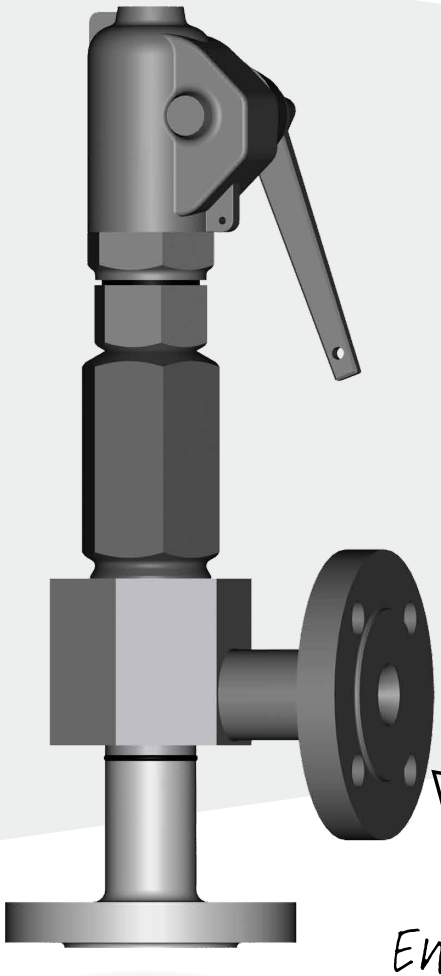
IMI BOPP & REUTHER

Si 032

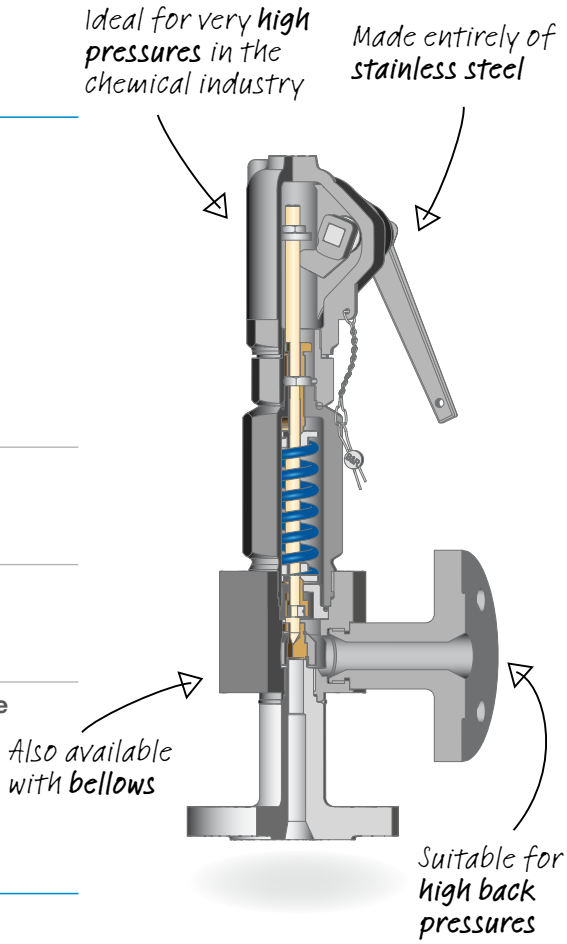


Engineering
GREAT Solutions

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

IMI Critical Engineering

Si 032



Features

Compact safety valve made of stainless steel 1.4571 for high pressures

- Forged steel body with variable connections
- Wear resistant with hard-faced seat (Stellite)

Inlet sizes
DN 15 to DN 25

Inlet pressure rating
PN 40 to PN 400

Set pressures
0.45 bar g up to 400 bar g

Temperature range
-270°C to +400°C

Overpressure

Vapours/gases	10%
Liquids	10%

Blowdown

Vapours/gases	10%
Liquids	20%

Allowable built-up back pressure without bellows
15% of the set pressure

Applications

- For vapours, gases and liquids
- Chemical industry
- Petrochemical industry
- Technical gases, cooling and oxygen applications
- Equipment engineering and chemical reactors
- Suitable for mobile pressure vessels
- Suitable for back pressures above 60 bar g

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 approval acc. to

TÜV.SV.12-1077.d_0.D / G / F.α_w.p

IMI Bopp & Reuther will not renew the existing VdTÜV type approval. 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 4126-7, DIN EN 12266-1 / -2 (insofar as applicable to safety valves), DIN EN 1092 parts I and II Flanges, AD 2000 Merkblatt A4, AD 2000 Merkblatt HP0, technical rules for steam boiler TRD108, TRD 110, TRD 421

Si 032

Type code

Type code					Ordering example
1	**Series**	Si 0	High-pressure compact safety valve		Si 0
2	**Design**	3	Conventional, closed bonnet		3
		4	Bellows, closed bonnet		
3	**Characteristic**	2	Regular Flow		2
4	**Druckklasse**	1	PN 10 – PN 40		2
		2	PN 63 – PN 160		
		3	PN 250 – PN 320		
		4	PN 400		
		9	Thread		
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		
6	**Material code**	34	X6CrNiMoTi17-12-2/1.4571		34
7	**Options**	.09	Locking sleeve (government ring)		19.25.28.60
		.18	Heating jacket		
		.19 [1]	High set pressure design		
		.22a	Weld end inlet		
		.22b	Weld end outlet		
		.25 [2]	Block body design		
		.28	Oil and grease free		
		.35	With lift restriction ring		
		.59	Stellited disc		
		.60 [3]	Stellited seat		

[1] The high pressure design (.19) is required for the flow diameter d_0 = 7 mm with set pressure >100 bar g and d_0 = 12.5 mm with set pressure >50 bar g.
[2] The block body design (.25) is standard for the type Si 0.
[3] Stellited seat is standard for the type Si 0.

Type ▶	**Si 0322 A 34 .19.25.28.60**
Please state ▶	
Set pressure	54.0 bar g
Fluid temperature	-190 °C
Fluid and state	Oxygen Liquid
Inlet	DN 25, PN 160, B2
Outlet	DN 25, PN 40, B1
Flow diameter	12.5 mm
Approval	97/23/EG (CE)

Si 032

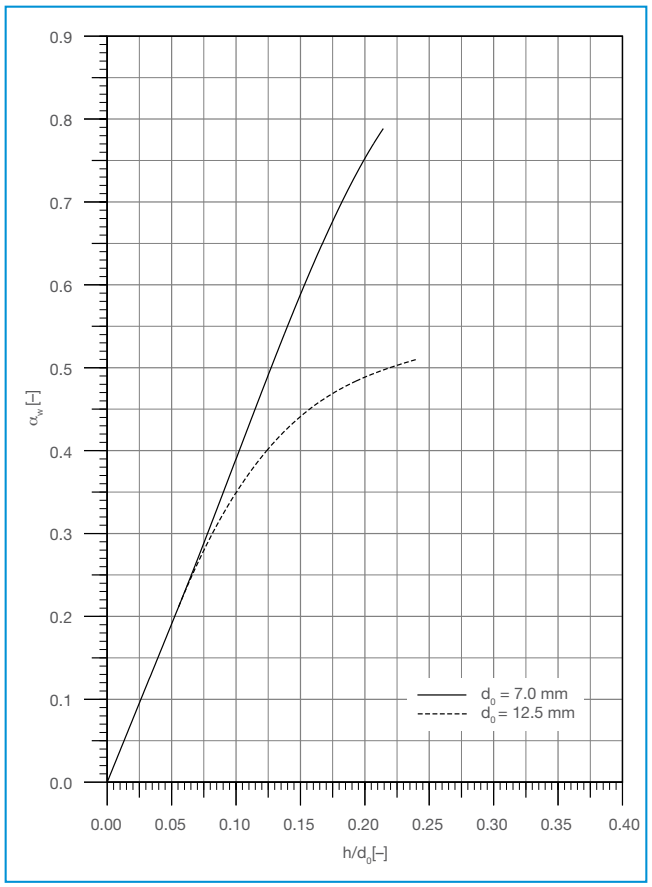
Coefficient of discharge

Fluid group	Inlet size	Flow diameter	$h/d_0 \geq$	Pressure $p_0 \geq$ [bar g]	$p_b/p_0 \leq$	α_w
Vapours/gases (D/G)	DN 15 to DN 25	7.0 mm	0.214	2.0	0.20	0.79
	DN 15 to DN 25	12.5 mm	0.240	2.0	0.20	0.51
Liquids (F)	DN 20 to DN 25	7.0 mm	0.214		-	0.54
	DN 20 to DN 25	12.5 mm	0.240		-	0.44

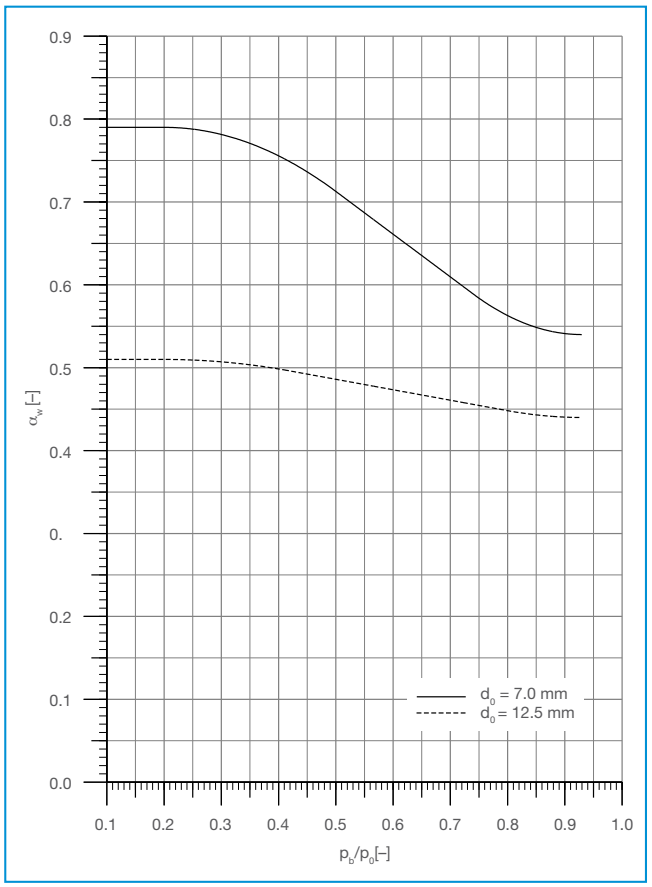
The coefficient of discharge for gases/vapours in a pressure ratio of $p_b/p_0 > 0.3$ and set pressure < 2.0 bar-g is shown in the diagram below.

The capacity of the selected safety valve 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 $h_{(reduced)} = d_0 \times (h/d_0)$.



Si 032 coefficient of discharge α_w depending on h/d_0 for gases and vapours



Si 032 coefficient of discharge α_w depending on p_b/p_0 for gases and vapour

Si 032

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

Fluid
Oxygen

Temperature T_0
87°C = 360.15 K

Isentropic exponent k
1.4

Molecular mass M
32 kg/kmol

Compressibility factor Z
0.992

Set pressure
67 bar g

Opening pressure p_0 at 10% accumulation
(67 × 1.1) + 1.01 = 74.71 bar a

Back pressure p_b
8.01 bar a

Required mass flow q_m
956 kg/hr

The pressure ratio $p_b/p_0 = 0.107$ is used to read the coefficient of discharge $K_{dr} = 0.790$ from the diagram "Si 032 coefficient of discharge α_w depending on p_b/p_0 gases and vapours". (α_w is identical to K_{dr})

As the condition for critical relief

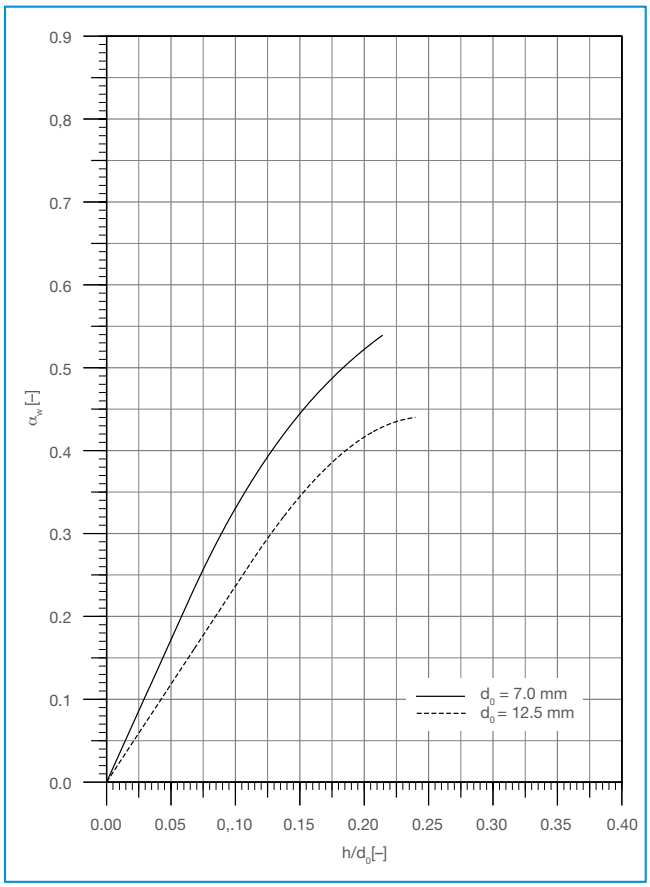
$$\frac{p_b}{p_0} > \left(\frac{2}{k+1}\right)^{\frac{k}{k-1}}$$

is met, the required flow area is calculated: $A = \dfrac{q_m}{p_0 \times C \times K_{dr} \sqrt{\dfrac{M}{Z \times T_0}}}$

where $C = 3.948 \sqrt{k \times \left(\dfrac{2}{k+1}\right)^{\frac{k+1}{k-1}}} = 2.703$, is added to

$$A = \frac{956}{74.71 \times 2.703 \times 0.790 \sqrt{\dfrac{32}{0.992 \times 360.15}}} = 20 \text{ mm}^2$$

With the flow area $A_0 = 39$ mm² the safety valve Si 0329 A 00, G¾ × G1, d_0 7.0 mm is suitable for the application (see page 8 for valve data).



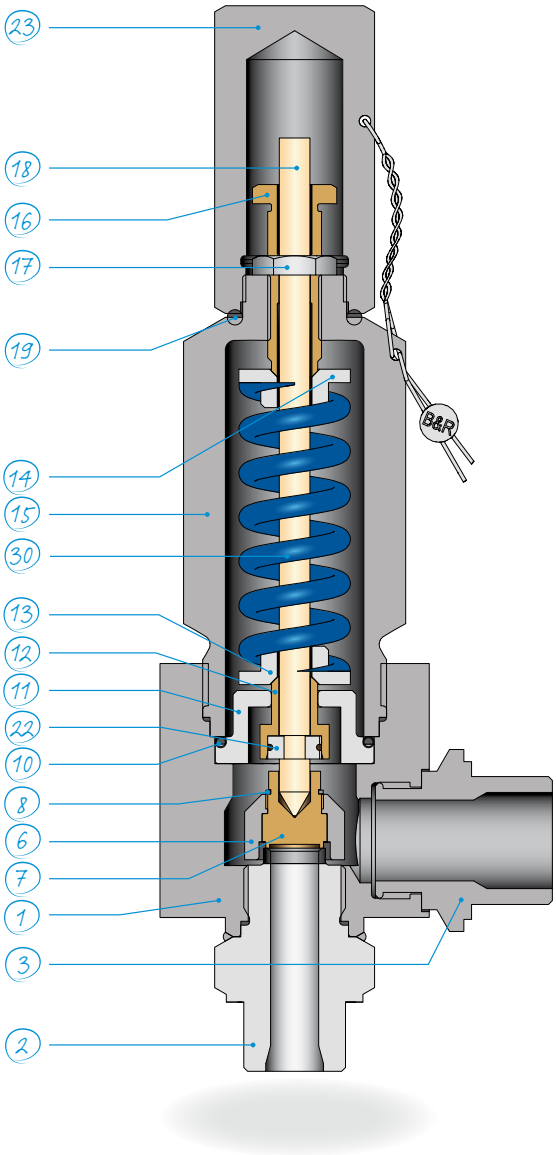
Si 032 coefficient of discharge α_w depending on h/d_0 for liquid

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 0329

Material code



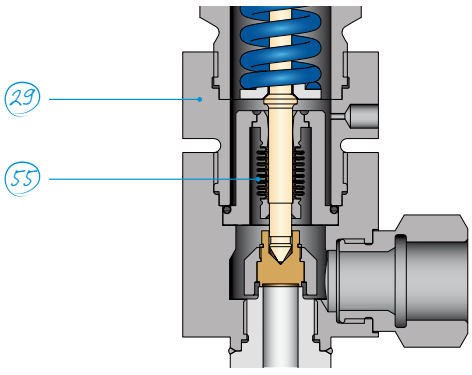
Material code			34
Temperature application range			-270°C to 400°C
Part	**Name**	**Spare part**	**Material**
1	Body		1.4571
2	Inlet nozzle		1.4571 / Seat hard-faced with Stellite
3	Outlet nozzle		1.4571
6	Disc holder	*2, 3 [1]	1.4571
7	Disc	*2, 3 [1]	1.4980
8	Locking ring	*2, 3 [1]	Spring steel
10	Sealing ring	*1, 2, 3	1.4541
11	Intermediate cover		1.4571
12	Lift stop		1.4571
13	Spring washer, bottom		1.4571
14	Spring washer, top		1.4571
15	Bonnet		1.4571
16	Adjusting screw		1.4571
17	Locknut		1.4571
18	Spindle		1.4571
19	Sealing ring	*1, 2, 3	1.4301 / Graphite
22	Ring (two-parts)		1.4571
23	Cap		1.4571
29	Intermediate spacer		1.4571
30	Spring	*3	1.4310
55	Bellows	*3	1.4571

[1] For the spare part we recommend the whole disc assembly consisting of disc, lift collar and locking ring.

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

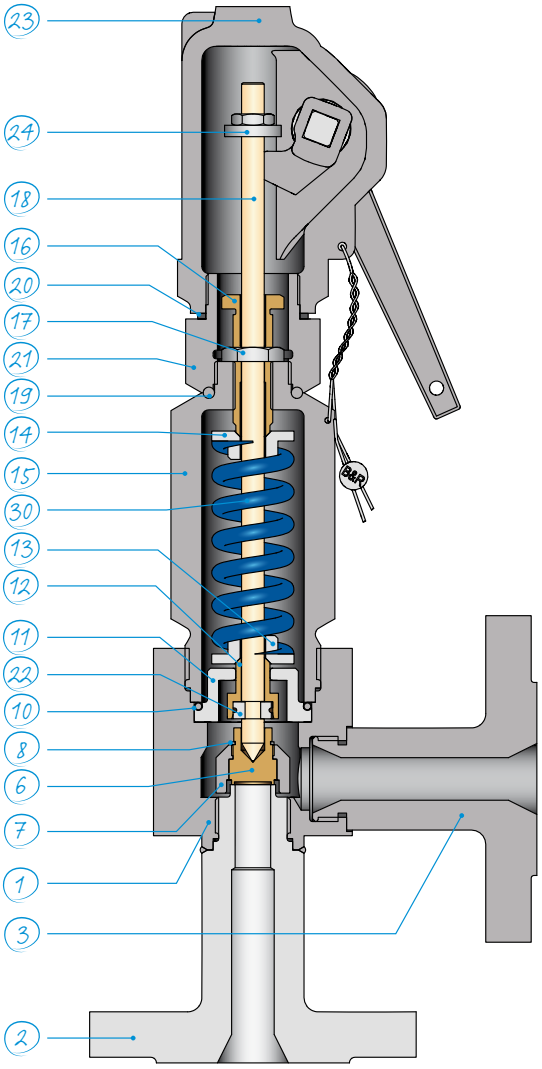
IMI Bopp & Reuther reserve the right to technical changes or selection of higher quality materials without prior notice. The material design can be adapted to customer specifications at any time upon request.

Bellows design Si 0429



Si 032

Material code



Materialcode			34
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1	Body		1.4571
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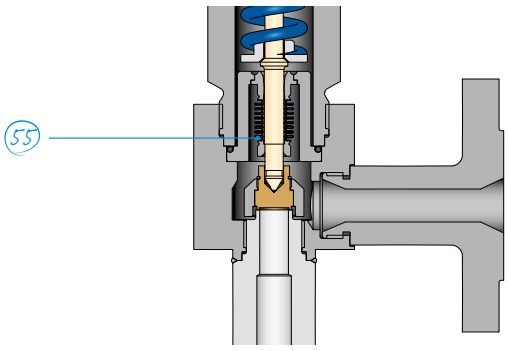
6	Disc holder	*2, 3 [1]	1.4571
7	Disc	*2, 3 [1]	1.4980
8	Locking ring	*2, 3 [1]	Spring steel
10	Sealing ring	*1, 2, 3	1.4541
11	Intermediate cover		1.4571
12	Lift stop		1.4571
13	Spring washer, bottom		1.4571
14	Spring washer, top		1.4571
15	Bonnet		1.4571
16	Adjusting screw		1.4571
17	Locknut		1.4571
18	Spindle		1.4571
19	Sealing ring	*1, 2, 3	1.4571
20	Seal	*1, 2, 3	1.4301 / Graphite
21	Adapter		1.4571
22	Ring (two-parts)		1.4571
23	Packed lifting lever (Cap)		1.4408
24	Lifting nut		1.4571
30	Spring	*3	1.4310
55	Bellows	*3	1.4571

Bellows design Si 042



[1] For the spare part we recommend the whole disc assembly consisting of disc, lift collar and locking ring.

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

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Si 0329

Sizes, pressure ranges and dimensions: Series Si 0 with threaded connection

Type	Size		Threaded connection [1]		Flow diameter [mm]	Flow area [mm²]	Min. set pressure [bar g]		Max. back pressure [bar g] [3]	Max. back pressure [bar g]	Centre to face dimension		Height [4] [5]		Weight [kg]
	Inlet	Outlet	Inlet, male thread	Outlet, female thread			Si 03	Si 04			S1 [mm]	S2 [mm]	Si 03 H1 [mm]	Si 04 H2 [mm]	
Si 0329	20	25	G¾	G1	7	38.48	0.45	[2]	400	200	67	60	280	[2]	7
Si 0x29					12.5	122.7		8						325	8
Si 0329	¾“	1“	NPT	NPT	7	38.48		[2]						[2]	7
Si 0x29					12.5	122.7		8						325	8

[1] The threads are pipe threads (G) in acc. with ISO 288-1 or National Pipe Thread Taper (NPT) in accordance with ASME B1.20.1. The stud ends comply with DIN 3852 – A or NPT accordingly. The screw plug holes comply with DIN 3852 – Y or NPT accordingly.

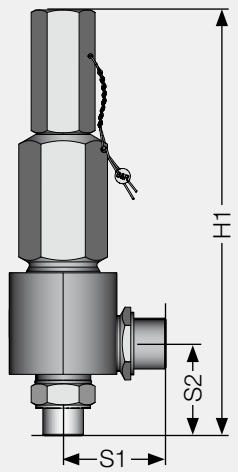
[2] The bellows design Si 04 is only available for valves with the flow diameter d_0 = 12.5.

[3] The high pressure design (.19) is required for the flow diameter d_0 = 7 mm with set pressure >100 bar g and d_0 = 12.5 mm with set pressure >50 bar g.

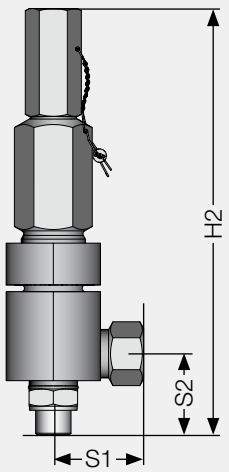
[4] The height increases by +40 mm for the high pressure design (.19).

[5] If lifting lever A or AB is selected, the height increases by +55 mm.

Si 0329



Si 0429



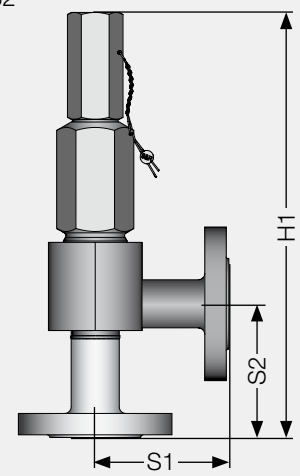
Si 032

Sizes, pressure ranges and dimensions: Series Si 0 with flange connection DIN/EN

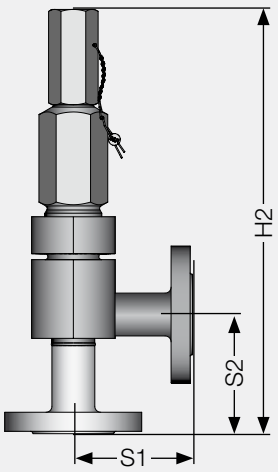
Type	Size		Flange connection[1]		Flow diameter [mm]	Flow area [mm²]	Min. set pressure [bar g]		Max. set pressure [bar g] [2) 3)]	Max. back pressure [bar g]	Centre to face dimension		Height [5) 6)]		Weight [kg]
	Inlet	Outlet	Inlet	Outlet			Si 03	Si 04			S1 [mm]	S2 [mm]	Si 03 H1 [mm]	Si 04 H2 [mm]	
Si 0321	15	25	PN 40	PN 40	7	38.48	0.45	4)	40	20	100	100	320	4)	9
Si 0322			PN 63 - 160						160	40					
				PN 63 - 160						80					10
Si 0323			PN 250 - 320	PN 40					320	40					
				PN 63 - 160						160					
Si 0324			PN 400	PN 250					400	200					
Si 0321	25	25	PN 40	PN 40					40	20					9
Si 0322			PN 63 - 160						160	40					
				PN 63 - 160						80					10
Si 0x21	15	25	PN 40	PN 40	12.5	122.7	0.45	8	40	20	100	100	320	365	9
Si 0x22			PN 63 - 160						160	40					
				PN 63 - 160						80					10
Si 0x23			PN 250	PN 40					240	40					
				PN 63 - 160						120					
Si 0x21	25	25	PN 40	PN 40					40	20					9
Si 0x22			PN 63 - 160						160	40					
				PN 63 - 160						80					10

1) Flanges PN 10-40 acc. to DIN EN 1092 x 2; facing type B1, from PN 63 facing type B2
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) The high pressure design (.19) is required for the flow diameter d_0 = 7 mm with set pressure >100 bar g and d_0 = 12.5 mm with set pressure >50 bar g.
4) The bellows design Si 04 is only available for valves with the flow diameter d_0 = 12.5.
5) The height increases by +40 mm for the high pressure design (.19).
6) If lifting lever A or AB is selected, the height increases by +55 mm.

Si 032



Si 042



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