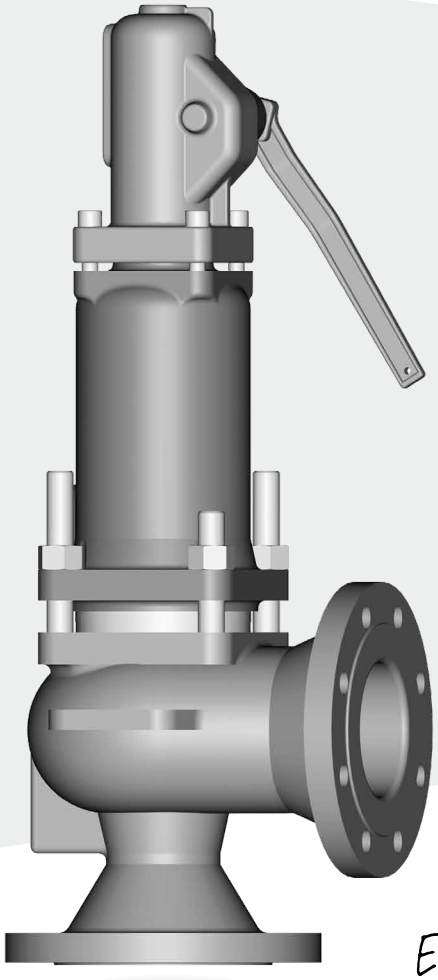
IMI BOPP & REUTHER

Si 4322



Engineering
GREAT Solutions

Safety valves for pressure relief in accordance to PED, DIN/EN and ASME

IMI Critical Engineering

Si 4322

Features

The modern pressure safety valve for regular capacities

- Cost-effective body design with seat bushing developed with the modular principle with other series
- Smooth and stable behaviour thanks to comparatively low lift
- Inner parts made of stainless steel (except spring and spring washer)

Inlet sizes
DN 25 to DN 100

Inlet pressure rating
PN 10 to PN 40

Set pressures
0.1 bar g to 40 bar g

Temperature range
-270°C to +450°C

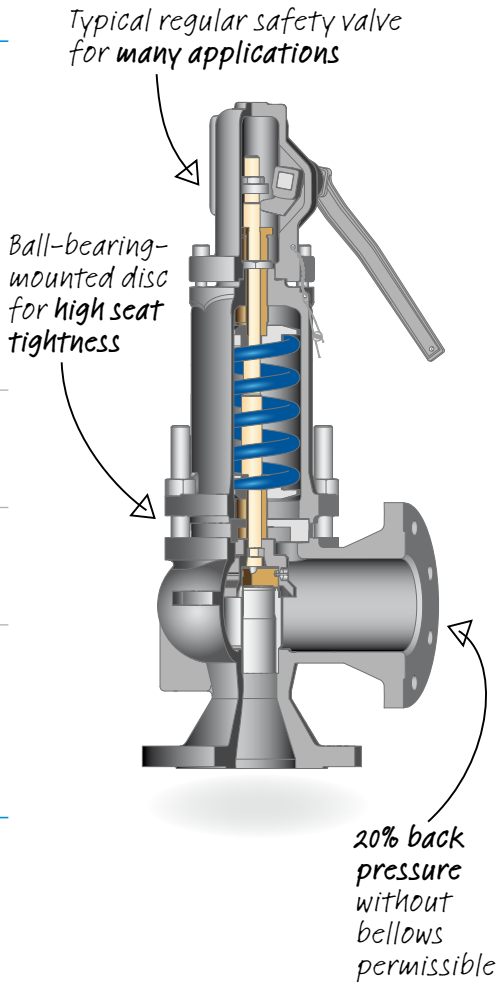
Overpressure

Vapours/gases	5%
Liquids	10%

Blowdown

Vapours/gases	10%
Liquids	20%

Allowable built-up back pressure without bellows
20% of the set pressure



Applications

- For vapours, gases and liquids
- Thermal expansion
- Protection of pipelines, protection of heat exchangers
- Chemical industry
- Petrochemical industry
- Technical gases
- Cooling and oxygen applications
- Other process applications up to PN 40

Approvals and standards

EC type examination

- Pressure Equipment Directive 97/23/EC
- DIN EN ISO 4126-1
- AD2000-Merkblatt A2
- VdTÜV Merkblatt “Sicherheitsventil 100”

VdTÜV type examination acc. to

TÜV.SV.12-1094.d_0.D / G / F.α_w.p

IMI Bopp & Reuther will not renew the existing VdTÜV type approvals. The requirements by VdTÜV and applicable standards are completely considered by the EC type examination.

The design, manufacture, testing and labelling meet the requirements of DIN EN ISO 4126-1, DIN EN 12266-1/-2 (insofar as applicable for safety valves), EN 1092-1, EN 1759-1, AD 2000-Merkblätter A2 and HP0, ASME B16.5, ASME VIII

Si 4322

Type code

Type code				Ordering example
1	**Series**	Si 4	Pressure safety valve for regular capacities	Si 4
2	**Design**	1	Conventional, open bonnet	4
		3	Conventional, closed bonnet	
		4	Bellows, closed bonnet	
		5	Bellows, open bonnet	
3	**Characteristic**	2	Regular Flow	2
4	**Pressure class**	2	Up to PN 40	2
5	**Cap**	G	Gas-tight cap	A
		GB	Gas-tight cap with test gag	
		A	Packed lifting lever	
		AB	Packed lifting lever with test gag	
		AK	Pneumatic actuator	
6	**Material code**	00	GP240GH / 1.0619 +N	00
		04	GX5CrNiMo19-11-2 / 1.4408	
7	**Options**	.09	Locking sleeve (government ring)	.35
		.11t	Disc with soft seal PTFE	
		.14a	Lift indication with inductive proximity switch in the cap	
		.14b	Lift indication with inductive proximity switch in the auxiliary housing	
		.14c	Lift indication with inductive proximity switch for exposed spindle with actuator AK	
		.15	Bonnet insulation spacer for high and low temperatures	
		.18	Heating jacket	
		.28	Oil and grease free	
		.35	With lift restriction ring	
		.57	Weight loading	
		.59	Stellited disc	
		.60	Stellited seat	

Type ►	**Si 4422 A 00.35**
Please state: ►	
Set pressure	18 bar g
Fluid temperature	20 °C
Fluid and state	Petrol Liquid
Inlet	DN 25, PN 40, B1
Outlet	DN 25, PN 16, B1
Flow diameter	13.6 mm
Approval	97/23/EG (CE)

Si 4322

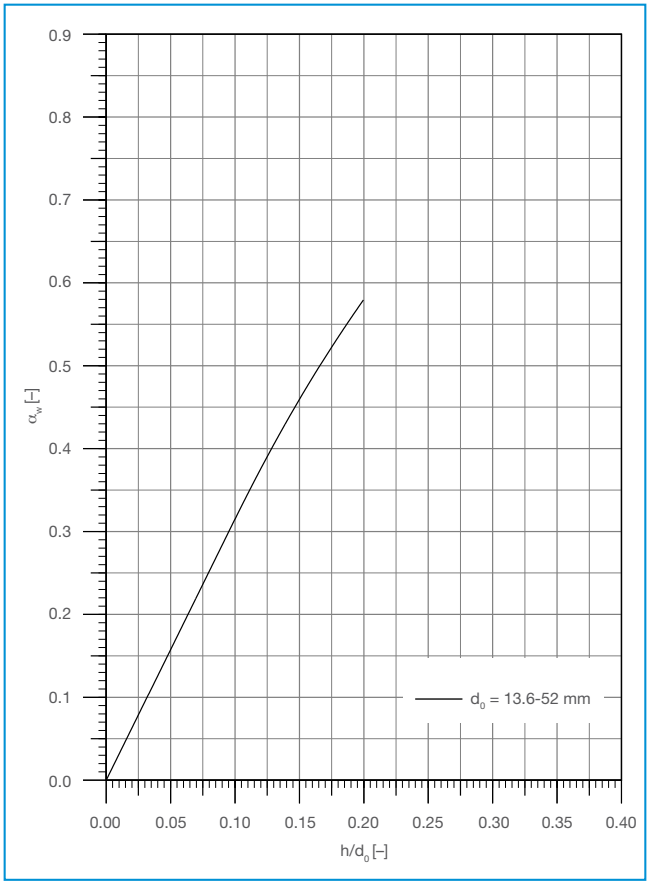
Coefficient of discharge

Fluid group	Inlet size	Flow diameter	$h/d_0 \geq$	$p_b/p_0 \leq$	α_w
Vapours / gases (D / G)	DN 25 to DN 100	13.6 mm to 52 mm	0.2	0.2	0.58
Liquids (F)	DN 25 to DN 100	13.6 mm to 52 mm	0.2	-	0.42

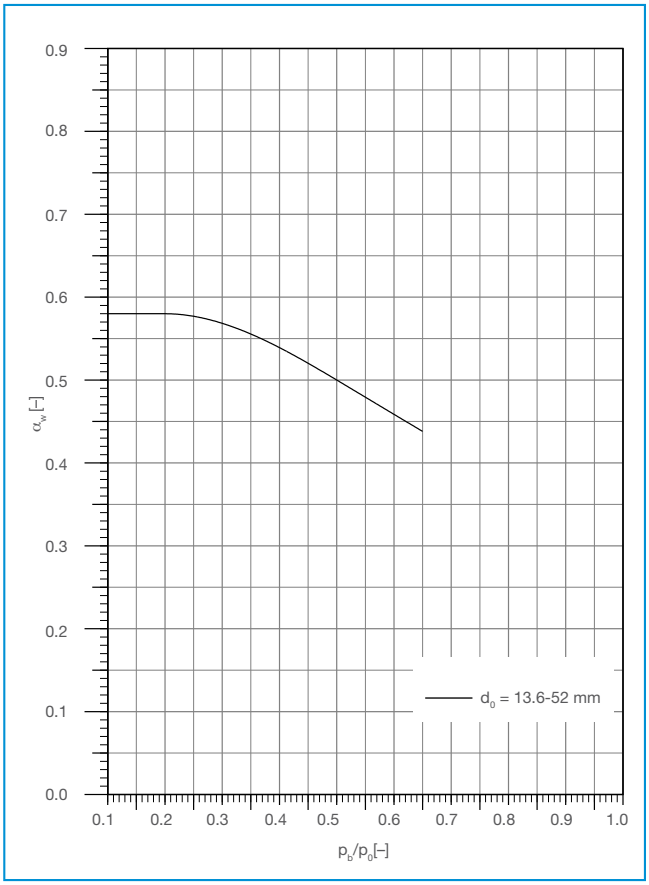
The coefficient of discharge for gases/vapours in a pressure ratio of p_b/p_0 >0,2 is shown in the diagram below.

The capacity of the selected safety valves can be adjusted to the required capacity by reducing the lift, thus reducing undesirable extra performance.

The following applies: $\alpha_{w(reduced)} = \alpha_w \times q_m/q_{mc}$. The required ratio h/d_0 is shown in the diagram below, and the reduced lift calculated with $h_{(reduced)} = d_0 \times (h/d_0)$. Please note that the lift is not allowed to be limited to a value of less than 30% of the full lift and must be at least 1 mm.



Si 4322 coefficient of discharge α_w depending on h/d_0 for gases and vapours



Si 4322 coefficient of discharge α_w depending on p_b/p_0 for gases and vapours

Si 4322

Sample calculation for a safety valve for use with liquid in accordance with DIN EN ISO 4126-7

Fluid
Glycerine

Density ρ
1260 kg/m³

Set pressure
3.99 bar g

Opening pressure p_0 at 10% accumulation
(4.0 × 1.1) + 1.01= 5.41 bar a

Back pressure p_b
1.01 bar a

Required mass flow q_m
20,000 kg/hr

Dynamic viscosity μ_0
1.48 Pa·s

Si 4322 coefficient of discharge α_w
0.420

The required flow area is

$$A = \frac{q_m}{1.61 \times K_{dr} \times K_v \times \sqrt{(p_0 - p_b) \times \rho}}$$

As the correction factor of the viscosity depends on the discharge capacity, a preselection and then possibly an iteration is required. With $K_v = 1$

$$A' = \frac{2000}{1.61 \times 0.420 \times 1 \times \sqrt{(5.41 - 1.01) \times 1260}} = 398 \text{ mm}^2$$

and the flow area $A_0 = 594$ mm² is a suitable preselection (see page 8).

The Reynolds number is calculated with:

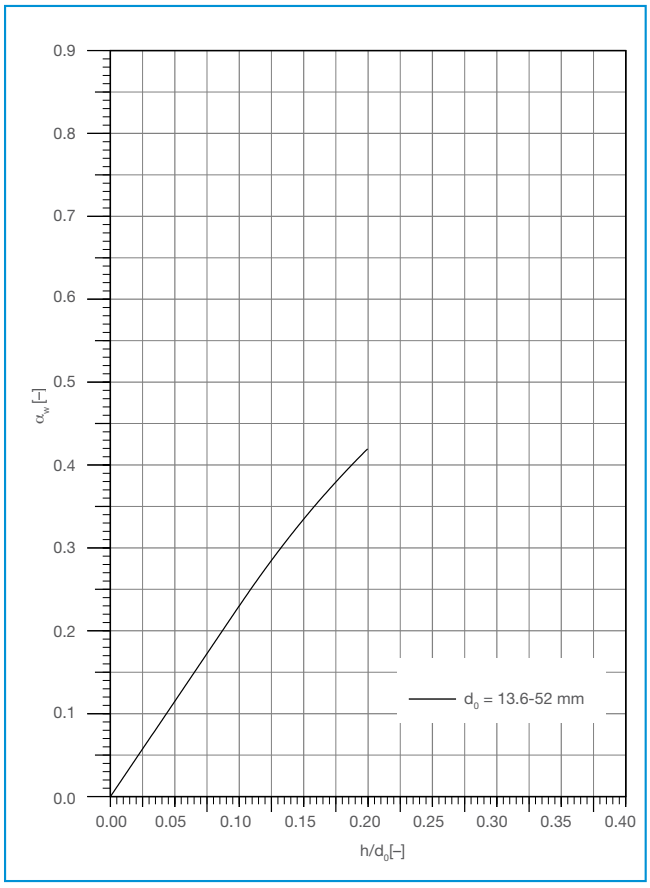
$$Re = \left(\frac{q_m}{3.6 \times \mu_0}\right) \times \sqrt{\frac{4}{\pi \times A}} = \left(\frac{20000}{3.6 \times 1.48}\right) \times \sqrt{\frac{4}{\pi \times 380}} = 174$$

$$K_v = \left(0.9935 + \frac{2.878}{Re^{0,5}} + \frac{342.75}{Re^{1,5}}\right)^{-1,0} = \left(0.9935 + \frac{2.878}{174^{0,5}} + \frac{342.75}{174^{1,5}}\right)^{-1,0} = 0.735$$

The q_m capacity of the safety valve with the flow area $A_0 = 594$ mm² is $K_v = 0.735$:

$$q_{mc} = 1.61 \times A_0 \times K_{dr} \times K_v \times \sqrt{(p_0 - p_b) \times \rho} = 21982 \text{ kg/hr}$$

The safety valve Si 4322 G 00, DN 50 x 50, PN 25 x 16 and the flow area $A_0 = 594$ mm² is adequately dimensioned for the application. For a more precise calculation of the capacity of the selected safety valve, it can be determined more precisely iteratively with the mass flow q_{mc} of the viscosity correction factor. The IMI Bopp & Reuther design program for safety valves Si-Tech 4 calculates K_v precisely iteratively.



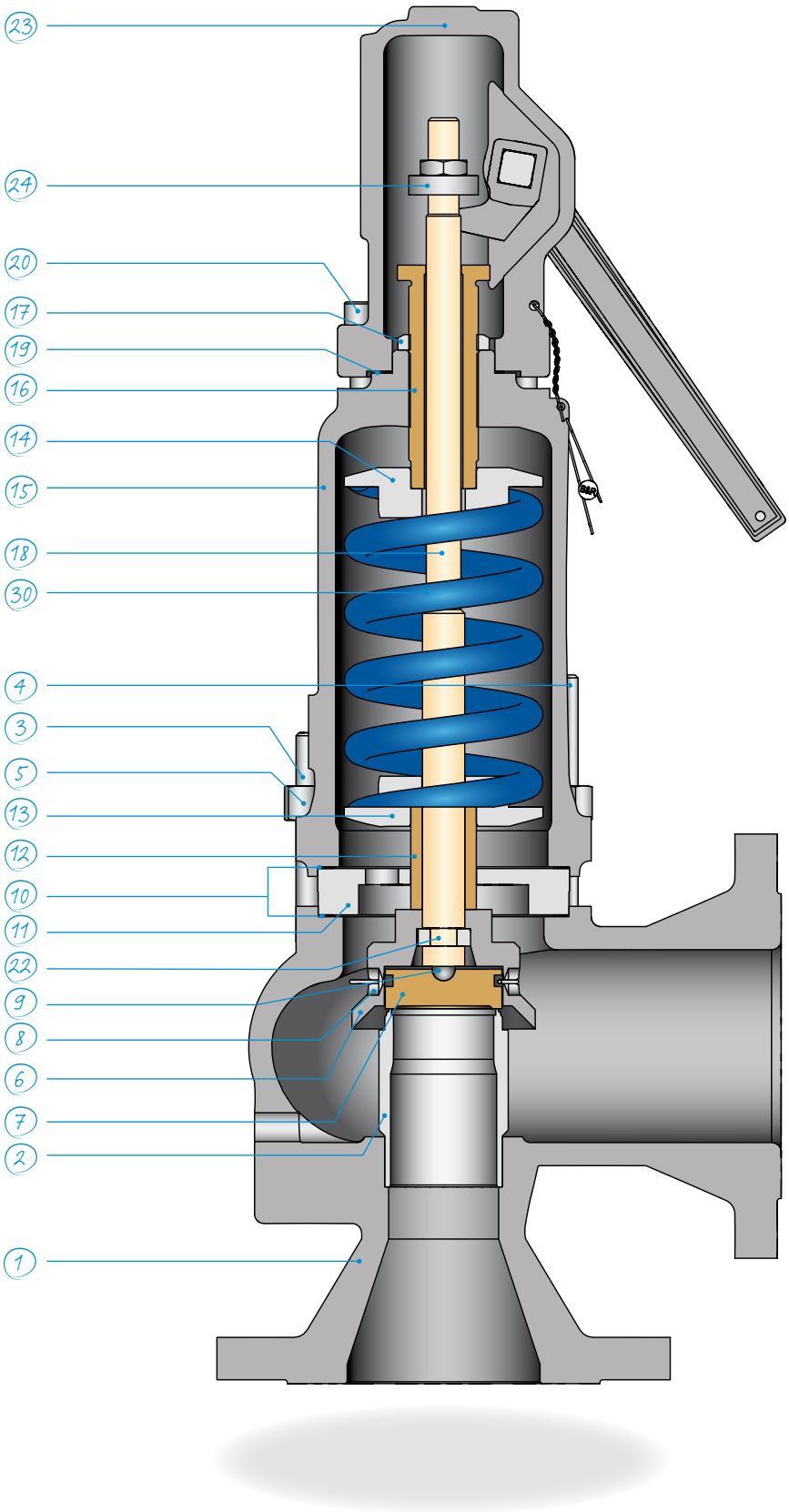
Si 4322 coefficient of discharge α_w depending on h/d_0 for liquid

The coefficients of discharge K_{dr} acc. to DIN EN ISO 4126-1 in this series are identical to the above coefficients of discharge α_w and the values in the diagrams.

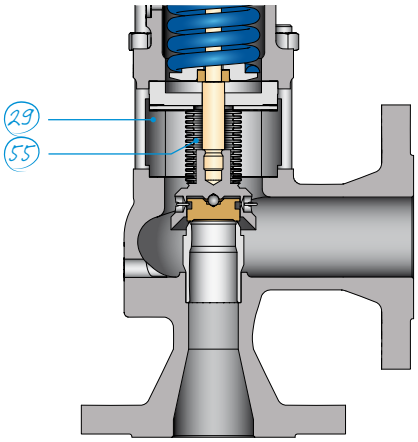
h	=	Lift [mm]
d_0	=	Flow diameter of the selected safety valve [mm]
h/d_0	=	Lift / flow diameter ratio
p_b	=	Absolute back pressure [bar a]
p_0	=	Absolute relieving pressure [bar a]
p_b/p_0	=	Absolute back pressure / absolute relieving pressure ratio
α_w	=	Coefficient of discharge acc. to AD 2000-Merkblatt A2
q_m	=	Required mass flow [kg/hr]
q_{mc}	=	Certified mass flow [kg/hr]

Si 4322

Material code



Bellows design Si 4422



Si 4322

Material code			00	04
Temperature application range			-10 °C to +450 °C [1]	-200 °C to +400 °C [2]
Part	**Name**	**Spare part**	**Material**	**Material**
1	Body		GP240GH / 1.0619	GX5CrNiMo19-11-2 / 1.4408
2	Seat bushing		1.4122	1.4571
3	Stud, short		1.1181	A4-70
4	Stud, long		1.1181	A4-70
5	Hexagon nut		04	04
6	Disc holder		1.4021	1.4571
7	Disc	*2, 3	1.4571	1.4571
8	Disc retainer		1.4571	1.4571
9	Ball		Stainless steel	Ceramic
10	Flat gasket	*1, 2, 3	1.4401 / Graphite	1.4401 / Graphite
11	Intermediate cover		1.4122	1.4571
12	Pressure sleeve		1.4122	1.4571
13	Spring washer, bottom		1.0460	1.4571
14	Spring washer, top		1.0460	1.4571
15	Bonnet [2]		GP240GH / 1.0619	GX5CrNiMo19-11-2 / 1.4408
16	Adjusting screw		1.4021	1.4571
17	Locknut		1.4122	1.4571
18	Spindle		1.4021	1.4571
19	Flat gasket	*1, 2, 3	1.4401 / Graphite	1.4401 / Graphite
20	Cylinder bolt		8.8	A4-70
22	Ring (two-parts)		1.4571	1.4571
23	Lifting lever		1.0619	1.4408
24	Lifting nut		1.4021	1.4571
29	Intermediate spacer		1.0619	1.4408
30	Spring [3]	*3	1.1200 1.8159	1.4310 1.8159, Chem. nickel plated
55	Bellows	*3	1.4571	1.4571

[1] If the specifications in AD 2000-Merkblatt W10 are met, the material can be used at temperatures as low as -85 °C.

[2] If the specifications in AD 2000-Merkblatt W10 are met, the material can be used at temperatures as low as -273 °C.

[3] The spring material selection depends on the valve size and set pressure as well as the temperature. Other spring materials are available for special operating conditions, e.g. temperatures > 400 °C or < -170 °C, and if the customer specifies this.

Spare parts:
*1 For start-up
*2 For 2 years of operation
*3 After several years of operation

IMI Bopp & Reuther reserve the right to technical changes or selection of higher quality materials without prior notice. The material design can be adapted to customer specifications at any time upon request.

Si 4322

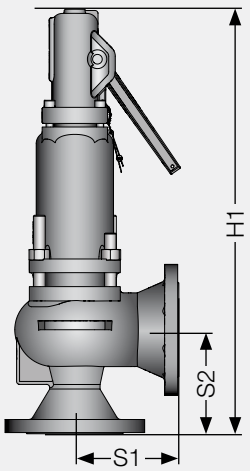
Sizes, pressure ranges and dimensions

Size	**DN_E**	25	40	50	65 [3]	80	100
	DN_A	25	40	50	65	80	100
Flow diameter [mm] d_0		13.6	22	27.5	35	42	52
Flow area [mm²] A_0		145	380	594	962	1385	2124
Min. set pressure [bar g]	**Si 41 / Si 43**	0.8	0.49	0.49	0.49	0.49	0.49
	Si 4322.57 [1]	0.12	0.2	0.1	0.13	0.13	0.16
	Si 44	4.0	1.5	1.5	1.5	1.5	1.5
Max. set pressure [2] **[bar g]**		40	40	40	40	40	40
Max. back pressure [bar g]		16	16	16	16	16	16
Inlet flange DIN EN [4]		PN 10 - 40					
Outlet flange DIN EN [4]		PN 10 - 16					
Centre to face dimension S1 [mm]		100	115	125	145	155	175
Centre to face dimension S2 [mm]		100	115	125	145	155	175
Height H1 [mm]		420	435	450	535	655	710
Height H2 [mm]		470	490	495	585	705	770
Drain size [5]		G¼	G¼	G¼	G¼	G¼	G⅜
Weight Si 41/43 [kg]		9	13	18	25	40	78
Weight Si 45/45 [kg]		11	15	21	28	44	82

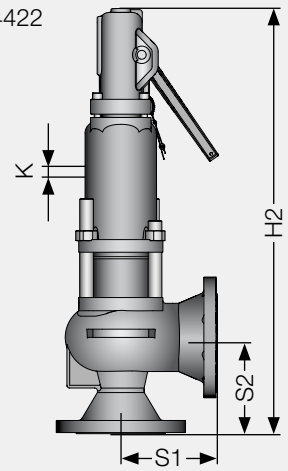
[1] Set pressure if the direct weight load option .57 is used.
[2] Stated pressures are maximum values corresponding to the spring forces. The component strength may need to be reviewed, and the suitable pressure rating selected, depending on the material and temperature.
[3] 4-hole flange drilling with DN 65 PN 10/16
[4] Flange PN 10 - 40 acc. to DIN EN 1092-2; facing type B1
[5] Drain E is only drilled into the body if condensate formation is to be expected.

Bonnet for bellows design with test connection K for bellows check. K to DN 80 x 80 – G¼, above G⅜

Si 4322



Si 4422



Si 4322

Capacity data for air (0°C and 1013 mbar) calculated according to AD-2000 Merkblatt A2 with 10% accumulation

DN_E x DN_A	25 x 25	40 x 40	50 x 50	65 x 65	80 x 80	100 x 100
Flow diameter d_0 [mm]	13.6	22	27.5	35	42	52
Set pressure p [bar g]	Nm^3/h Air					
1	106	277	433	701	1.009	1.547
2	178	465	727	1.178	1.696	2.600
3	245	641	1.002	1.623	2.337	3.582
4	311	813	1.270	2.058	2.963	4.542
5	374	978	1.529	2.476	3.566	5.466
10	690	1.804	2.819	4.467	6.576	10.081
15	1.005	2.630	4.110	6.658	9.587	14.696
20	1.321	3.457	5.401	8.749	12.598	19.311
25	1.637	4.283	6.692	10.840	15.609	23.927
30	1.952	5.109	7.983	12.930	18.620	28.542
35	2.268	5.935	9.273	15.021	21.631	33.157
40	2.584	6.761	10.564	17.112	24.641	37.772

Capacity data for water (20°C and 998 kg/m³) calculated according to AD-2000 Merkblatt A2 with 10% accumulation

DN_E x DN_A	25 x 25	40 x 40	50 x 50	65 x 65	80 x 80	100 x 100
Flow diameter d_0 [mm]	13.6	22	27.5	35	42	52
Set pressure p [bar g]	10^3 kg/h Water					
1	3.25	8.51	13.3	21.5	31.0	47.5
2	4.60	12.0	18.8	30.4	43.8	67.2
3	5.63	14.7	23.0	37.3	53.7	82.4
4	6.50	17.0	26.6	43.1	62.0	95.1
5	7.27	19.0	29.7	48.2	69.4	106
10	10.2	26.9	42.0	68.1	98.1	150
15	12.6	32.9	51.5	83.4	120	184
20	14.5	38.0	59.5	96.4	138	212
25	16.2	42.5	66.5	107	155	237
30	17.8	46.6	72.8	118	170	260
35	19.2	50.3	78.7	127	183	281
40	20.5	53.8	84.1	136	196	300

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