Marvac

Tank Protection Products

Introduction

The effects of exceeding design pressure or vacuum limits in unprotected storage tanks and facilities, can have catastrophic effects on both plant and personnel.

Pressure/Vacuum valves should be used to protect any pressurised system from the effects of exceeding its design pressure limit.

A Pressure/Vacuum valve is designed to breathe out during tank filling and breathe in while the tank is being emptied.

Liquid storage tanks containing harmful or dangerous vapours can be protected by the use of inert gas blankets. These blankets are controlled by self regulating tank blanketing valves.

Many tank systems require access for cleaning and for sampling, for this Manways and Gauge Hatches are required.

Marvac design and manufacture valves to ISO9001 in different configurations to suit a variety of applications. These valves are compliant with the European ATEX and PED directives when applicable.

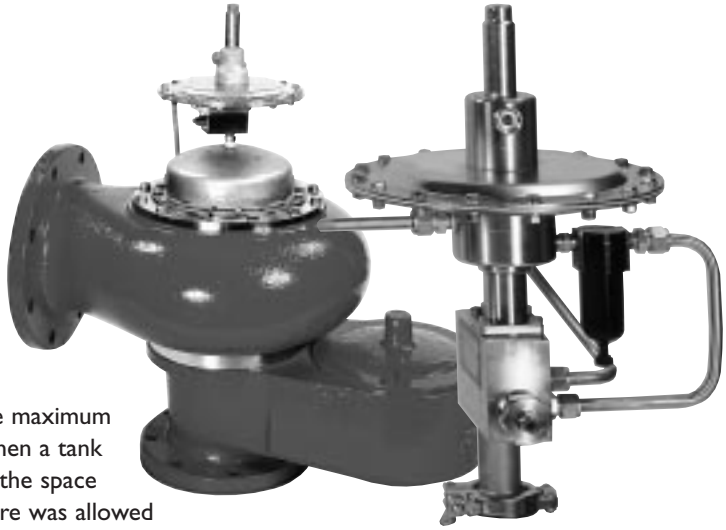
The ***Marvac*** range of tank equipment comprises:

- **Low Pressure Safety Valves**
- **Low Pressure Pilot Valves**
- **Vacuum Valves**
- **Combination Pressure/Vacuum Valves**
- **Emergency Vent/Manways**
- **Gauge Hatches**
- **Tank Blanketing Valves**

All Marvac valves are available through our global agent distribution network, supported by our own regional sales offices around the world.

SECTION	PAGE	CONTENTS
Introduction	3 - 6	Introduction
	7 - 10	How they work
	11 - 18	Dimensions and weights
	18 - 19	Accessories
	20	Materials
Sizing	21 - 23	Determination of venting requirement - API 2000
	24	Surface area calculation
	25	Gas flow conversion
	26	Tank blanketing valve sizing
	27	API 2000 Formula
	28	Coefficients
	29	Useful vapour and gas data
Capacity	30 - 33	Air capacity tables
Terms, Definitions and Conversions	34	Useful terms and definitions
	35	Useful conversions
Transportation Protection	36	'Megaflo' P/V Valve
	36	'Tank-A-Vent' Bursting Disc

INTRODUCING THE MARVAC RANGE OF TANK PROTECTION VALVES



Marvac manufacture an extensive range of products to protect low pressure storage tanks and vessels. These products help to prevent damage to the tank and also prevent the tanks contents from escaping, ensuring the safety of personnel and the surrounding environment.

Pressure/Vacuum valves are designed to limit the maximum pressure and vacuum that can exist in a tank. When a tank is being filled the gas (air, vapour, etc.) that filled the space above the liquid is compressed and if this pressure was allowed to exceed the design pressure of the tank, then it would explode. Also, if the temperature of the tank increases, then the effect of vaporisation and expansion would cause the pressure to rise. Conversely, emptying the tank, or a reduction in temperature, causes a vacuum to be created.

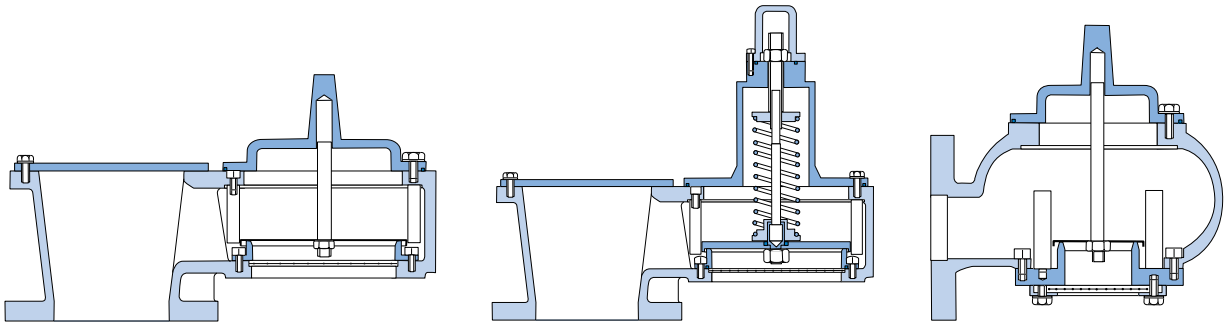
If the stored liquid is not volatile then the tank can be allowed to breathe through a free vent (fig 750). This is effectively an orifice with a hood and screen to keep out rain and birds. However, if the liquid is volatile then a free vent will allow valuable product vapour to be emitted to the atmosphere.

Fitting a relief valve allows the pressure in the tank to be increased above atmospheric. Such an increase in pressure, increases the boiling point of the liquid, reducing the amount of vapour which would otherwise form. When the relief valve does lift it will predominantly discharge air rather than product vapour.

Pressure/Vacuum Relief Valves

The Marvac range of pressure only, vacuum only and combined pressure and vacuum relief valves, can be weight, spring or pilot operated. These valves are extensively used to alleviate the problems caused by thermal effects and the filling and emptying of storage tanks and vessels.

VACUUM RELIEF RANGE (Typical diagrams)

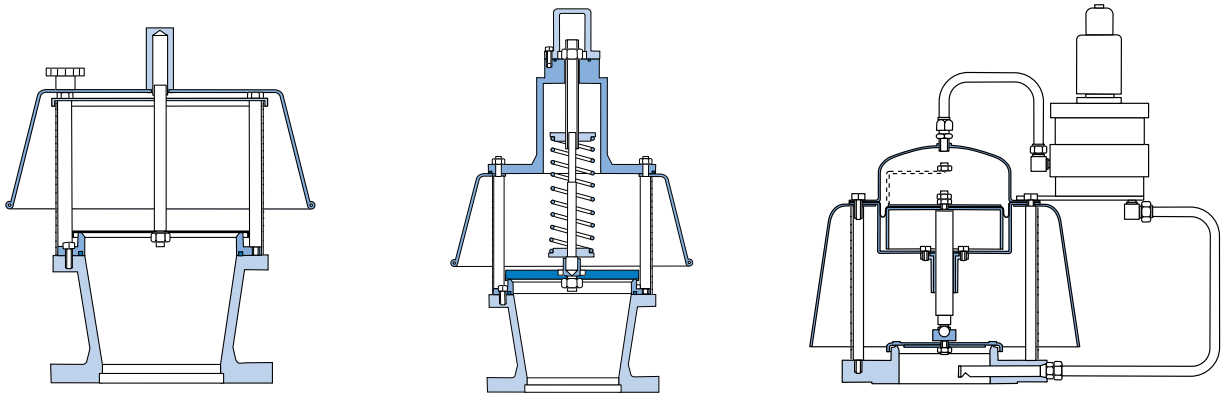


Weight loaded

Spring loaded

Side mounted
(Weight or Spring loaded)

PRESSURE RELIEF ATMOSPHERIC VENT RANGE (Typical diagrams)

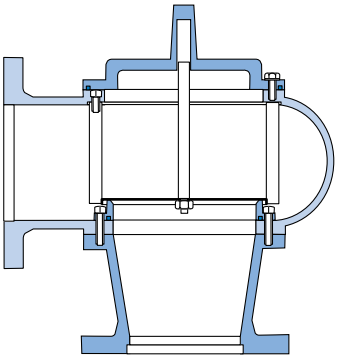


Weight loaded

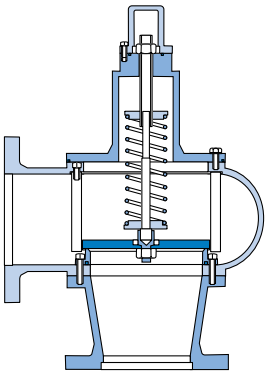
Spring loaded

Pilot operated

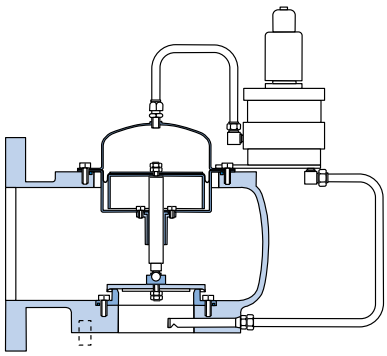
PRESSURE RELIEF PIPED VENT RANGE (Typical diagrams)



Weight loaded

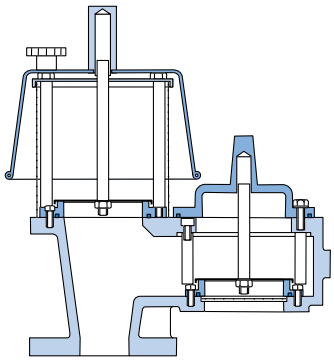


Spring loaded

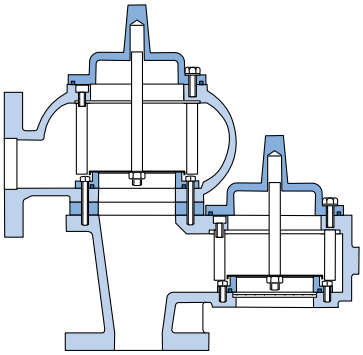


Pilot operated

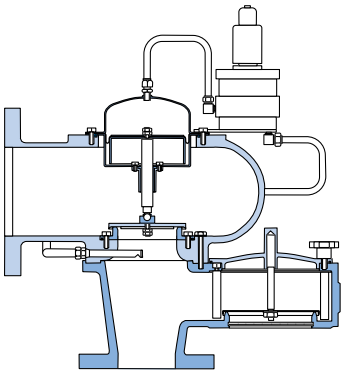
PRESSURE & VACUUM RANGE (Typical diagrams)



Atmospheric vent
weight loaded



Piped vent
weight loaded

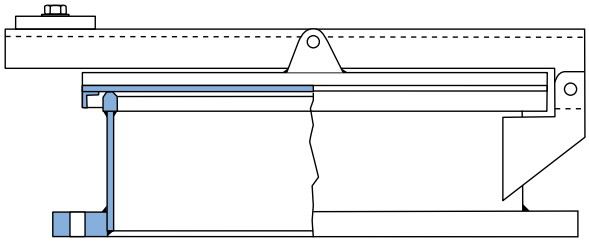


Piped vent
pilot operated

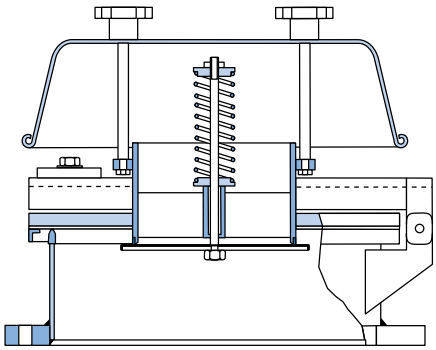
These are also available in spring operated styles.

MANWAY RANGE (Typical diagrams)

Emergency Vent/Manways provide over pressure protection in the event of the tank being subjected to fire exposure. They also provide access to the vessel (from the top) for internal inspection.



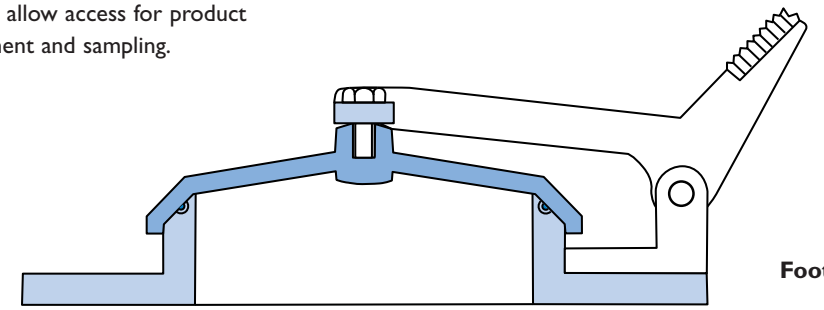
Emergency Vent/Manway



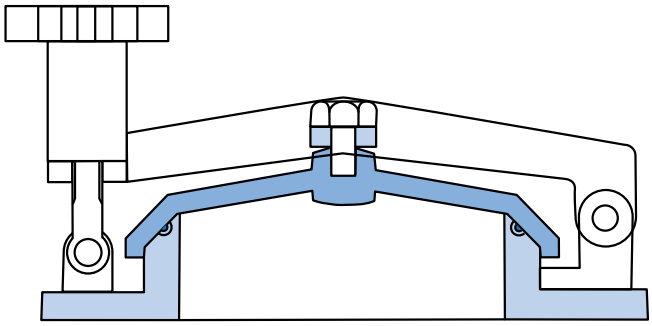
Emergency Vent/Manway with a Spring Vacuum Valve

GAUGE HATCH RANGE (Typical diagrams)

Gauge Hatches allow access for product level measurement and sampling.



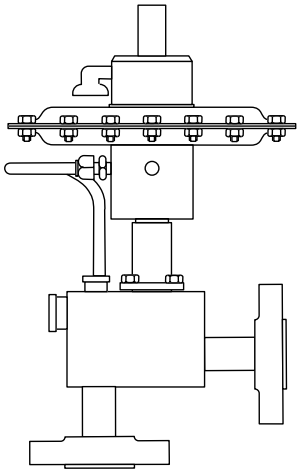
Foot operated



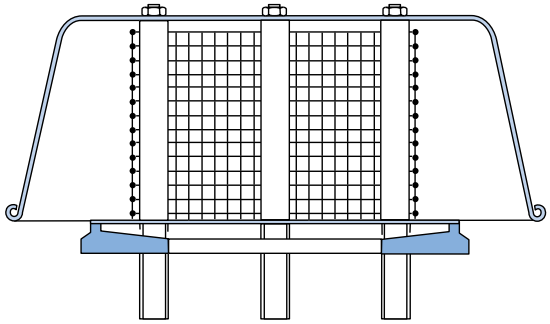
Lockable

TANK BLANKETING RANGE (Typical diagram)

Tank Blanketing Valves- Dedicated to provide inert or rich blanketing of storage tanks to reduce harmful fugitive emissions and the evaporation of product.

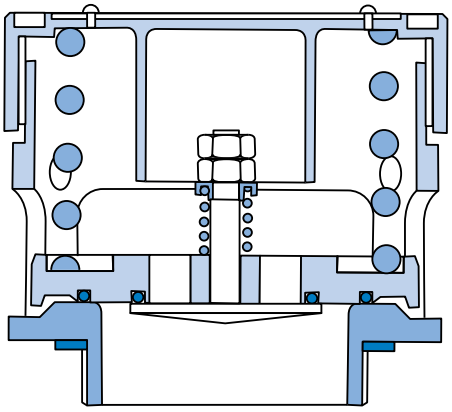


FREE VENT (Typical diagram)

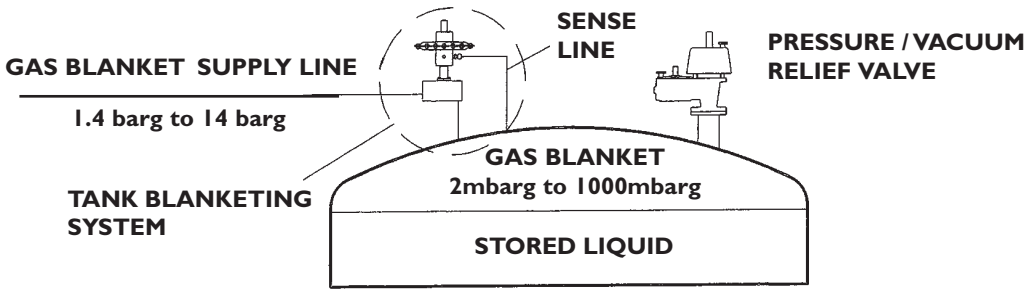


TRANSPORTATION VALVE (Typical diagram)

A Pressure/Vacuum or Pressure only safety relief valve, to meet the stringent requirements demanded by the Road, Rail and Container Tank industry.



TANK BLANKETING SYSTEMS FIGURE 77A



* To avoid tank corrosion or stored fluid degradation due to the ingress of air (humidity).
* To reduce the risk of explosion by diluting the oxygen in the tank with inert gas.
* To protect the environment from gases being emitted directly to the atmosphere.
* To protect the tank from imploding due to extreme vacuum conditions.

PRODUCT CODING

TYPICAL EXAMPLE

Tank blanketing valve, size 1", stainless steel body, ANSI 300 connection, 75% excess flow, viton gaskets, supply filter.

77A	H	X	2	4	V	A	F

77A — TANK BLANKETING VALVE

H — BODY SIZE
F = ½"
H = 1"
J = 2"

X — MATERIAL
C = CARBON STEEL
X = 316 St. St.

2 — CONNECTION RATING
1 = 150#RF or PN 16
2 = 300#RF or PN 40
9 = THREADED

4 — FLOW RESTRICTION
Restriction as a % of maximum flow

	Valve Size		
Code	0.5"	1.0"	2.0"
1	N/A	10%	20%
2	N/A	25%	40%
3	N/A	50%	60%
4	N/A	75%	80%
0	100%	100%	100%

V — SEAT AND SEAL MATERIAL
V = VITON (Standard)
B = BUNA-N
C = CHEMRAZ
E = EPDM
K = KALREZ
(gasket over diaphragm is always PTFE)

A — CONNECTION STANDARD
A = ANSI
P = PN
N = NPT

F — ACCESSORIES
A = NONE
F = SUPPLY FILTER
P = INTEGRAL PRESSURE SENSING
I = BACK FLOW PREVENTOR

VACUUM RELIEF

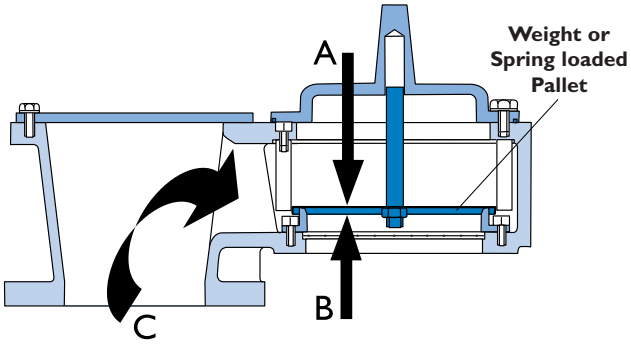


Fig.1 Valve closed.
The downward acting force "A" (generated from either weights or a spring) provides the vacuum set pressure. This force is greater than the atmospheric force "B" acting upward. When the tank is filling, force "C" is generated, which acts with force "A" keeping the valve firmly closed.

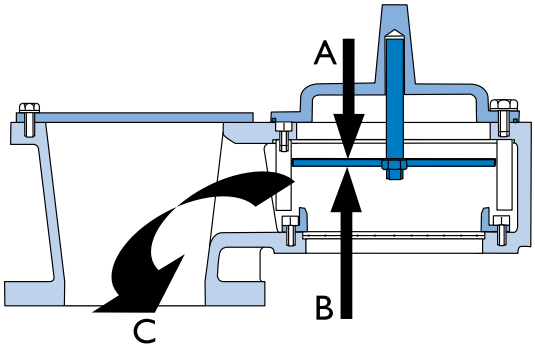


Fig. 2 Valve open.
When the tank is emptying, a vacuum force "C" is generated, which helps to lift the pallet by acting with force "B" and against force "A". This allows the tank to breathe air in.

PRESSURE RELIEF

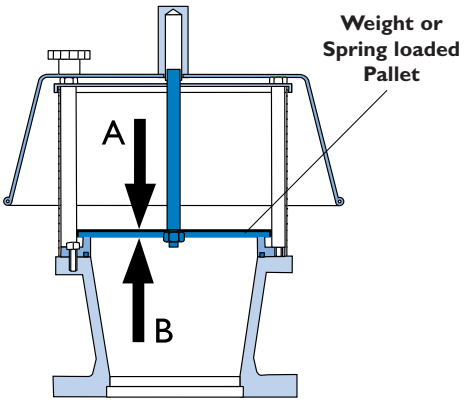


Fig. 3 Valve closed.
The downward acting force "A" (generated from either weights or a spring) provides the set pressure. This force is greater than the system operating force "B" acting upward.

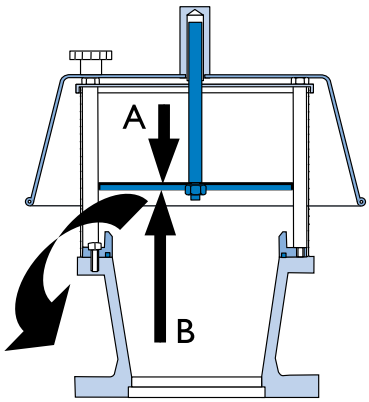


Fig. 4 Valve open.
When the system pressure force "B" increases to above force "A", the pallet lifts and the tank vapours are released to the atmosphere. If such vapours are not permitted to be vented to atmosphere, a piped vent version is available.

COMBINED PRESSURE & VACUUM RELIEF

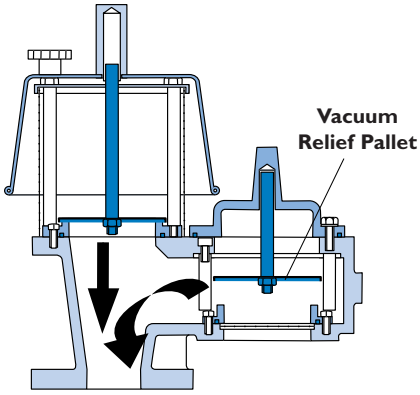


Fig. 5 Tank emptying.

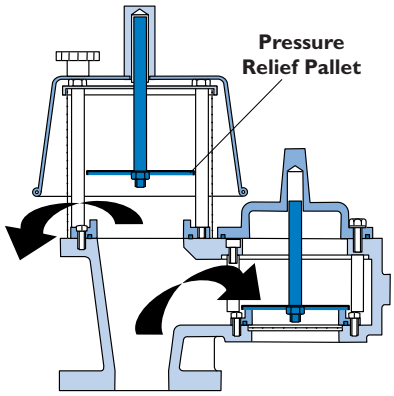
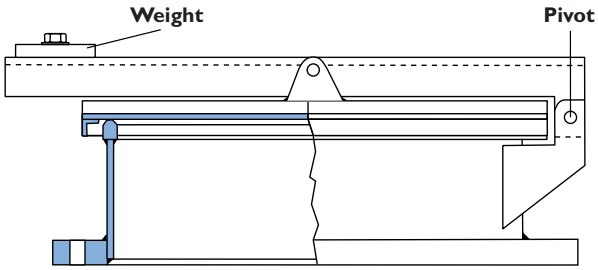


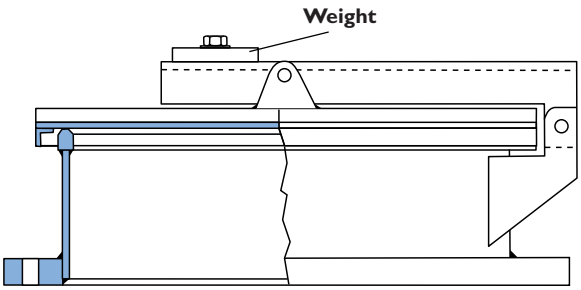
Fig. 6 Tank filling.

The operation of the Vacuum relief pallet and the Pressure relief are as explained above.

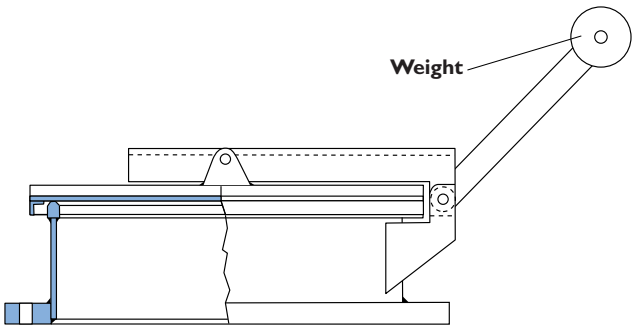
MANWAY/EMERGENCY VENTS



High Set Pressures



Medium Set Pressures



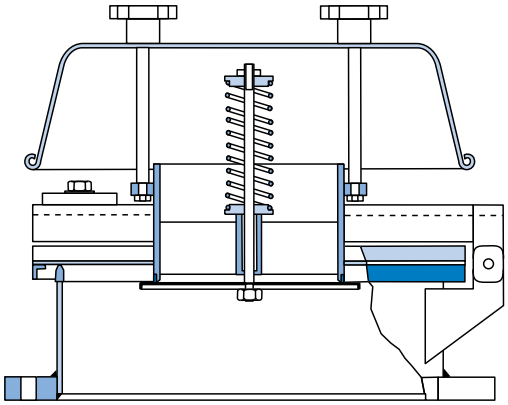
Low Set Pressures

Manway/Emergency Vents

These items have two uses:
The pallet is hinged and can be manually lifted out of the way allowing access to the tank for cleaning and inspection.

Secondly the pallet has weights which can be calculated to give a defined set pressure. In the event of a fire the pallet will lift at a predetermined pressure, thus supplying a large venting area.

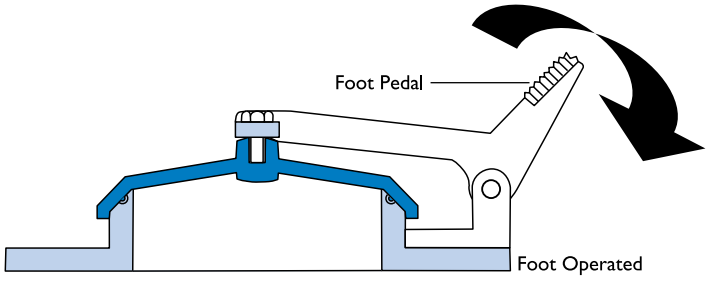
By positioning the weights at different distances from the pivot point a wide variation in set pressures can be achieved.

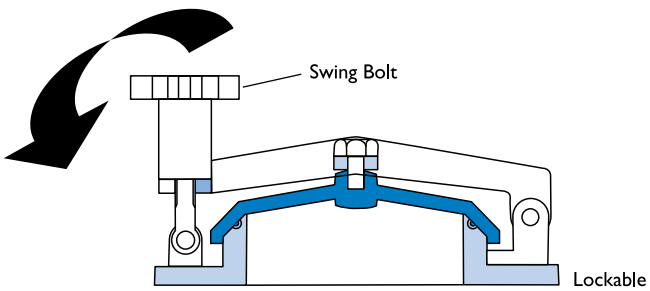


Manway/Emergency Vents

These items can also be supplied with vacuum valves.

GAUGE HATCHES



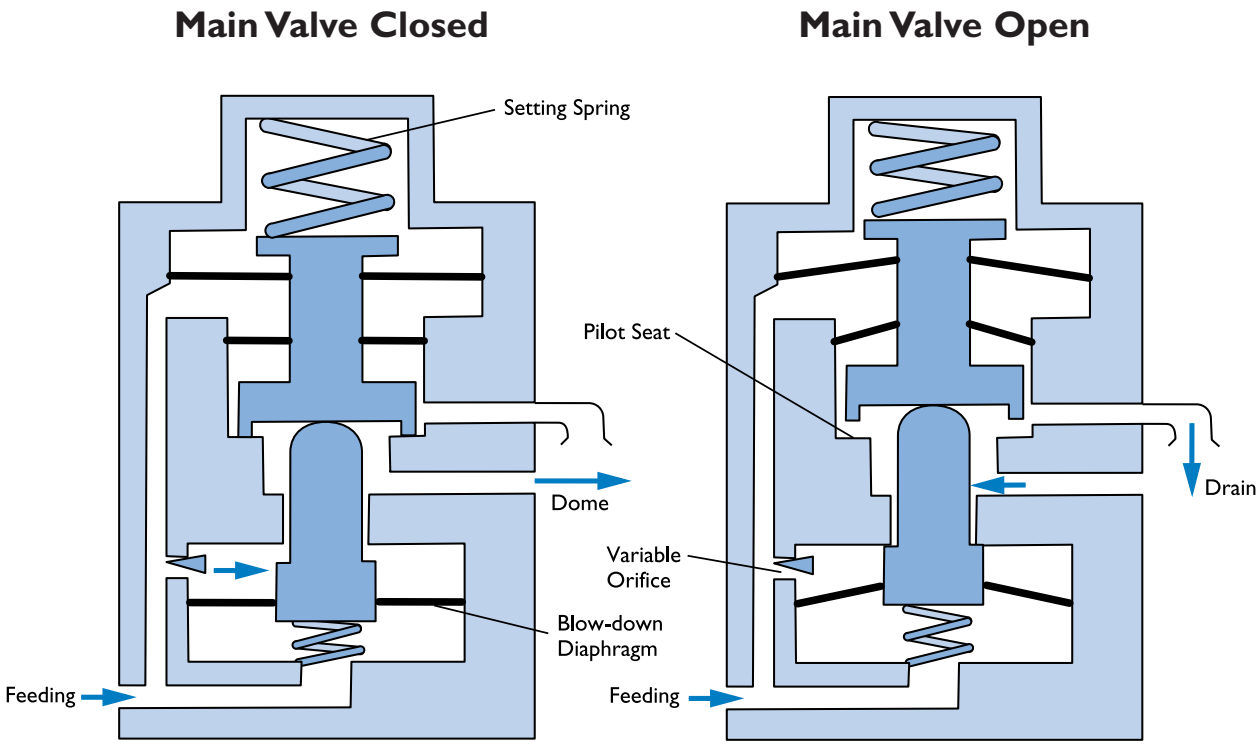


Gauge hatches allow access for product level measurement and sampling.

There are two types:

Foot operated: where quick access is required. To be used on non-pressure containing systems.

Lockable: for use on systems that are subject to pressurisation. The cover is held in place by the swing bolt, which has a hand wheel for easy locking.



Main Valve Closed

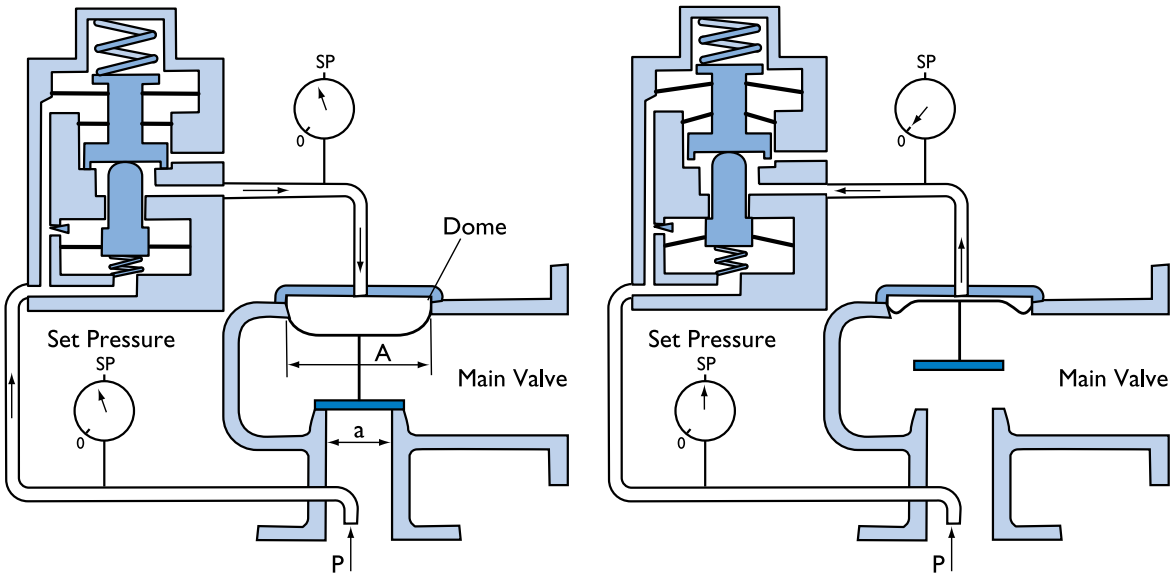
When the system pressure "P" is below the set pressure "SP", the pressure in the dome and the main valve inlet are equal.

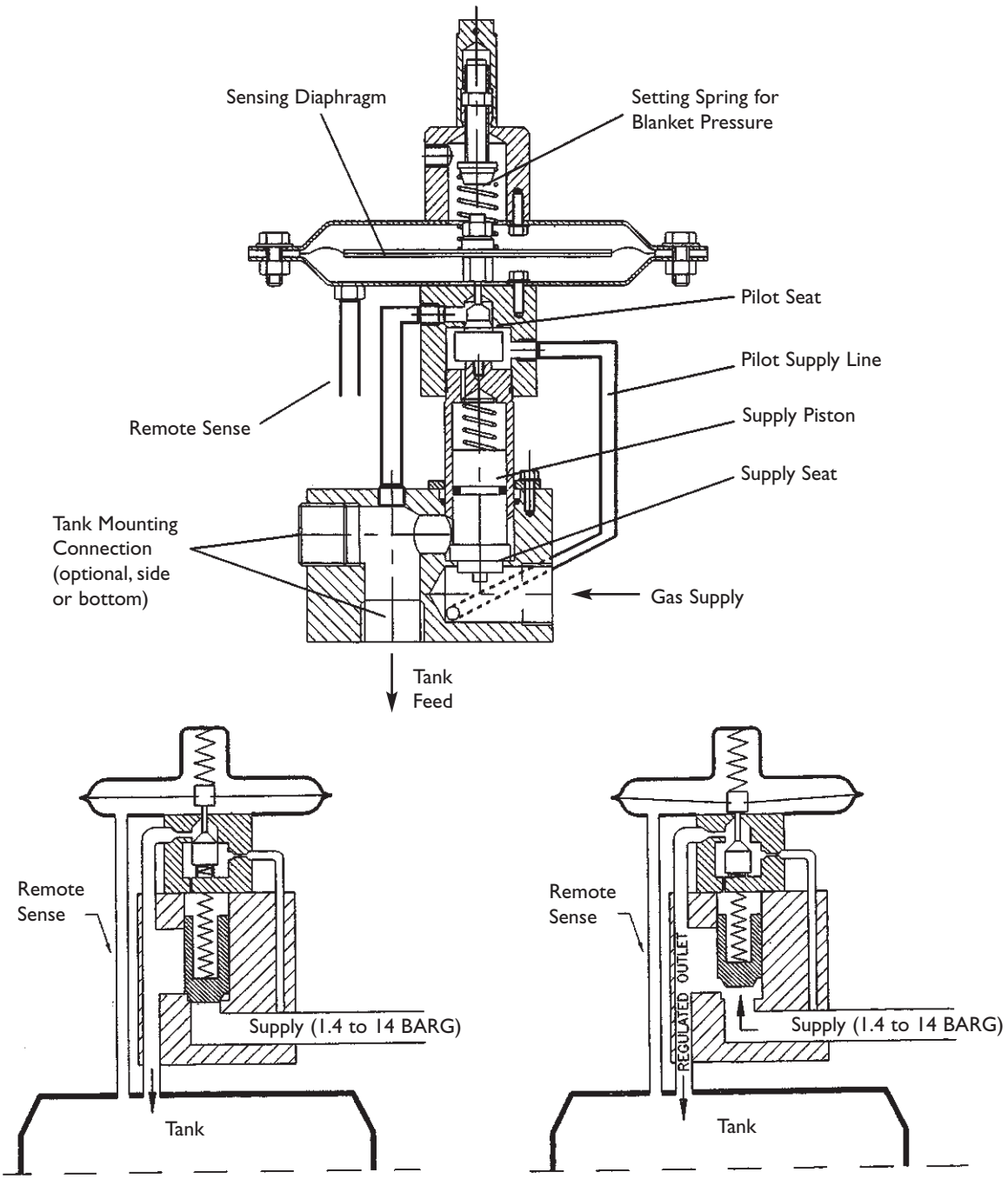
As the top of the piston "A" has a bigger area than the seat area "a", then the downward acting force is the greater, hence the main valve remains closed and leak tight.

Main Valve Open

When the system pressure "P" reaches the set pressure "SP", the pilot seat lifts slightly and creates a flow in the "Feeding" sense line. The variable orifice restricts this flow to the top of the blow-down diaphragm, creating a low pressure above it and a high pressure below. This in turn gives a boost to the pilot lift. The dome pressure is released via the drain to the atmosphere and the main valve responds by lifting fully at the set pressure.

When the system pressure "P" falls below the set pressure "SP" the pilot acts in reverse and the dome is once again fed with pressure and the main valve closes.





Supply Seat Closed

When the tank is at its desired pressure, the pilot and supply seats are closed. The supply pressure is fed up the pilot supply line to the top of the supply piston. As the pressure is equal on top and underneath the piston, the seat is held firmly closed by the piston spring.

Flow Restriction
The flow through the DN25 (1") and DN50 (2") valves can be restricted to suit the system requirements (see page 6 for details).

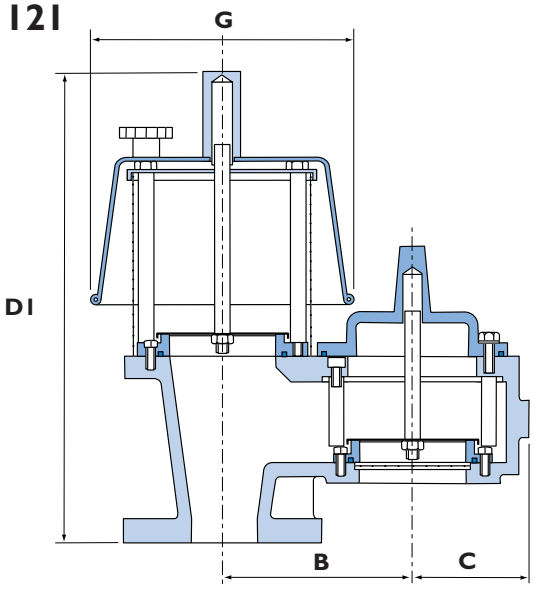
Tank Blanketing Valve Sizing
Please refer to page 26.

Supply Seat Open

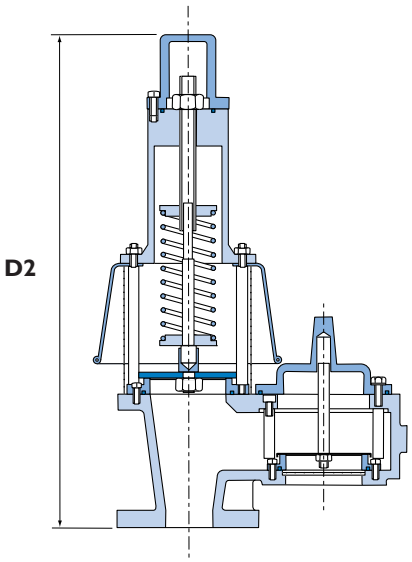
When the tank is below its desired pressure, the pressure under the diaphragm is reduced via the remote sense line, the setting spring pushes the diaphragm and pilot seat down, allowing the pressure at the top of the supply piston to enter the tank. The supply pressure is restricted in the pilot supply line. Now that the pressure is greater underneath the piston, the supply seat is opened and the tank is fed with gas from the supply until the pressure rises sufficiently to lift the pilot seat and pressurise the top of the piston, thus closing the supply seat. The pressure is monitored and the above cycle is continuous.

Atmospheric Vents

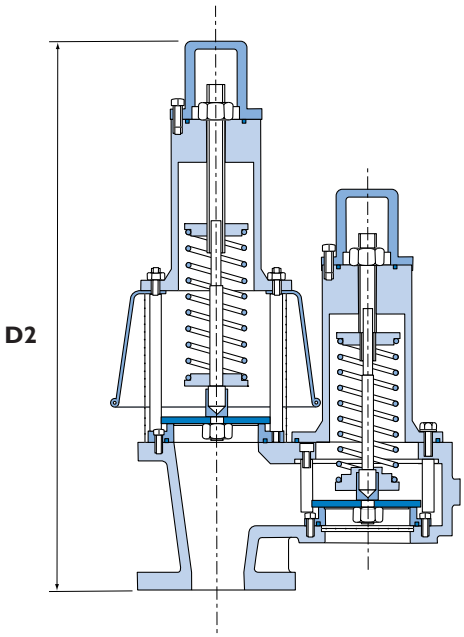
121



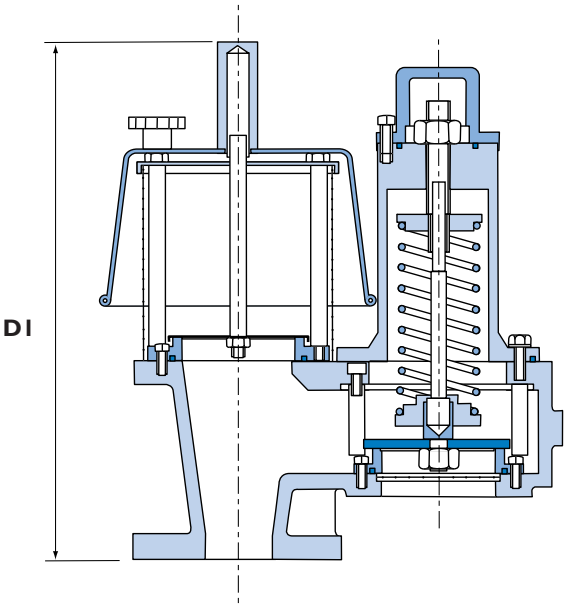
121S



121SS



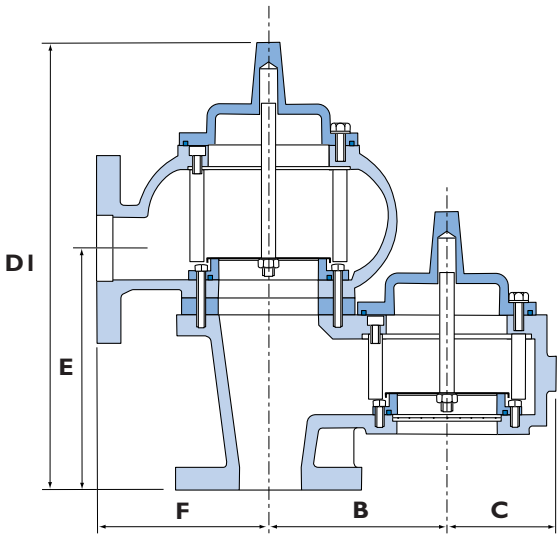
121SV



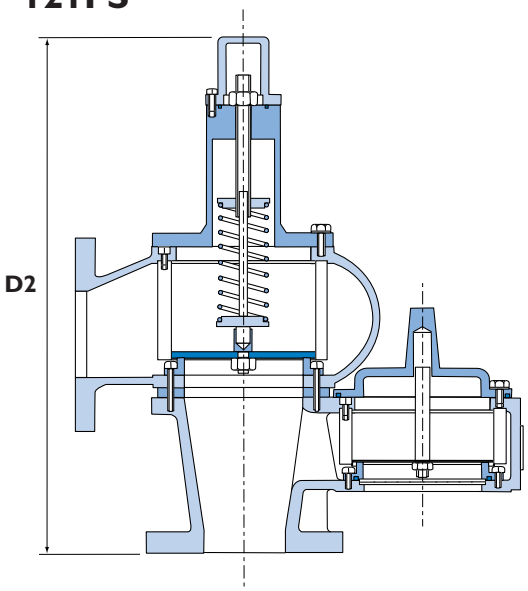
DIMENSIONS mm						APPROXIMATE WEIGHTS - Kgs							
						121		121S		121SS		121SV	
VALVE SIZE	B	C	D1	D2	G	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS
DN50 (2")	146	81	362	533	202	6	19	8	26	10	31	8	26
DN80 (3")	185	100	393	564	253	8	29	11	40	14	51	11	40
DN100 (4")	213	119	421	591	303	12	40	17	52	22	64	17	52
DN150 (6")	280	143	477	659	392	20	52	28	75	34	98	28	75
DN200 (8")	335	173	584	707	535	33	80	43	100	53	120	43	100
DN250 (10")	397	202	639	810	620	50	137	62	167	74	197	62	167
DN300 (12")	450	235	677	826	682	66	185	80	226	94	267	80	226

Piped Vents

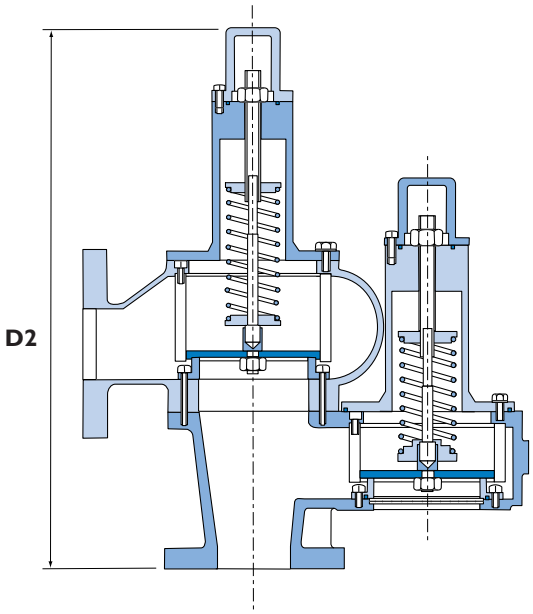
121F



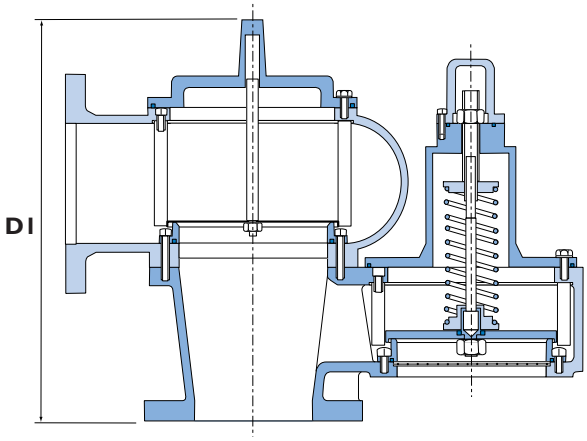
121FS



121FSS



121FSV



DIMENSIONS mm							APPROXIMATE WEIGHTS - Kgs							
							121F		121FS		121FSS		121FSV	
VALVE SIZE	B	C	D1	D2	E	F	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS
DN50 (2")	146	81	364	528	197	140	9	41	11	48	13	55	11	48
DN80 (3")	185	100	424	571	238	180	12	60	16	70	20	80	16	70
DN100 (4")	213	119	472	612	261	200	18	85	25	97	32	109	25	97
DN150 (6")	280	143	517	670	310	242	32	113	40	125	48	137	40	125
DN200 (8")	335	173	590	730	362	310	50	168	60	188	70	208	60	188
DN250 (10")	397	202	650	831	400	358	76	250	88	280	100	310	88	280
DN300 (12")	450	235	725	870	435	393	101	346	115	385	130	424	115	385

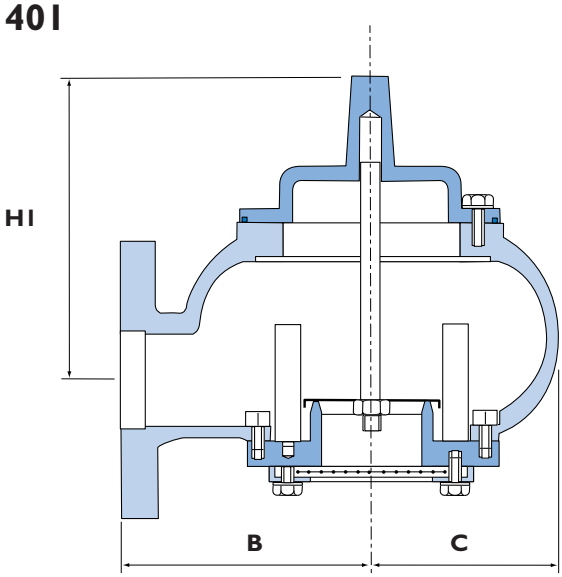
SIDE MOUNTED VACUUM RELIEF

PIPED VENTS

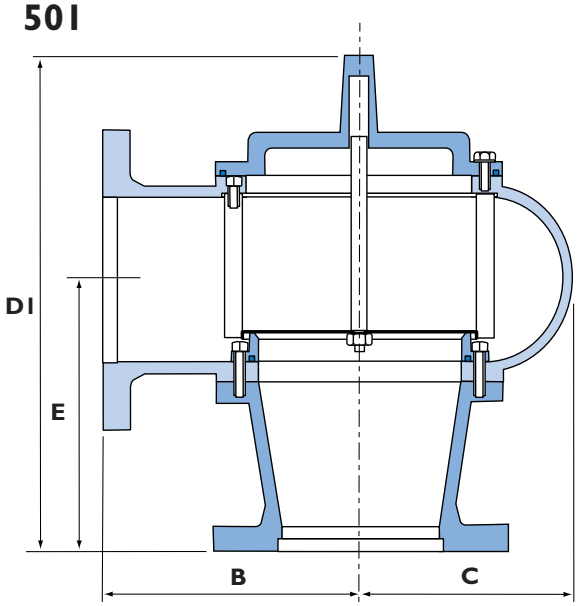
PRESSURE RELIEF (bottom mount)

or VACUUM RELIEF (side mount)

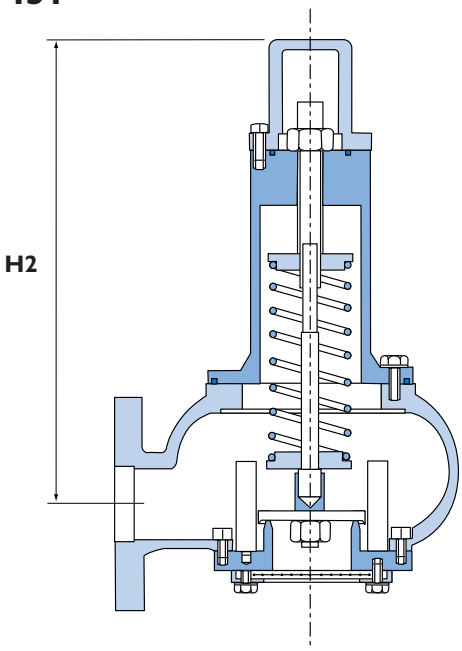
401



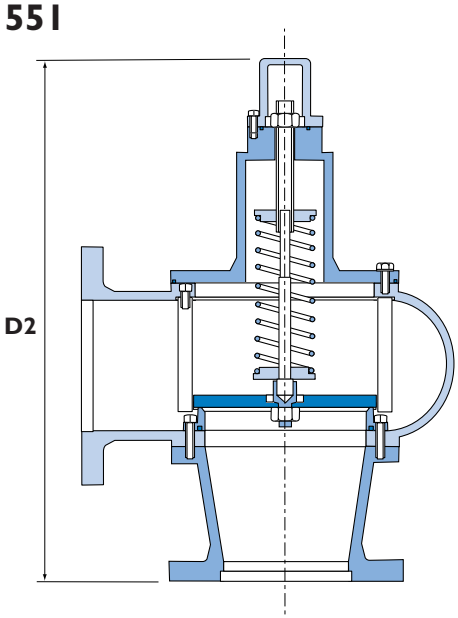
501



451



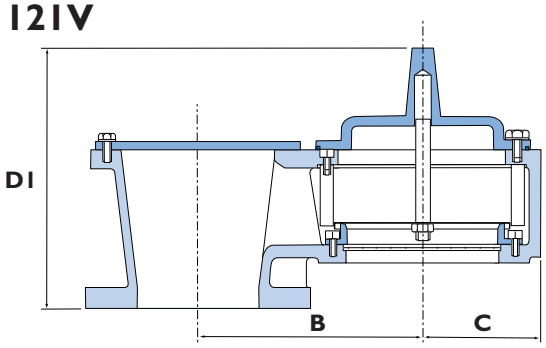
551



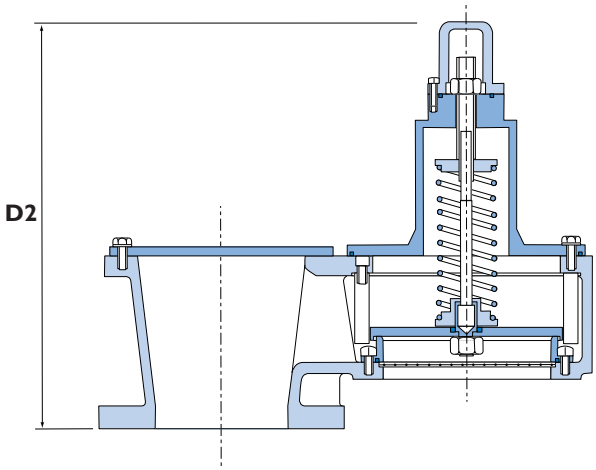
DIMENSIONS mm								APPROXIMATE WEIGHTS - Kgs							
								401		451		501		551	
VALVE SIZE	B	C	D1	D2	E	H1	H2	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS	ALUM	CS/SS
DN50 (2")	140	105	308	472	142	166	330	4	11	6	17	6	16	8	22
DN80 (3")	180	140	370	518	184	179	334	6	17	8	24	9	24	11	31
DN100 (4")	200	162	424	563	212	202	351	10	25	13	35	14	37	16	47
DN150 (6")	242	202	483	635	274	200	361	17	43	18	56	24	65	25	78
DN200 (8")	310	237	557	696	329	217	361	26	68	27	84	36	99	37	114
DN250 (10")	358	280	605	773	355	230	418	39	101	42	122	55	144	68	155
DN300 (12")	393	326	653	798	363	300	435	51	135	55	150	72	196	76	211
DN400 (16")	510	417	989	997	572	417	435	70	180	75	210	91	241	96	271

BOTTOM MOUNTED VACUUM RELIEF

121V



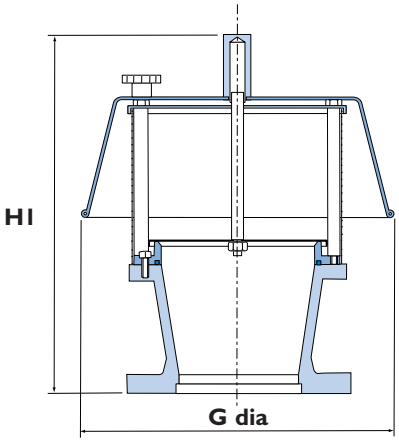
121VS



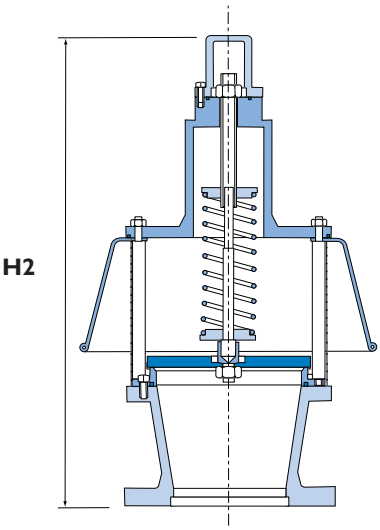
PRESSURE RELIEF

ATMOSPHERIC VENTS

601



651

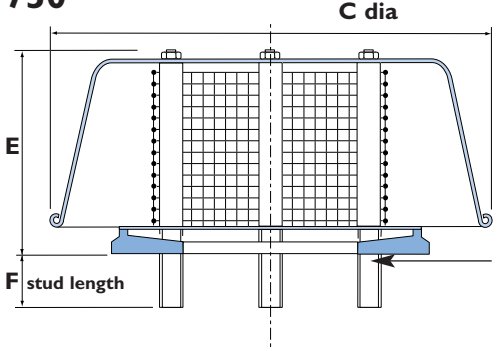


DIMENSIONS mm					APPROXIMATE WEIGHTS - Kgs			
					121V		121VS	
VALVE SIZE	B	C	D1	D2	ALUM	CS/SS	ALUM	CS/SS
DN50 (2")	146	81	226	390	6	17	8	24
DN80 (3")	185	100	264	411	7	27	10	38
DN100 (4")	213	119	289	430	10	36	15	49
DN150 (6")	280	143	307	465	18	48	25	72
DN200 (8")	335	173	357	562	30	75	40	95
DN250 (10")	397	208	406	610	46	131	58	160
DN300 (12")	450	235	441	677	60	176	76	215

DIMENSIONS mm				APPROXIMATE WEIGHTS - Kgs			
				601		651	
VALVE SIZE	G	H1	H2	ALUM	CS/SS	ALUM	CS/SS
DN50 (2")	202	307	478	3	6	5	13
DN80 (3")	253	339	510	5	11	7	19
DN100 (4")	303	372	542	7	17	11	29
DN150 (6")	392	443	620	12	29	16	42
DN200 (8")	555	552	675	18	43	24	60
DN250 (10")	620	627	797	27	67	34	85
DN300 (12")	682	650	832	36	88	45	110
DN400 (16")	900	760	980	46	110	57	140

OPEN VENT

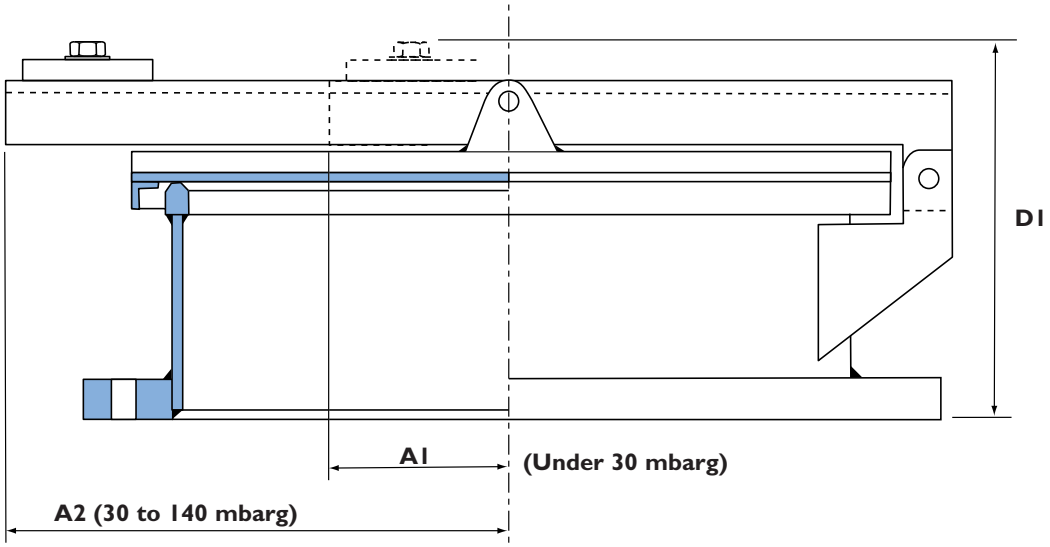
750



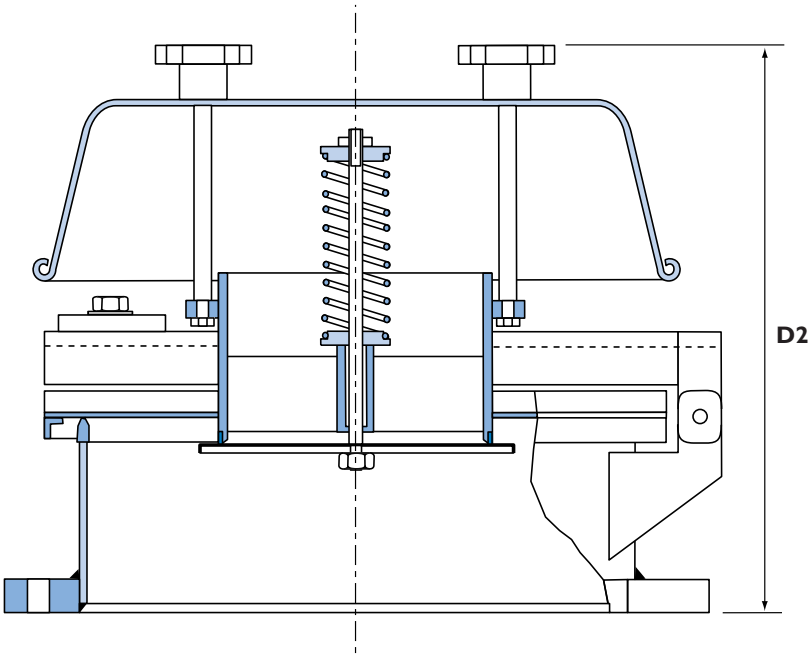
Note: The flange diameter, stud PCD, number and size of stud are to suit the required flange standard.

DIMENSIONS mm				APPROXIMATE WEIGHTS - Kgs	
				750	
VALVE SIZE	C	E	F	ALUM	CS/SS
DN50 (2")	202	126	35	2	4
DN80 (3")	252	132	35	4	8
DN100 (4")	304	143	38	5	12
DN150 (6")	392	165	50	8	19
DN200 (8")	555	182	50	12	28
DN250 (10")	620	202	55	18	45
DN300 (12")	682	224	55	24	58

785



786



DIMENSIONS mm					APPROXIMATE WEIGHTS - Kgs			
					785		786	
VALVE SIZE	A1	A2	D1	D2	ALUM	CS/SS	ALUM	CS/SS
DN250 (10")	93	293	246	N/A	14	35	N/A	N/A
DN300 (12")	67	367	246	N/A	16	40	N/A	N/A
DN400 (16")	316	446	246	510	18	50	N/A	N/A
DN450 (18")	325	445	246	510	20	60	53	86
DN500 (20")	331	671	246	510	25	130	58	165
DN600 (24")	368	818	246	510	30	160	63	195
DN750 (30")	422	1042	246	510	40	190	73	225
DN800 (32")	273	1022	246	510	50	230	83	265
DN900 (36")	125	1455	246	510	80	260	113	295

PILOT OPERATED PRESSURE RELIEF - PIPED VENT

910

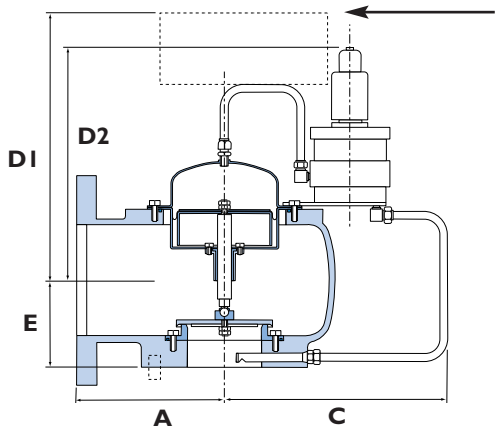


Diagram is a high pressure pilot valve (above 300mbarg).
Low pressure pilot (below 300 mbarg) shown dotted.

DIMENSIONS mm						APPROXIMATE WEIGHTS - Kgs 910	
VALVE SIZE	A	C	D1	D2	E	ALUM	CS/SS
2" x 3"	153	275	305	355	76	15	26
3" x 4"	193	290	327	380	89	20	40
4" x 6"	200	308	318	385	118	32	50
6" x 8"	245	380	335	435	146	45	80
8" x 10"	330	410	365	465	171	71	130
10" x 12"	410	470	405	510	201	117	240
12" x 16"	510	500	472	580	242	186	330

920

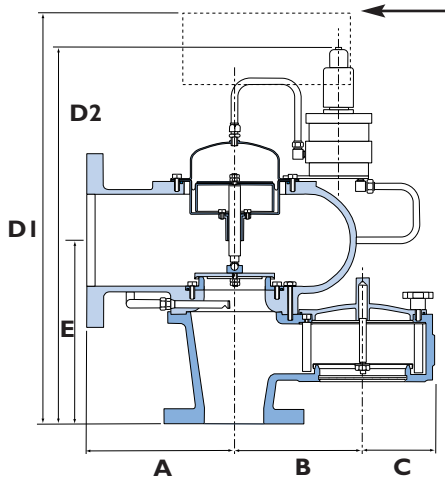


Diagram is a high pressure pilot valve (above 300mbarg).
Low pressure pilot (below 300 mbarg) shown dotted.

DIMENSIONS mm							APPROXIMATE WEIGHTS - Kgs 920	
VALVE SIZE	A	B	C	D1	D2	E	ALUM	CS/SS
2" x 3"	153	146	81	455	505	226	35	46
3" x 4"	193	185	100	527	580	252	50	70
4" x 6"	200	213	119	540	605	300	72	100
6" x 8"	245	280	143	585	655	340	100	140
8" x 10"	330	335	173	660	760	406	151	210
10" x 12"	410	397	202	780	885	456	254	354
12" x 16"	510	450	235	860	970	530	371	515

PILOT OPERATED PRESSURE RELIEF - ATMOSPHERIC VENT

930

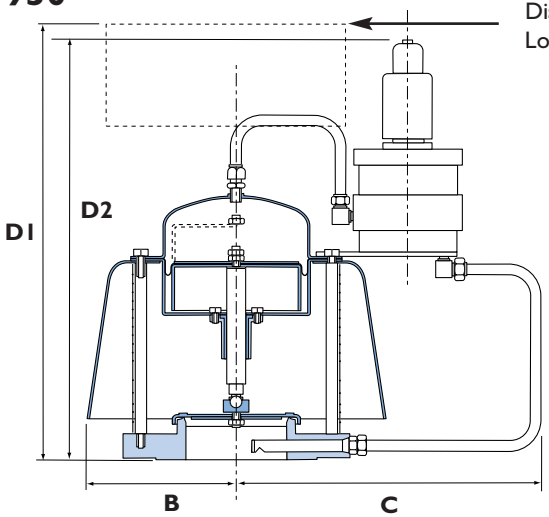
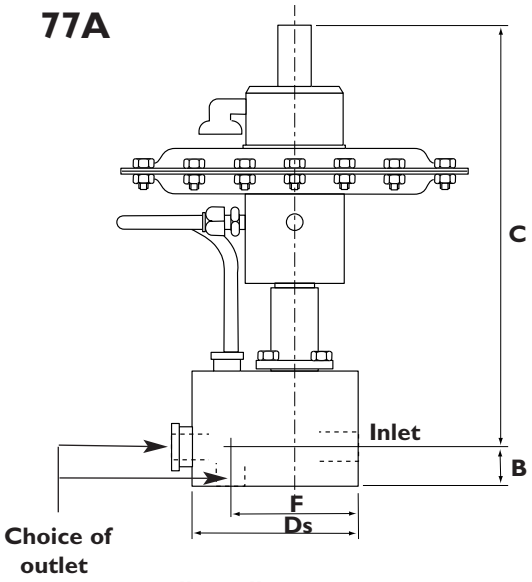


Diagram is a high pressure pilot valve (above 300mbarg).
Low pressure pilot (below 300 mbarg) shown dotted.

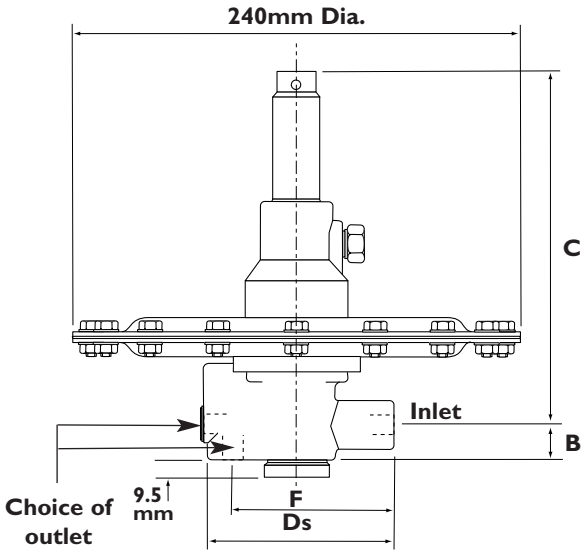
DIMENSIONS mm					APPROXIMATE WEIGHTS - Kgs 930	
VALVE SIZE	B	C	D1	D2	ALUM	CS/SS
2"	100	275	376	416	7	20
3"	120	275	400	450	8	22
4"	150	305	420	485	10	27
6"	197	327	430	530	15	39
8"	250	366	488	588	23	58
10"	303	400	533	638	34	88
12"	361	491	665	775	42	105

TANK BLANKETING VALVE

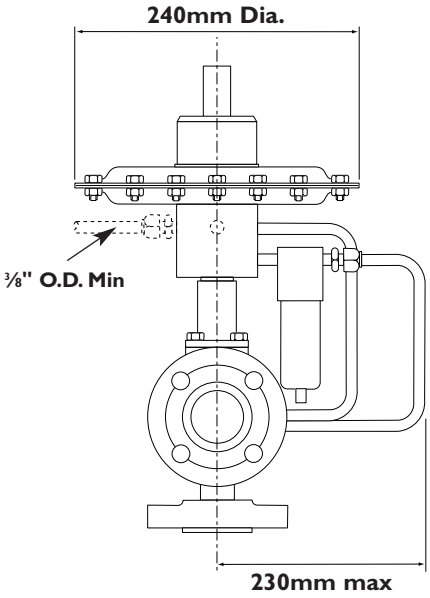
77A

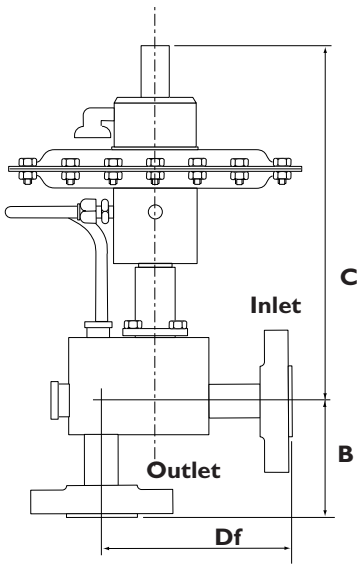


1" & 2" SCREWED

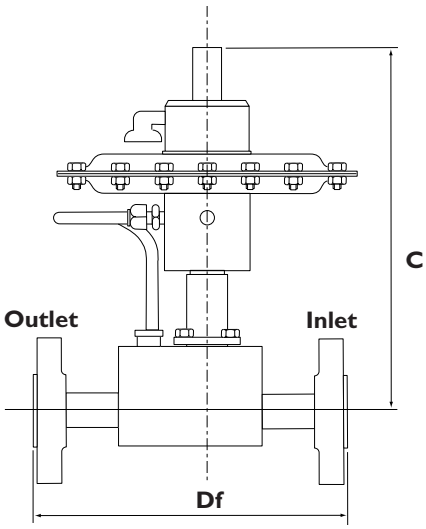


½" SCREWED





ANGLE PATTERN

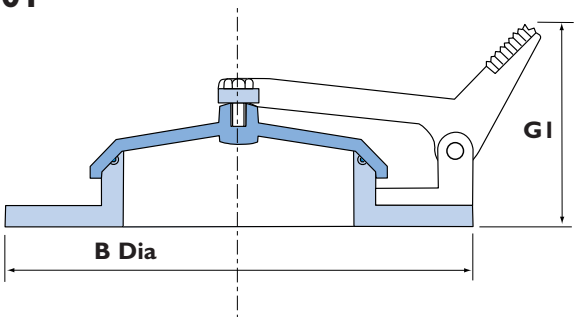


STRAIGHT THROUGH

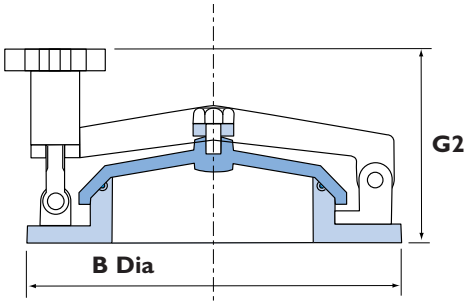
DIMENSIONS mm								WEIGHT
Body Size	Connections	Type	B	C	Df	Ds	F	Approx Kgs
½"	½" Screwed	Angle pattern	37	170	n/a	90	70	6
½"	½" Screwed	Straight through	37	170	n/a	90	n/a	6
½"	½" Flanged	Angle pattern	100	170	195	n/a	n/a	7
½"	½" Flanged	Straight through	37	170	330	n/a	n/a	7
½"	1" Flanged	Angle pattern	100	170	195	n/a	n/a	8
½"	1" Flanged	Straight through	37	170	330	n/a	n/a	8
1"	1" Screwed	Angle pattern	23	331	n/a	n/a	82	9
1"	1" Screwed	Straight through	23	331	n/a	140	n/a	9
1"	1" Flanged	Angle pattern	85	331	144	n/a	n/a	10
1"	1" Flanged	Straight through	31	331	242	n/a	n/a	10
2"	2" Screwed	Angle pattern	61	462	n/a	246	154	20
2"	2" Screwed	Straight through	61	462	n/a	246	n/a	20
2"	2" Flanged	Angle pattern	130	462	225	n/a	n/a	25
2"	2" Flanged	Straight through	n/a	462	385	n/a	n/a	25

GAUGE HATCHES

801



851



DIMENSIONS mm				APPROXIMATE WEIGHTS - Kgs			
				801		851	
VALVE SIZE	B	G1	G2	ALUM	CS/SS	ALUM	CS/SS
DN100 (4")	229	118	115	3	9	3	9
DN150 (6")	280	118	118	7	20	7	22
DN200 (8")	343	121	121	11	33	12	36

ACCESSORIES & SPECIALS

The Marvac range of tank protection valves can be supplied with a wide range of accessories and many special variants can be provided. Such accessories and variants are required by difficult process plant applications.

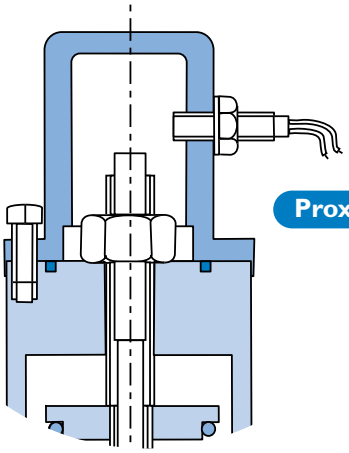
We list below some of the available options and welcome the opportunity to review and offer a solution to any customer specific requirements.

Pilot Valves

- Back flow preventer
- Field test connection
- Supply filter
- Integral sense
- Internal sense
- Cryogenic valves

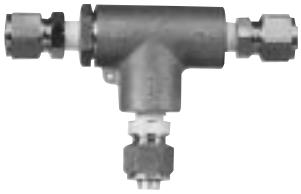
General

- Proximity switch
- Steam jackets
- Steam chests
- Test bench
- Cleaning in place
- Tri-clamp connections
- Plastic valves
- Flame arresters
- Bursting discs



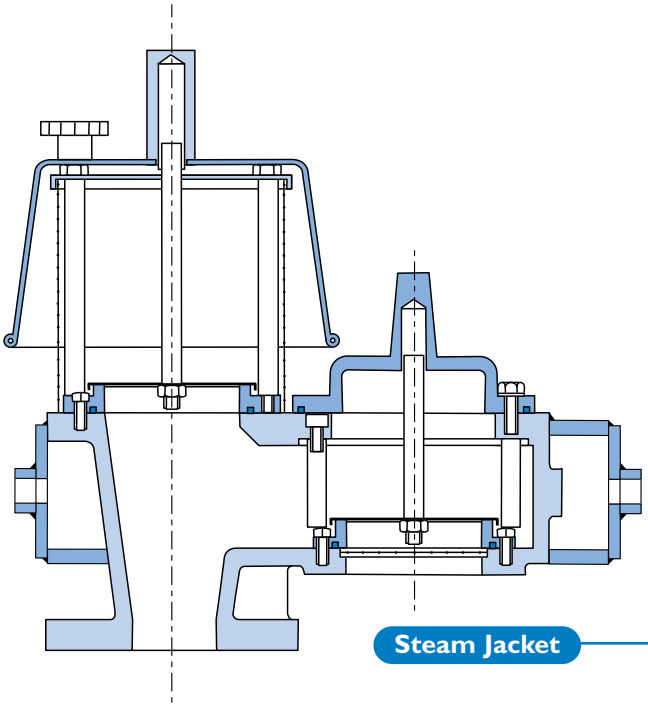
Proximity Switch

Supply Filter

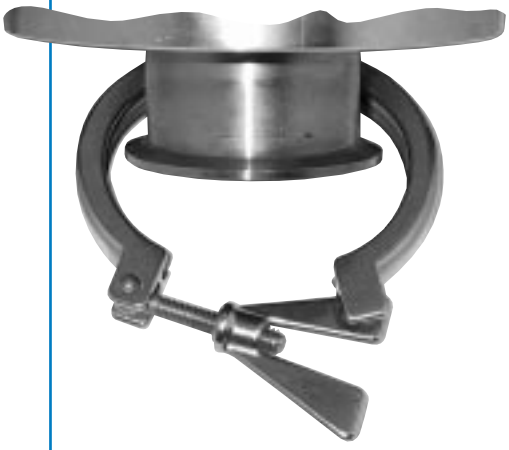


Back Flow Preventer

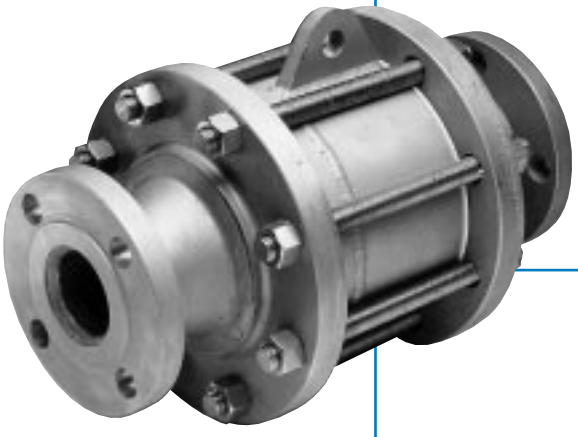
Field Test Connector



Steam Jacket



Tri-Clamp



Flame Arrester

MATERIALS

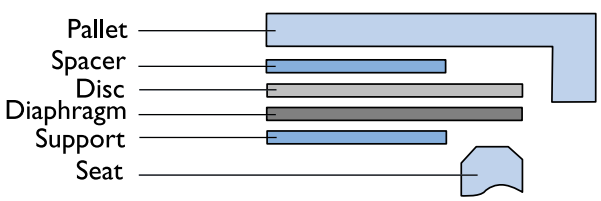
Description	Minimum deg F	Minimum deg C	Maximum deg F	Maximum deg C
BODY				
Aluminium LM25-BSEN1706	-321	-196	302	150
Carbon steel SA216-WCB	-20	-29	500	260
Low Temp. CS SA352-LCB	-40	-40	500	260
Stainless steel SA351-CF8M	-321	-196	500	260
Hastelloy SA494-CW12MW	-40	-40	500	260
Polypropylene	5	-15	194	90
PVDF	5	-15	194	90
Carbon steel-Halar Coated	-20	-29	248	120
Stainless steel-Halar Coated	-94	-70	248	120
SPRING				
Stainless steel	-321	-196	500	260
Inconel X750	-321	-196	500	260
TRIM				
MM-Metal	-321	-196	500	260
MD-PTFE	-321	-196	500	260

MATERIAL AVAILABILITY

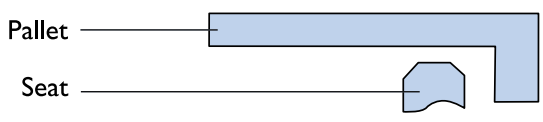
Valve Range	Aluminium	Carbon steel	Low Temp. CS	Stainless steel	High Gr. Alloys	Fabricated CS	Fabricated SS	Fabricated Alum	Cryogenic	Metal seat	Soft seat	Polypropylene	PVDF	Halar Coated
121	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓
401/451	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓
501/551	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓
601/651	✓	✓	✓	✓	✓	x	x	x	x	✓	✓	✓	✓	✓
750	✓	✓	x	✓	x	x	x	x	x	n/a	n/a	x	x	x
785/786	x	x	x	x	x	✓	✓	✓	x	✓	✓	x	x	✓
910	✓	✓	✓	✓	✓	x	x	x	✓	x	✓	x	x	✓
920	✓	✓	✓	✓	✓	x	x	x	✓	x	✓	x	x	✓
930	✓	✓	✓	✓	✓	x	x	x	✓	x	✓	x	x	✓
801/851	✓	✓	x	✓	x	x	x	x	x	x	✓	✓	✓	✓
77A	x	✓	x	✓	x	x	x	x	x	x	✓	x	x	x
011	x	x	x	✓	✓	x	x	x	x	x	✓	x	x	x

TRIM TYPES

MD - Metal to Diaphragm



MM - Metal to Metal



Determination of Equivalent Air Venting Requirements to API 2000

The following scenarios should be considered when determining the venting requirements of atmospheric or low pressure storage tanks.

1/ Tank In-Breathing - VACUUM RELIEF:

The total requirement is the sum of the following two scenarios.

A/ The resultant air flow in to the tank due to the out-flow of liquid during emptying.

B/ Thermal in-breathing due to the atmospheric cooling effect (contracting or condensing) on the vapour within the tank.

2/ Tank Out-Breathing - PRESSURE RELIEF:

The total requirement is the sum of the following three scenarios.

A/ The resultant air flow out of the tank due to the in-flow of liquid during filling.

B/ Thermal out-breathing due to the atmospheric heating effect (expansion) on the vapour within the tank.

C/ The maximum flow from the tank blanketing valve, should it fail open.

3/ Out-Breathing due to External Fire - PRESSURE RELIEF

When a tank can be subjected to an external fire source, the venting requirement can exceed the requirements outlined above.

1/ Tank In-Breathing - VACUUM RELIEF:

A/ Liquid emptying:

IMPERIAL - For each Barrel/hr (42 USGPH) of liquid being emptied, an in-breathing rate of 5.6 SCFH of air is required.

METRIC - For each M^3/h (1000 l/h) of liquid being emptied, an in-breathing rate of 0.94 Nm^3/h of air is required.

B/ Thermal contraction:

Read the in-breathing rate from the tables below.

It is important to realise that the Tank Capacity stated is the physical capacity (volume) and not the emptying rate.

IMPERIAL		
Tank capacity (Physical)		In-Breathing
Barrels	US Gallons	SCFH Air
60	2,500	60
100	4,200	100
500	21,000	500
1,000	42,000	1,000
2,000	84,000	2,000
3,000	126,000	3,000
4,000	168,000	4,000
5,000	210,000	5,000
10,000	420,000	10,000
15,000	630,000	15,000
20,000	840,000	20,000
25,000	1,050,000	24,000
30,000	1,260,000	28,000
35,000	1,470,000	31,000
40,000	1,680,000	34,000
45,000	1,890,000	37,000
50,000	2,100,000	40,000
60,000	2,520,000	44,000
70,000	2,940,000	48,000
80,000	3,360,000	52,000
90,000	3,780,000	56,000
100,000	4,200,000	60,000
120,000	5,040,000	68,000
140,000	5,880,000	75,000
160,000	6,720,000	82,000
180,000	7,560,000	90,000

METRIC		
Tank capacity (Physical)		In-Breathing
Cubic metres	Litres	Nm^3/h Air
10	10,000	1.69
20	20,000	3.37
100	100,000	16.90
200	200,000	33.70
300	300,000	50.60
500	500,000	84.30
700	700,000	118
1,000	1,000,000	169
1,500	1,500,000	253
2,000	2,000,000	337
3,000	3,000,000	506
3,180	3,180,000	536
4,000	4,000,000	647
5,000	5,000,000	787
6,000	6,000,000	896
7,000	7,000,000	1,003
8,000	8,000,000	1,077
9,000	9,000,000	1,136
10,000	10,000,000	1,210
12,000	12,000,000	1,345
14,000	14,000,000	1,480
16,000	16,000,000	1,615
18,000	18,000,000	1,745
20,000	20,000,000	1,877
25,000	25,000,000	2,179
30,000	30,000,000	2,495

2/ Tank Out-Breathing - PRESSURE RELIEF

A/ Liquid filling:

For liquids with a *Flash Point above 100 °F (37.80 °C) or a *Boiling Point above 300 °F (148.90 °C)

IMPERIAL - For each Barrel/hr (42 USGPH) of liquid being filled, an out-breathing rate of 6 SCFH of air is required.

METRIC - For each M^3/h (1000 l/h) of liquid being filled, an out-breathing rate of 1.01 Nm^3/h of air is required.

For liquids with a *Flash Point below 100 °F (37.80 °C) or a *Boiling Point below 300 °F (148.90 °C)

IMPERIAL - For each Barrel/hr (42 USGPH) of liquid being filled, an out-breathing rate of 12 SCFH of air is required.

METRIC - For each M^3/h (1000 l/h) of liquid being filled, an out-breathing rate of 2.02 Nm^3/h of air is required.

B/ Thermal expansion:

Read the Out-breathing rate from the tables below.

It is important to realise that the tank capacity stated is the physical capacity (volume) and not the emptying rate.

IMPERIAL			
Tank capacity (Physical)		Out-breathing	
		*Flash>=100°F Boiling>=300°F	*Flash<100°F Boiling<300°F
Barrels	US Gallons	SCFH Air	SCFH Air
60	2,500	40	60
100	4,200	60	100
500	21,000	300	500
1,000	42,000	600	1,000
2,000	84,000	1,200	2,000
3,000	126,000	1,800	3,000
4,000	168,000	2,400	4,000
5,000	210,000	3,000	5,000
10,000	420,000	6,000	10,000
15,000	630,000	9,000	15,000
20,000	840,000	12,000	20,000
25,000	1,050,000	15,000	24,000
30,000	1,260,000	17,000	28,000
35,000	1,470,000	19,000	31,000
40,000	1,680,000	21,000	34,000
45,000	1,890,000	23,000	37,000
50,000	2,100,000	24,000	40,000
60,000	2,520,000	27,000	44,000
70,000	2,940,000	29,000	48,000
80,000	3,360,000	31,000	52,000
90,000	3,780,000	34,000	56,000
100,000	4,200,000	36,000	60,000
120,000	5,040,000	41,000	68,000
140,000	5,880,000	45,000	75,000
160,000	6,720,000	50,000	82,000
180,000	7,560,000	54,000	90,000

METRIC			
Tank capacity (Physical)		Out-breathing	
		*Flash>=37.80°C Boiling>=148.90°C	*Flash<37.80°C Boiling<148.90°C
Cubic metres	Litres	Nm3/h Air	Nm3/h Air
10	10,000	1.01	1.69
20	20,000	2.02	3.37
100	100,000	10.10	16.90
200	200,000	20.20	33.70
300	300,000	30.30	50.60
500	500,000	50.60	84.30
700	700,000	70.80	118
1,000	1,000,000	101	169
1,500	1,500,000	152	253
2,000	2,000,000	202	337
3,000	3,000,000	303	506
3,180	3,180,000	388	536
4,000	4,000,000	472	647
5,000	5,000,000	537	787
6,000	6,000,000	602	896
7,000	7,000,000	646	1,003
8,000	8,000,000	682	1,077
9,000	9,000,000	726	1,136
10,000	10,000,000	807	1,210
12,000	12,000,000	888	1,345
14,000	14,000,000	969	1,480
16,000	16,000,000	1,047	1,615
18,000	18,000,000	1,126	1,745
20,000	20,000,000	1,307	1,877
25,000	25,000,000	1,378	2,179
30,000	30,000,000	1,497	2,495

*NOTE: When the data is available for both the "FLASH POINT" and the "BOILING POINT" use the "FLASH POINT", otherwise you may use whichever is available.

C/ Tank Blanketing Valve

Refer to page 26 for the capacity supplied from the Tank Blanketing Valve.

3/ Out-Breathing due to External Fire - PRESSURE RELIEF:

For tanks subjected to an external fire source, the venting requirement can be determined as follows:

Imperial Units:

$$VR = 3.091 \times \left(\frac{QF}{L}\right) \times \left(\frac{T}{M}\right)^{0.5}$$

Metric Units:

$$VR = 881.55 \times \left(\frac{QF}{L}\right) \times \left(\frac{T}{M}\right)^{0.5}$$

Where:		Imperial Units	Metric Units
VR =	Air Venting Requirement.	SCFH Air	Nm^3/h Air
A =	Wetted surface area of Tank (see page 24).	Square Feet	Square metres
Q =	Heat input from fire exposure (see below).	BTU/h	Watts
F =	Environmental factor (if unknown use 1). This should be provided by the customer, or if more information is known about the location, insulation, etc. then refer to tables in API 2000.	No Units	No Units
L =	Latent heat of vaporisation of the stored liquid. (1BTU/lb = 2327J/Kg).	BTU/lb	J/Kg
T =	Temperature of relieving vapour. Normally assumed to be the boiling point of the stored fluid at the relieving pressure.	Degrees Rankin (R)	Degrees Kelvin (K)
M =	Molecular weight of the relieving vapour.	No Units	No Units

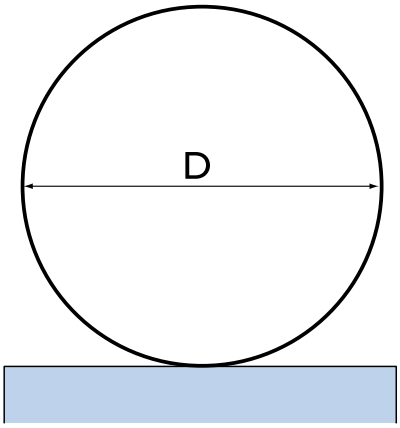
IMPERIAL - Heat input from fire exposure		
Wetted surface area	Design pressure	Heat input
Square Feet	Psig	BTU/hr
<200	<=15	Q=20,000A
>=200 and <1000	<=15	Q=199,300A^0.566
>=1000 and <2800	<=15	Q=963,400A^0.338
>=2800	>1 and <=15	Q=21,000A^0.82
>=2800	<=1	Q=14,090,000

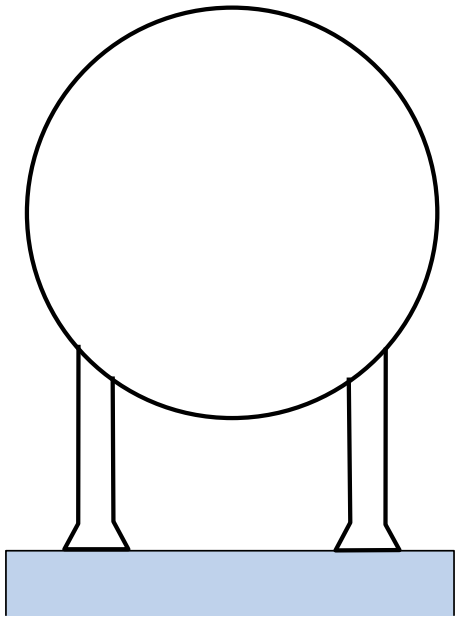
METRIC - Heat input from fire exposure		
Wetted surface area	Design pressure	Heat input
Square Metres	Barg	Watts
<18.6	<=1.034	Q=63,150A
>=18.6 and <93	<=1.034	Q=224,200A^0.566
>=93 and <260	<=1.034	Q=630,400A^0.338
>=260	>0.07 and <=1.034	Q=43,200A^0.82
>=260	<=0.07	Q=4,129,700

WETTED SURFACE AREA CALCULATION

Sphere: API 2000 states, the wetted area is equal to 55% of the total surface area or the surface area to a height of 30 feet (9.14 metres) above ground, whichever is the greater.

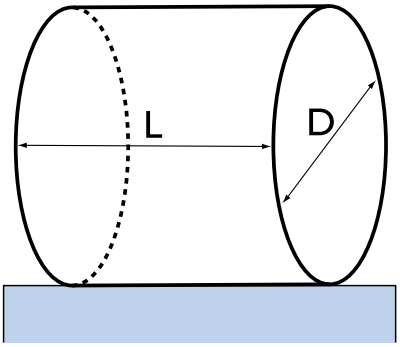
Total surface area = ¶ D^2

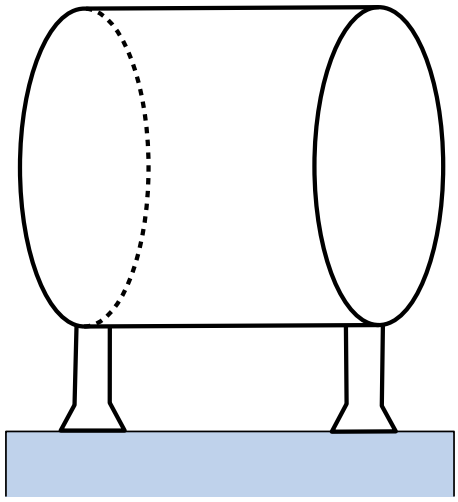




Horizontal: API 2000 states, the wetted area is equal to 75% of the total surface area or the surface area to a height of 30 feet (9.14 metres) above ground, whichever is the greater.

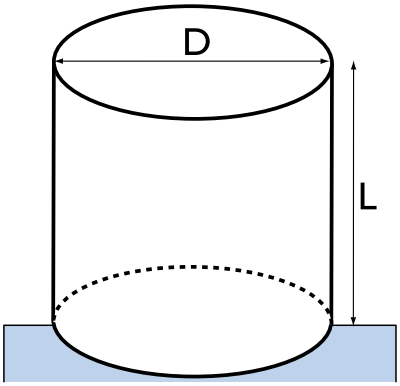
Total surface area = ¶ (DL + D^2/2) **(Flat Ends)**

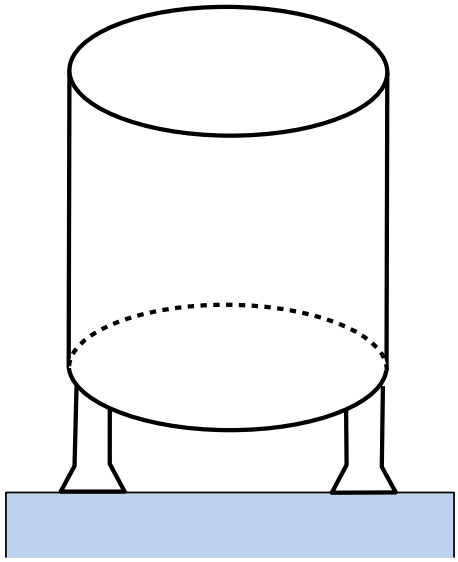




Vertical: API 2000 states, the wetted area is equal to 100% of the total surface area or the surface area to a height of 30 feet (9.14 metres) above ground, whichever is the greater.

Total surface area = ¶ (DL + D^2/2) **(Flat Ends)**





NOTES: ¶ = 3.1416

Deduct the area of one end for a vertical tank on the ground.

Determination of Equivalent Air Venting Requirements from a Given Gas Flow

The following formula can be used to convert a given gas flow to the equivalent Air flow.

Volumetric Gas Flow

When the given flow is in Volumetric units use this procedure:

$$\text{Free Air Flow Rate} = \frac{\text{Free Gas Flow Rate x SG Correction Factor}}{\text{Temperature Correction Factor}}$$

Where the flow rates are in either SCFH or Nm^3/h (do not mix).

SG Correction Factor			
Gas SG	SG Factor	Gas SG	SG Factor
0.20	0.447	1.10	1.049
0.30	0.548	1.20	1.095
0.40	0.632	1.30	1.140
0.50	0.707	1.40	1.183
0.60	0.775	1.50	1.225
0.65	0.806	1.60	1.265
0.70	0.837	1.70	1.304
0.75	0.866	1.80	1.342
0.80	0.894	1.90	1.378
0.85	0.922	2.00	1.414
0.90	0.949	2.50	1.581
0.95	0.975	3.00	1.732
1.00	1.000	3.50	1.871
1.05	1.025	4.00	2.000

Temperature Correction Factor								
Temp deg F	Temp deg C	Temp Factor	Temp deg F	Temp deg C	Temp Factor	Temp deg F	Temp deg C	Temp Factor
5	-15	1.0575	70	21	0.991	220	93	0.893
10	-12	1.0518	80	27	0.981	220	104	0.875
15	-9	1.0463	90	32	0.972	240	116	0.862
20	-7	1.0408	100	38	0.964	260	127	0.85
25	-4	1.0355	110	43	0.955	280	138	0.838
30	-1	1.0302	120	49	0.947	300	149	0.827
35	2	1.0249	130	54	0.939	320	160	0.817
40	4	1.0198	140	60	0.931	340	171	0.806
45	7	1.0147	150	66	0.923	360	182	0.796
50	10	1.0098	160	71	0.916	380	193	0.787
55	13	1.0048	170	77	0.908	400	204	0.778
60	16	1.0000	180	82	0.901	420	216	0.769

Mass Gas Flow

When the given flow is in Mass units use this procedure:

$$\text{Free Gas Flow Rate } (Nm^3/h) = \frac{\text{Gas Flow kg/h x 22.414}}{\text{Gas Molecular Weight}}$$

$$\text{Free Air Flow Rate } (Nm^3/h) = \text{Free Gas } Nm^3/h \times \sqrt{\frac{\text{MW Gas}}{\text{MW Air}}}$$

TANK BLANKETING VALVE SIZING

To correctly size and select a Tank Blanketing Valve, firstly determine the "in-breathing" flow rate of the protected tank or vessel.

From the tables shown below, using the "Supply Line" pressure and the required "in-breathing" flow rate, select a Tank Blanketing Valve which gives a rated capacity greater than the required flow.

Note: The 1" unit can have its flow restricted to 10%, 25%, 50% or 75% of the maximum flow show, thus matching the two flows more accurately. The 2.0" unit can be restricted to 20%, 40%, 60% or 80%. However the 0.5" unit cannot be restricted.

AIR

	1/2" unit		1" unit		2"	
Supply Line Pressure	Max. Air Rated Capacity		Max. Air Rated Capacity		Max. Air Rated Capacity	
Barg	Nm^3/h	Kg/h	Nm^3/h	Kg/h	Nm^3/h	Kg/h
1.4	10	13	375	485	1533	1984
2	16	20	445	576	1930	2498
3	22	28	593	767	2570	3327
4	27	35	740	959	3211	4156
5	33	42	888	1150	3851	4984
6	38	49	1036	1341	4492	5813
7	44	57	1183	1532	5132	6642
8	49	64	1331	1723	5773	7471
9	55	71	1479	1915	6413	8300
10	60	78	1627	2106	7053	9129
11	66	85	1774	2297	7694	9957
12	71	92	1922	2488	8334	10786
13	77	99	2070	2679	8975	11615
14	80	105	2190	2840	9487	12278

NITROGEN

	1/2" unit		1" unit		2" unit	
Supply Line Pressure	Max. Nitrogen Rated Capacity		Max. Nitrogen Rated Capacity		Max. Nitrogen Rated Capacity	
Barg	Nm^3/h	Kg/h	Nm^3/h	Kg/h	Nm^3/h	Kg/h
1.4	10	13	388	501	1560	1949
2	16	20	453	566	1964	2454
3	22	27	603	754	2616	3269
4	27	35	753	942	3267	4083
5	33	41	904	1130	3919	4897
6	39	49	1054	1318	4571	5712
7	45	56	1204	1506	5222	6526
8	50	63	1355	1693	5874	7340
9	56	70	1505	1881	6526	8155
10	61	76	1655	2069	7177	8969
11	67	83	1806	2257	7829	9783
12	72	90	1956	2445	8481	10598
13	78	97	2106	2633	9133	11412
14	83	107	2230	2790	9654	12063

Note: When the 0.5" valve is internal sensed the flow is only 25% of the above.

API 2000 - VALVE SIZING (AIR)

Once the required Air venting rates have been determined from the preceding pages or been given by the customer, the following calculation should be conducted to determine the required valve discharge area. Once this area has been determined, select the first standard valve flow area above this.

Metric Units:

$$A = \frac{VR}{12{,}503\ Kd\ (P_1+At)F\sqrt{\frac{K}{MTZ(k-1)}\left[\left(\frac{P_2+At}{P_1+At}\right)^{\frac{2}{k}}-\left(\frac{P_2+At}{P_1+At}\right)^{\frac{k+1}{k}}\right]}}$$

Imperial Units:

$$A = \frac{VR}{278{,}700\ Kd\ (P_1+At)F\sqrt{\frac{K}{MTZ(k-1)}\left[\left(\frac{P_2+At}{P_1+At}\right)^{\frac{2}{k}}-\left(\frac{P_2+At}{P_1+At}\right)^{\frac{k+1}{k}}\right]}}$$

Where:			Imperial Units	Metric Units
VR	=	Air Venting Requirements	SCFH Air	Nm^3/h Air
A	=	Required flow area of valve	in^2	cm^2
Kd	=	Coefficient of discharge (see page 28)		
P_1	=	Inlet flowing pressure (Set + Over Pressure – Inlet Pressure Loss)††	Psig	Barg
P_2	=	Outlet Pressure (Back Pressure)	Psig	Barg
K	=	Ratio of Specific Heats	Air = 1.4	Air = 1.4
T	=	Temperature at valve inlet	520 deg R	273 deg K
M	=	Molecular weight	Air = 28.97	Air = 28.97
Z	=	Compressibility factor	Air = 1.0	Air = 1.0
At	=	Atmospheric pressure	14.7 Psi	1.0138 Bar
F	=	Over Pressure factor (see page 28) (Use 1 for pilot valves)		

†† The Inlet Pressure Loss is due to factors such as difficult Inlet Piping, Flame Arresters etc. and must be less than the Over Pressure.

COEFFICIENTS

Valve Type	PRESSURE							VACUUM						
	Kd	Over Pressure Factor - F						Kd	Over Pressure Factor - F					
		10%	20%	30%	40%	50%	=>100%		10%	20%	30%	40%	50%	=>100%
121	0.957	0.4629	0.5841	0.6688	0.7356	0.7931	1.0000	0.536	0.4142	0.5205	0.6175	0.7071	0.7929	1.0000
121S	0.474	0.3418	0.4831	0.5781	0.6371	0.6983	1.0000	0.536	0.4142	0.5205	0.6175	0.7071	0.7929	1.0000
121SV	0.957	0.4629	0.5841	0.6688	0.7356	0.7931	1.0000	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
121SS	0.474	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
121V	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.536	0.4142	0.5205	0.6175	0.7071	0.7929	1.0000
121VS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
121F	0.515	0.3689	0.4641	0.5709	0.6757	0.7922	1.0000	0.536	0.4142	0.5205	0.6175	0.7071	0.7929	1.0000
121FS	0.339	0.3215	0.4543	0.5487	0.6195	0.6962	1.0000	0.536	0.4142	0.5205	0.6175	0.7071	0.7929	1.0000
121FSV	0.515	0.3689	0.4641	0.5709	0.6757	0.7922	1.0000	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
121FSS	0.339	0.3215	0.4543	0.5487	0.6195	0.6962	1.0000	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
401	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.529	0.4291	0.5406	0.6333	0.7164	0.7921	1.0000
451	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.320	0.3375	0.4781	0.5719	0.6281	0.7000	1.0000
501	0.515	0.3689	0.4641	0.5709	0.6757	0.7922	1.0000	0.515	0.3689	0.4641	0.5709	0.6757	0.7922	1.0000
551	0.339	0.3215	0.4543	0.5487	0.6195	0.6962	1.0000	0.339	0.3215	0.4543	0.5487	0.6195	0.6962	1.0000
601	0.957	0.4629	0.5841	0.6688	0.7356	0.7931	1.0000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
651	0.474	0.3418	0.4831	0.5781	0.6371	0.6983	1.0000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
785	0.462	1,0000	1.0000	1.0000	1.0000	1.0000	1.0000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
786	0.462	1,0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.474	0.3418	0.4831	0.5781	0.6371	0.6983	1.0000

P2/P1 (abs)	Kd (910)	Kd (920)
1.00	0.666	0.659
0.98	0.671	0.663
0.96	0.675	0.668
0.94	0.680	0.673
0.92	0.686	0.678
0.90	0.691	0.683
0.88	0.696	0.689
0.86	0.702	0.694
0.84	0.708	0.700
0.82	0.714	0.706
0.80	0.720	0.712
0.78	0.726	0.719
0.76	0.733	0.725
0.74	0.740	0.732
0.72	0.747	0.739
0.70	0.754	0.747
0.68	0.762	0.755
0.66	0.770	0.762
0.64	0.778	0.771
0.62	0.787	0.780
0.60	0.796	0.789
0.58	0.805	0.798
0.56	0.815	0.808
0.54	0.826	0.818
0.52	0.837	0.829
0.52	0.848	0.841

P1 (mbarg)	Kd (930)
10	0.794
20	0.812
30	0.823
40	0.831
50	0.837
60	0.842
70	0.846
80	0.850
90	0.853
100	0.856
150	0.868
200	0.876
250	0.882
300	0.888
350	0.892
400	0.896
450	0.900
500	0.903
550	0.906
600	0.908
650	0.911
700	0.913
750	0.915
800	0.917
850	0.919
900	0.921
950	0.922
1000	0.924

PILOT SET RANGE	
Set Pressure	mbarg
Min	10
Max	1000

Flow Areas	
Valve Inlet	Flow Area
Inch	cm^2
2	20.27
3	45.61
4	81.08
6	182.44
8	324.33
10	506.77
12	729.75
16	1297.34
18	1641.95
20	2027.09
24	2919.01
30	4560.96
32	5189.36
36	6567.78

Representative data on some vapours and gases

Gas or Vapour	K	C imperial	C metric	M	$\sqrt{M}$	G*	$\sqrt{G}$
Acetaldehyde	1.14	331	2.51	44	6.633	1.519	1.232
Acetic Acid	1.15	332	2.52	60	7.746	2.071	1.439
Acetylene	1.26	343	2.61	26.04	5.103	0.899	0.948
Air	1.40	356	2.70	28.97	5.382	1	1
Ammonia	1.31	348	2.64	17.03	4.127	0.587	0.766
Argon	1.67	377.5	2.87	40	6.325	1.381	1.175
Benzene	1.12	329	2.50	78.11	8.838	2.70	1.643
Butadiene 1.3	1.12	329	2.50	54.09	7.355	1.922	1.386
n-Butane	1.09	325	2.47	58.12	7.63	2.07	1.439
iso-Butane	1.1	327	2.49	58.12	7.63	2.07	1.439
i-Butane	1.11	327	2.49	56.10	7.49	1.937	1.392
iso-Butylene	1.12	329	2.49	56.10	7.49	1.998	1.413
Carbon Dioxide	1.29	346	2.68	44.01	6.634	1.53	1.237
Carbon Disulphate	1.21	338	2.57	76.13	8.726	2.628	1.621
Carbon Monoxide	1.40	356	2.70	28.00	5.292	0.967	0.983
Chloride	1.36	353	2.68	70.91	8.421	2.45	1.565
Cyclohexane	1.09	325	2.47	84.16	9.174	2.905	1.705
Decane	1.03	319	2.42	142	11.92	4.91	2.216
Dowthern A	1.043	320	2.43	165	12.85	5.696	2.386
DowthernE	-	-	-	147	12.12	5.074	2.253
Ethane	1.19	336	2.55	30.07	5.483	1.05	1.025
Ethene (Ethylene)	1.24	341	2.59	28.05	5.297	0.977	0.988
Ethyl Alcohol	1.13	330	2.50	46.07	6.787	1.59	1.261
Ethyl Benzine	1.07	323	2.46	106.16	10.31	3.67	1.916
Ethyl Chloride	1.19	336	2.55	64.50	8.031	2.226	1.492
Freon 11	1.14	331	2.51	137.37	11.72	4.742	2.177
Freon 12	1.14	331	2.51	120.92	10.995	4.174	2.043
Freon 22	1.18	325	2.55	86.48	9.299	2.985	1.727
Freon 114	1.09	325	2.47	170.93	13.073	5.90	2.429
Helium	1.66	377	2.86	4	2	0.138	0.3716
n-Heptane	1.05	321	2.44	100	10	3.49	1.868
n-Hexane	1.06	322	2.45	86.17	9.283	2.97	1.723
Hydrogen Chloride	1.41	357	2.71	36.47	6.039	1.27	1.127
Hydrogen	1.41	357	2.71	2.02	1.421	0.070	0.265
Hydrogen Sulphide	1.32	349	2.65	34.08	5.838	1.19	1.091
Methane	1.31	348	2.64	16.04	4.005	0.555	0.745
Menthyl Alcohol	1.20	337	2.56	32	5.657	1.11	1.054
Menthyl Butane	1.08	324	2.46	72.15	8.494	2.49	1.578
Methyl Chloride	1.20	337	2.56	50.48	7.105	1.742	1.320
Natural Gas	1.27	344	2.61	19	4.359	0.656	0.8009
Nitric Oxide	1.40	356	2.70	30	5.477	1.036	1.018
Nitrogen	1.40	356	2.70	28.02	5.294	0.967	0.9834
Nitrous Oxide	1.30	347	2.63	44	6.633	1.519	1.233
Nonane	1.04	320	2.43	128	11.31	4.43	2.105
n-Octane	1.05	321	2.44	114.22	10.687	3.94	1.985
Oxygen	1.40	356	2.70	32	5.657	1.10	1.0490
n-Pentane	1.07	323	2.46	72.15	8.494	2.49	1.578
Phenol	1.30	347	2.63	94	9.695	3.27	1.808
Propane	1.13	330	2.50	44.09	6.64	1.55	1.245
Propylene	1.15	332	2.52	42.08	6.487	1.476	1.214
Sulphur Dioxide	1.29	346	2.63	64.06	8.004	2.26	1.503
Steam	1.33	349	2.66	18	4.243	0.622	0.7887
Styrene	1.07	323	2.46	104.14	10.21	3.60	1.897
Toluene	1.09	325	2.47	92	9.592	3.18	1.783

*Air = 1.0 at 14.7 psia and 60°F.

121/121S/121SV/121SS/121V/121VS – ATMOSPHERIC VENTS

SETTING		DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")		DN200 (8")		DN250 (10")		DN300 (12")	
		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.	
mbarg		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Vac. Wt.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
Vac. Spr.		70	800	70	800	70	800	70	800	70	800	70	800	70	800
Press. Wt		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
Press. Spr.		70	3500	70	3500	70	3500	70	3000	70	2500	70	2000	70	2000
		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
VACUUM SET WEIGHT LOADED	2.5	44	64	99	145	175	257	394	578	702	1029	1096	1608	1578	2316
	5	62	91	140	205	248	364	557	817	992	1455	1550	2274	2232	3275
	10	88	129	197	289	351	514	787	1155	1403	2058	2192	3215	3156	4630
	20	124	182	279	409	496	727	1113	1633	1983	2909	3098	4545	4461	6545
	30	152	223	341	501	607	890	1363	1999	2427	3561	3793	5564	5462	8012
	40	175	257	394	378	700	1027	1573	2307	2802	4110	4378	6421	6304	9247
	50	196	287	440	646	783	1148	1758	2578	3131	4592	4892	7176	7045	10333
	60	214	314	482	707	857	1257	1925	2823	3428	5028	5357	7857	7714	11314
	70	231	339	521	763	925	1357	2078	3048	3702	5428	5784	8482	8328	12214
VACUUM SET SPRING LOADED	70	127	180	285	405	507	720	1140	1616	2030	2879	3172	4498	4567	6478
	80	136	192	305	433	542	769	1218	1727	2169	3076	3389	4807	4881	6921
	90	144	204	323	459	575	815	1291	1831	2300	3261	3593	5096	5174	7338
	100	151	215	341	483	606	859	1360	1929	2423	3436	3786	5369	5452	7731
	200	213	302	480	680	853	1209	1916	2715	3412	4835	5332	7555	7678	10879
	400	299	423	673	952	1196	1693	2687	3802	4786	6773	7478	10583	10769	15240
	600	363	514	818	1156	1454	2055	3265	4615	5815	8220	9086	12844	13084	18496
	800	416	588	937	1323	1666	2353	3741	5283	6664	9410	10413	14704	14994	21173
PRESSURE SET WEIGHT LOADED	2.5	88	119	198	269	351	478	789	1073	1406	1912	2196	2987	3163	4302
	5	124	169	280	380	497	676	1116	1518	1988	2704	3106	4224	4472	6083
	10	176	239	395	538	703	956	1578	2106	2810	3822	4391	5973	6323	8601
	20	248	338	559	760	993	1351	2230	3033	3973	5403	6207	8442	8938	12157
	30	304	413	684	930	1216	1653	2730	3713	4863	6614	7599	10335	10943	14882
	40	351	477	789	1074	1403	1908	3151	4286	5613	7634	8771	11928	12630	17176
	50	392	533	882	1200	1568	2133	3522	4789	6273	8530	9802	13329	14115	19194
	60	429	584	966	1313	1717	2335	3856	5244	6869	9340	10733	14594	15456	21015
	70	464	630	1043	1418	1854	2521	4164	5661	7416	10083	11588	15755	16687	22688
PRESSURE SET SPRING LOADED	70	190	270	427	608	760	1081	1706	2428	3038	4326	4707	6759	6836	9733
	80	203	289	457	650	812	1155	1823	2595	3247	4622	5073	7222	7305	10399
	90	215	306	484	689	860	1225	1932	2751	3442	4900	5378	7656	7745	11025
	100	227	323	510	726	907	1291	2036	2898	3627	5162	5667	8066	8160	11615
	200	319	454	718	1022	1277	1816	2867	4079	5107	7265	7980	11352	11492	16346
	400	448	636	1007	1431	1791	2544	4022	5713	7163	10176	11193	15901	16118	22897
	600	544	772	1224	1737	2176	3088	4886	6934	8704	12351	13600	19298	19584	27789
	800	623	884	1403	1988	2494	3535	5600	7938	9974	14139	15585	22092	22443	31813
	1000	692	980	1557	2205	2768	3920	6215	8802	11071	15679	17299	24499	24910	35279
	2000	948	1338	2133	3011	3792	5352	8532	12019	15168	21409	23701	33452	34129	48171
	2500	1046	1474	2353	3317	4182	5896	9392	13240	16730	23584	N/A	N/A	N/A	N/A
	3000	1131	1593	2546	3585	4525	6373	10162	14311	N/A	N/A	N/A	N/A	N/A	N/A
	3500	1208	1700	2718	3825	4832	6799	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Maximum setting limitations:- Aluminium 1000 mbarg/Plastic 200 mbarg.

121F/121FS/121FSV/121FSS – PIPED VENTS

SETTING		DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")		DN200 (8")		DN250 (10")		DN300 (12")	
		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.	
mbarg		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Vac. Wt.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
Vac. Spr.		70	800	70	800	70	800	70	800	70	800	70	800	70	800
Press. Wt		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
Press. Spr.		70	3500	70	3500	70	3500	70	3000	70	2500	70	2000	70	2000
		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
VACUUM SET WEIGHT LOADED	2.5	44	64	99	145	175	257	394	578	702	1029	1096	1608	1578	2316
	5	62	91	140	205	248	364	557	817	992	1455	1550	2274	2232	3275
	10	88	129	197	289	351	514	787	1155	1403	2058	2192	3215	3156	4630
	20	124	182	279	409	496	727	1113	1633	1983	2909	3098	4545	4461	6545
	30	152	223	341	501	607	890	1363	1999	2427	3561	3793	5564	5462	8012
	40	175	257	394	378	700	1027	1573	2307	2802	4110	4378	6421	6304	9247
	50	196	287	440	646	783	1148	1758	2578	3131	4592	4892	7176	7045	10333
	60	214	314	482	707	857	1257	1925	2823	3428	5028	5357	7857	7714	11314
	70	231	339	521	763	925	1357	2078	3048	3702	5428	5784	8482	8328	12214
VACUUM SET SPRING LOADED	70	127	180	285	405	507	720	1140	1616	2030	2879	3172	4498	4567	6478
	80	136	192	305	433	542	769	1218	1727	2169	3076	3389	4807	4881	6921
	90	144	204	323	459	575	815	1291	1831	2300	3261	3593	5096	5174	7338
	100	151	215	341	483	606	859	1360	1929	2423	3436	3786	5369	5452	7731
	200	213	302	480	680	853	1209	1916	2715	3412	4835	5332	7555	7678	10879
	400	299	423	673	952	1196	1693	2687	3802	4786	6773	7478	10583	10769	15240
	600	363	514	818	1156	1454	2055	3265	4615	5815	8220	9086	12844	13084	18496
	800	416	588	937	1323	1666	2353	3741	5283	6664	9410	10413	14704	14994	21173
PRESSURE SET WEIGHT LOADED	2.5	38	59	85	133	150	236	337	531	601	945	939	1477	1352	2127
	5	53	84	120	188	212	334	477	750	850	1336	1328	2088	1912	3007
	10	75	118	169	266	300	472	675	1061	1202	1890	1877	2952	2703	4271
	20	106	167	239	376	425	668	954	1499	1698	2671	2654	4173	3822	6010
	30	130	204	292	460	520	817	1167	1836	2079	3270	3249	5109	4679	7356
	40	150	236	338	531	600	943	1347	2118	2400	3773	3750	5896	5400	8490
	50	168	264	377	593	671	1054	1506	2367	2682	4217	4191	6599	6035	9488
	60	184	289	413	649	734	1154	1649	2592	2937	4617	4589	7214	6608	10388
	70	198	312	446	701	793	1246	1780	2798	3171	4984	4954	7788	7134	11215
PRESSURE SET SPRING LOADED	70	128	188	287	423	511	752	1147	1689	2043	3008	3192	4700	4597	6768
	80	136	201	307	452	546	803	1226	1804	2183	3214	3411	5022	4912	7231
	90	145	213	326	479	579	852	1299	1913	2315	3407	3617	5324	5208	7666
	100	152	224	343	505	610	897	1369	2015	2439	3590	3811	5609	5488	8077
	200	215	316	483	710	859	1263	1928	2836	3435	5052	5367	7893	7728	11367
	400	301	442	677	995	1204	1769	2704	3973	4817	7076	7527	11057	10839	15922
	600	366	537	823	1208	1463	2147	3286	4821	5853	8588	9146	13419	13170	19324
	800	419	614	943	1383	1677	2458	3766	5520	6708	9832	10481	15362	15092	22122
	1000	465	681	1047	1533	1861	2726	4180	6121	7445	10903	11633	17036	16752	24532
	2000	638	930	1434	2094	2550	3722	5727	8358	10201	14887	15939	23261	22952	33496
	2500	703	1025	1582	2306	2813	4100	6316	9207	11251	16400	N/A	N/A	N/A	N/A
	3000	761	1108	1712	2493	3043	4431	6834	9951	N/A	N/A	N/A	N/A	N/A	N/A
	3500	812	1182	1828	2660	3250	4728	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Maximum setting limitations:- Aluminium 1000 mbarg/Plastic 200 mbarg.

401/451 – SIDE MOUNTED VACUUM VALVES

SETTING		DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")		DN200 (8")		DN250 (10")		DN300 (12")		DN400 (16")	
		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.	
mbarg		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
401 Wt.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
451 Spr.		70	800	70	800	70	800	70	800	70	800	70	800	70	800	70	800
		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
401 –VACUUM SET WEIGHT LOADED	2.5	45	64	101	145	180	257	404	578	719	1029	1124	1608	1618	2316	2877	4117
	5	64	91	143	205	254	364	571	817	1017	1455	1589	2274	2288	3275	4068	5822
	10	90	129	202	289	359	514	807	1155	1438	2058	2247	3215	3235	4630	5751	8231
	20	127	182	286	409	508	727	1141	1633	2032	2909	3176	4545	4573	6545	8130	11635
	30	156	223	350	501	622	890	1397	1999	2488	3561	3888	5564	5599	8012	9953	14243
	40	179	257	404	578	718	1027	1612	2307	2872	4110	4487	6421	6462	9247	11488	16439
	50	201	287	451	646	802	1148	1802	2578	3210	4592	5015	7176	7222	10333	12838	18370
	60	220	314	494	707	879	1257	1973	2823	3514	5028	5491	7857	7907	11314	14058	20113
	70	237	339	534	763	949	1357	2130	3048	3794	5428	5929	8482	8537	12214	15178	21714
451 – VACUUM SET SPRING LOADED	70	127	180	285	405	507	720	1140	1616	2030	2879	3172	4498	4567	6478	8120	11516
	80	136	192	305	433	542	769	1218	1727	2169	3076	3389	4807	4881	6921	8676	12305
	90	144	204	323	459	575	815	1291	1831	2300	3261	3593	5096	5174	7338	9199	13045
	100	151	215	341	483	606	859	1360	1929	2423	3436	3786	5369	5452	7731	9692	13744
	200	213	302	480	680	853	1209	1916	2715	3412	4835	5332	7555	7678	10879	13649	19341
	400	299	423	673	952	1196	1693	2687	3802	4786	6773	7478	10583	10769	15240	19144	27093
	600	363	514	818	1156	1454	2055	3265	4615	5815	8220	9086	12844	13084	18496	23261	32881
	800	416	588	937	1323	1666	2353	3741	5283	6664	9410	10413	14704	14994	21173	26657	37642

Maximum setting limitations:
Plastic 200 mbarg.

501/551 – BOTTOM MOUNTED LOW PRESSURE SAFETY or SIDE MOUNTED VACUUM VALVES

SETTING		DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")		DN200 (8")		DN250 (10")		DN300 (12")		DN400 (16")	
		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.	
mbarg		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
501 Wt. Press.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
501 Wt. Vac.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
551 Spr. Press.		70	3500	70	2800	70	2100	70	2100	70	2100	70	2000	70	2000	70	1500
551 Spr. Vac.		70	800	70	800	70	800	70	800	70	800	70	800	70	800	70	800
		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
501 – SETTING WEIGHT LOADED	2.5	38	59	85	133	150	236	337	531	601	945	939	1477	1352	2127	2404	3780
	5	53	84	120	188	212	334	477	750	850	1336	1328	2088	1912	3007	3399	5346
	10	75	118	169	266	300	472	675	1061	1202	1890	1877	2952	2703	4271	4806	7558
	20	106	167	239	376	425	668	954	1499	1698	2671	2654	4173	3822	6010	6794	10684
	30	130	204	292	460	520	817	1167	1836	2079	3270	3249	5109	4679	7356	8317	13078
	40	150	236	338	531	600	943	1347	2118	2400	3773	3750	5896	5400	8490	9600	15094
	50	168	264	377	593	671	1054	1506	2367	2682	4217	4191	6599	6035	9488	10729	16867
	60	184	289	413	649	734	1154	1649	2592	2937	4617	4589	7214	6608	10388	11748	18468
	70	198	312	446	701	793	1246	1780	2798	3171	4984	4954	7788	7134	11215	12683	19938
551 – SETTING SPRING LOADED	70	128	188	287	423	511	752	1147	1689	2043	3008	3192	4700	4597	6768	8173	12031
	80	136	201	307	452	546	803	1226	1804	2183	3214	3411	5022	4912	7231	8733	12856
	90	145	213	326	479	579	852	1299	1913	2315	3407	3617	5324	5208	7666	9259	13629
	100	152	224	343	505	610	897	1369	2015	2439	3590	3811	5609	5488	8077	9756	14359
	200	215	316	483	710	859	1263	1928	2836	3435	5052	5367	7893	7728	11367	13739	20207
	400	301	442	677	995	1204	1769	2704	3973	4817	7076	7527	11057	10839	15922	19270	28306
	600	366	537	823	1208	1463	2147	3286	4821	5853	8588	9146	13419	13170	19324	23413	34353
	800	419	614	943	1383	1677	2458	3766	5520	6708	9832	10481	15362	15092	22122	26831	39327
	1000	465	681	1047	1533	1861	2726	4180	6121	7445	10903	11633	17036	16752	24532	29781	43612
	2000	638	930	1434	2094	2550	3722	5727	8358	10201	14887	15939	23261	22952	33496	N/A	N/A
	2100	651	950	1466	2139	2606	3802	5863	8555	10423	15208	N/A	N/A	N/A	N/A	N/A	N/A
	2800	739	1076	1662	2421	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3500	812	1182	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Maximum setting limitations: Aluminium 1000 mbarg/Plastic 200 mbarg.

601/651 – LOW PRESSURE SAFETY VALVES ATMOSPHERIC VENTS

SETTING		DN50 (2")		DN80 (3")		DN100 (4")		DN150 (6")		DN200 (8")		DN250 (10")		DN300 (12")		DN400 (16")	
		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.		Set Press.	
mbarg		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
601 Wt.		2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70	2.5	70
651 Spr.		70	3500	70	2800	70	2100	70	2100	70	2100	70	2000	70	2000	70	1500
SETTING		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
601 – PRESSURE SET WEIGHT LOADED	2.5	88	119	198	269	351	478	789	1073	1406	1912	2196	2987	3163	4302	5622	7648
	5	124	169	280	380	497	676	1116	1518	1988	2704	3106	4224	4472	6083	7950	10814
	10	176	239	395	538	703	956	1578	2106	2810	3822	4391	5973	6323	8601	11241	15290
	20	248	338	559	760	993	1351	2230	3033	3973	5403	6207	8442	8938	12157	15891	21613
	30	304	413	684	930	1216	1653	2730	3713	4863	6614	7599	10335	10943	14882	19454	26457
	40	351	477	789	1074	1403	1908	3151	4286	5613	7634	8771	11928	12630	17176	22454	30535
	50	392	533	882	1200	1568	2133	3522	4789	6273	8530	9802	13329	14115	19194	25093	34122
	60	429	584	966	1313	1717	2335	3856	5244	6869	9340	10733	14594	15456	21015	27477	37361
	70	464	630	1043	1418	1854	2521	4164	5661	7416	10083	11588	15755	16687	22688	29666	40334
651 – PRESSURE SET SPRING LOADED	70	190	270	427	608	760	1081	1709	2433	3038	4326	4747	6759	6836	9733	12153	17302
	80	203	289	457	650	812	1155	1823	2595	3247	4622	5073	7222	7305	10399	7305	18488
	90	215	306	484	689	860	1225	1932	2751	3442	4900	5378	7656	7745	11025	7745	19600
	100	227	323	510	726	907	1291	2036	2898	3627	5162	5667	8066	8160	11615	14507	20650
	200	319	454	718	1022	1277	1816	2867	4079	5107	7265	7980	11352	11492	16346	20430	29060
	400	448	636	1007	1431	1791	2544	4022	5713	7163	10176	11193	15901	16118	22897	28654	40707
	600	544	772	1224	1737	2176	3088	4886	6934	8704	12351	13600	19298	19584	27789	34816	49403
	800	623	884	1403	1988	2494	3535	5600	7938	9974	14139	15585	22092	22443	31813	39898	56557
	1000	692	980	1557	2205	2768	3920	6215	8802	11071	15679	17299	24499	24910	35279	44285	62718
	2000	948	1338	2133	3011	3792	5352	8532	12019	15168	21409	23701	33452	34129	48171	N/A	N/A
	2100	969	1367	2180	3076	3875	5467	8719	12302	15499	21870	N/A	N/A	N/A	N/A	N/A	N/A
	2800	1098	1547	2471	3481	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	3500	1208	1700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Maximum setting limitations: Aluminium 1000 mbarg/Plastic 200 mbarg.

785/786 – EMERGENCY VENTS

SETTING		DN250 (10")		DN300 (12")		DN400 (16")		DN450 (18")		DN200 (20")		DN600 (24")		DN750 (30")		DN800 (32")		DN900 (36")	
		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.		Over Press.	
mbarg		20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%	20%	40%
786 VACUUM SPRING LOAD	2.5	N/A	N/A	N/A	N/A	N/A	N/A	576	820	576	820	576	820	576	820	576	820	576	820
	10	N/A	N/A	N/A	N/A	N/A	N/A	1151	1640	1151	1640	1151	1640	1151	1640	1151	1640	1151	1640
	20	N/A	N/A	N/A	N/A	N/A	N/A	1627	2318	1627	2318	1627	2318	1627	2318	1627	2318	1627	2318
	30	N/A	N/A	N/A	N/A	N/A	N/A	1992	2837	1992	2837	1992	2837	1992	2837	1992	2837	1992	2837
	40	N/A	N/A	N/A	N/A	N/A	N/A	2300	3275	2300	3275	2300	3275	2300	3275	2300	3275	2300	3275
	250	N/A	N/A	N/A	N/A	N/A	N/A	5698	8103	5698	8103	5698	8103	5698	8103	5698	8103	5698	8103
PRESSURE SET WEIGHT LOADED	4.5	2435	2630	3506	3787	6234	6733	7890	8521	9740	10520	14026	15149	21915	23670	24935	26932	31558	34085
	10	3629	3920	5226	5644	9290	10034	11758	12699	14516	15678	20904	22577	32662	35276	37162	40137	47033	50798
	20	5130	5540	7387	7978	13133	14183	16622	17951	20521	22162	29550	31913	46171	49864	52533	56734	66487	71804
	40	7249	7828	10438	11272	18557	20039	23487	25361	28996	31310	41754	45087	65241	70448	74229	80154	93947	101445
	60	8871	9577	12774	13791	22709	24518	28741	31031	35482	38309	51095	55165	79835	86196	90835	98072	114963	124122
	80	10234	11048	14737	15909	26200	28283	33159	35796	40937	44192	58949	63636	92108	99432	104789	113131	132635	143182
	100	11432	12340	16463	17769	29267	31590	37041	39981	45730	49359	65851	71077	102893	111058	117069	126360	148165	159924
	120	12513	13504	18019	19446	32034	34571	40543	43754	50052	54017	72075	77785	112618	121539	128134	138284	162170	175015
	140	13504	14572	19446	20984	34571	37304	43754	47213	54017	58288	77785	83934	121159	131148	138284	149217	175015	188852

Maximum setting limitations: Plastic 200 mbarg.

SETTINGS			
Weight Loaded		Spring Loaded	
Pressure		Vacuum	
Min mbarg	Max mbarg	Min mbarg	Max mbarg
4.5	140	2.5	250

NOTE:
The 786 vacuum capacity is based on a nominal DN200 (8") vacuum valve, which is fitted to all sizes DN450 (18") and above.

TERMS AND DEFINITIONS

For the purpose of this catalogue the following Terms and Definitions have been applied from API2000.

Accumulation:
The pressure increase in a tank over its maximum allowable working pressure when the vent valve is relieving (expressed in pressure units or percentage of the maximum allowable working pressure). Maximum allowable accumulations are typically established by applicable codes for operating and fire contingencies.

Barrel:
A liquid unit of measure equal to 42 US gallons (0.159 cubic metres).

BTU:
British Thermal Unit, a unit of heat that will increase the temperature of one pound of water one degree Fahrenheit.

Emergency venting:
The venting required when an abnormal condition, such as ruptured internal heating coils or an external fire, exists either inside or outside of a tank.

Normal venting:
The venting required because of operational requirements or atmospheric changes.

Overpressure:
The pressure increase at the valve inlet above the set pressure, when the valve is relieving, expressed as a percentage of the set pressure. It is the same as accumulation when the valve is set at the maximum allowable working pressure and the inlet piping losses are zero.

Petroleum:
Crude oil.

Petroleum products:
Hydrocarbon materials or other products derived from crude oil.

PV valve:
A weight-loaded, pilot-operated or spring-loaded valve, used to relieve excess pressure and/or vacuum that has developed in a tank.

Rated relieving capacity:
The flow capacity of a relief device expressed in terms of air flow at standard conditions (SCFH or Nm^3/h) at a designated pressure or vacuum.

Relief device:
Any device used to relieve excess pressure and/or vacuum that has developed in a tank.

Relieving pressure:
The pressure at the inlet of a relief device when it is flowing at the required relieving capacity.

Required flow capacity:
The flow capacity of a relief device required to prevent excessive pressure or vacuum in a tank under the most severe operating or emergency conditions.

SCFH:
Standard cubic feet of air or gas per hour (same as free air or free gas) at a temperature of 60^0 F (15.6^0 C) and a pressure of 14.7 pounds per square inch absolute (1.014 bar absolute).

Nm^3/h:
Normal cubic meters of air or gas per hour at a temperature of 0^0 C and pressure of 1.014 bar.

Set pressure:
The gauge pressure at the device inlet at which the relief device is set to start opening under service conditions (measurable lift begins).

Thermal inbreathing:
The movement of air or blanketing gas into a tank when vapours in the tank contract or condense as a result of weather changes (e.g. a decrease in atmospheric temperature).

Thermal outbreathing:
The movement of vapours out of a tank when vapours in the tank expand and liquid in the tank vapourises as a result of weather changes (e.g. an increase in atmospheric temperature).

Wetted area:
The surface area of a tank exposed to liquid on the interior and heat from a fire on the exterior.

PRESSURE

GIVEN UNITS \ REQUIRED UNITS	mbarg	barg	psig	mm water	inch water	inch Mercury	kpag	kg/cm²g	oz/in²g
mbarg		0.001	0.0145	10.21	0.4019	0.02961	0.1	0.00102	0.232
barg	1000		14.5	10207	401.9	29.61	100	1.0197	232.1
psig	68.95	0.0689		703.8	27.71	2.042	6.895	0.0703	16
mm water	0.098	0.0001	0.001421		0.0394	0.0029	0.0098	0.0001	0.0227
inch water	2.488	0.0025	0.03609	25.4		0.0737	0.2488	0.0025	0.5775
inch Mercury	33.77	0.0338	0.4898	344.7	13.57		3.377	0.0344	7.836
kpag	10	0.01	0.145	102.1	4.019	0.2961		0.0102	2.321
kg/cm²g	980.7	0.9807	14.22	10010	394.1	29.04	98.07		227.6
oz/in²g	4.309	0.0043	0.0625	43.99	1.732	0.1276	0.4309	0.0044	

VOLUME

GIVEN UNITS \ REQUIRED UNITS	ft³	Litres	M³	US gal.	Barrel
ft³		28.317	0.02832	7.4805	0.1781
Litres	0.0351		0.001	0.26417	0.00629
M³	35.3147	1000		264.172	6.28981
US gal.	0.13368	3.78451	0.003785		0.00283
Barrel	5.61458	158.9873	0.15899	42	

Required Units
=
Given Units
x
Chart Factor

AREA

GIVEN UNITS \ REQUIRED UNITS	in²	ft²	Sq Yards	m²	mm²
in²		0.006944	0.0007716	0.00064516	645.6
ft²	144		0.11111	0.0929	92900
Sq Yards	1296	9		0.83613	836100
m²	1550	10.764	1.196000		1xE+06
mm²	0.00155	1.076E-05	1.196xE-06	1xE-06	

VELOCITY

GIVEN UNITS \ REQUIRED UNITS	Ft/sec	Ft/min	M/sec	M/min	Km/hr
Ft/sec		60	0.3048	18.288	1.09728
Ft/min	0.01667		0.00508	0.3048	0.01829
M/sec	3.28084	196.85		60	3.6
M/min	0.05468	3.28084	0.016670		0.06
Km/hr	0.91134	5.468E+01	0.27777	16.6667	

MASS

GIVEN UNITS \ REQUIRED UNITS	Ounces	Pounds	Kgs	Tonnes	Grams
Ounces		0.0625	0.02835	2.835xE-05	28.3495
Pounds	16		0.45359	4.536xE-04	453.59
Kgs	35.274	2.2046		0.001	1000
Tonnes	35274	2204.623	1000.000000		1xE+06
Grams	0.03527	2.205E-03	0.00100	1xE-06	

LENGTH

GIVEN UNITS \ REQUIRED UNITS	Inches	Feet	Yards	mm	Metres
Inches		0.83333	0.02777	25.4	0.0254
Feet	12		0.33333	304.800000	0.3048
Yards	36	3		914.4	0.9144
mm	0.03937	0.00328	0.001936		0.001
Metres	39.37	3.2808	1.0936	1000	

The Marvac "MEGAFLO" Valve

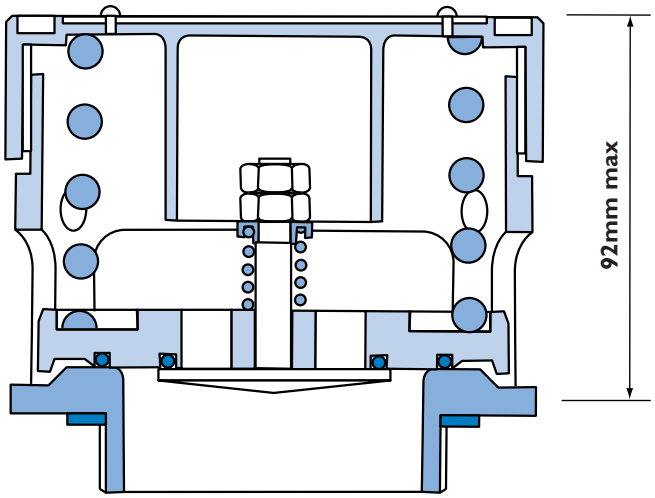
The Marvac - **Megaflo fig 011**
Is a Pressure/Vacuum or Pressure only safety relief valve, designed to be compact yet achieve high discharge capacities. These two stringent requirements are demanded by Road, Rail and Container Tank manufacturers to minimise size and weight, yet maximise protection.

The valves are manufactured in 316 stainless steel and can be electrochemically polished for use in hygienic applications. Seal materials are FEP encapsulated "O" rings ensuring compatibility with highly corrosive media. A flame gauze can be fitted for use on flammable processes. Seal life is maximised by having a metal back-up seat, which gives continued protection in the event of seal failure.

Materials: Body 316ss
Internals 316ss
Seals FEP/PTFE

Size: 2½"

Connections: Screwed BSP
Flanged available



IMCO Ref.	Set Pressure Barg	Discharge Capacity m3/h AIR
IMCO1-4	4.40	11696
IMCO1-3	3.71	10156
IMCO2	2.17	9266
	3.31	6722

Standard Vacuum Setting = 0.203 Barg

The Marston "TANK-A-VENT" Bursting Disc

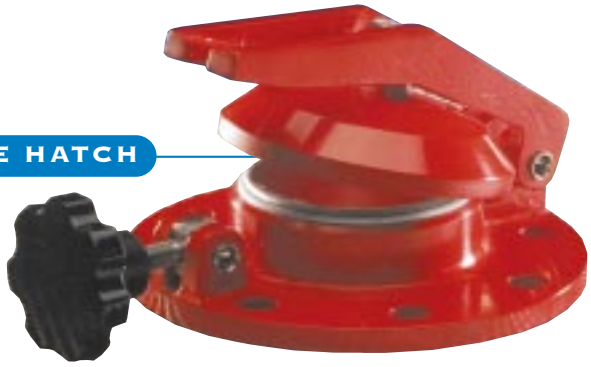
The Marston "TANK-A-VENT" Bursting Disc is specifically designed for the protection of safety valves on road and rail tankers.

- Suitable for Gas or Liquid applications.
- Non fragmentational.
- Simple one piece installation.
- Available with support for vacuum operation.
- No holder required.
- Wide range of material options available.

Marvac

Product Range

GAUGE HATCH



TANK BLANKETING

PRESSURE VACUUM

PLASTIC PRESSURE VACUUM

PILOT OPERATED

MANWAY/EMERGENCY VENT

TRANSPORTATION VALVE

Marvac

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Assistance:

Our experienced and fully trained team of Technical Sales Engineers and agents are available to give advice and assistance on the sizing and selection of the Marvac Product Range.

This service is available to you by calling your local agent or our Marvac Technical Sales Department, who will be happy to help.

Details of our worldwide network of distributors and regional offices are available on our website.

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