32	32	40	40	1500	150	300	600	1500	150	300	600	1500	150
M	44	44	51	51	51	51	73	73	1500	150	300	600	1500	150	300	600	1500	150
N (NPT)	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	1/2"	1/2"	1500	150	300	600	1500	150	300	600	1500	150
MASSA SENZA LEVA-Without lever (KG)	19	20	28	30	44	31	47	60	63	30	47	50	63	52	68	86	105	114
MASSA CON LEVA-With lever (KG)	21	22	30	32	46	33	50	63	66	32	50	53	66	55	73	92	110	121

DN entrata-inlet DN uscita-outlet ORIFICIO - Orifice	4"			6"			8"			10"			12"			
	L - M	P	L - M - N	P	L	Q - R	O	R	L	Q - R	O	R	L	Q - R	O	R
RATING ENTRATA Inlet rating	100	100	160	160	250	16	16	16	40	40	40	40	40	40	40	40
RATING USCITA Outlet rating	100	100	160	160	250	16	16	16	40	40	40	40	40	40	40	40
A	210	197	222	254	222	150	16	16	150	16	16	16	150	16	16	16
B	1065	1129	1129	1302	1129	1226	1348	1348	1226	1348	1348	1348	1226	1348	1348	1348
C	56	220	64	64	71	220	260	260	220	260	260	260	220	260	260	260
D	56	220	64	64	71	220	260	260	220	260	260	260	220	260	260	260
E	56	220	64	64	71	220	260	260	220	260	260	260	220	260	260	260
F	56	220	64	64	71	220	260	260	220	260	260	260	220	260	260	260
G	278	370	310	374	310	216	216	216	216	216	216	216	216	216	216	216
H	278	370	310	374	310	216	216	216	216	216	216	216	216	216	216	216
K	278	370	310	374	310	216	216	216	216	216	216	216	216	216	216	216
L	278	370	310	374	310	216	216	216	216	216	216	216	216	216	216	216
M	278	370	310	374	310	216	216	216	216	216	216	216	216	216	216	216
N (NPT)	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"	1 1/2"
MASSA SENZA LEVA-Without lever (KG)	111	120	128	143	154	230	240	260	230	240	260	270	250	280	365	385
MASSA CON LEVA-With lever (KG)	118	128	143	154	154	240	260	270	240	260	270	285	260	290	370	380



NOTE In case of 3-5483 type valve equipped with auxiliary piston, contact Parcol Technical Department for mass and dimensions

- 1) When the outlet flange is RJ increase the dimension A of 6.5 mm for ANSI 150 and 8 mm for ANSI 300
- 2) The dimension C is the same both with standard cap and lifting lever
- 3) For 3-5483 type valve only



PARCOL S.p.A. Via Isonzo, 2 – 20010 CANEGRATE (MI) – ITALY
 TELEPHONE: +39 0331 413 111 – FAX: +39 0331 404 215
 E-mail: sales@parcol.com – <http://www.parcol.com>