LESER

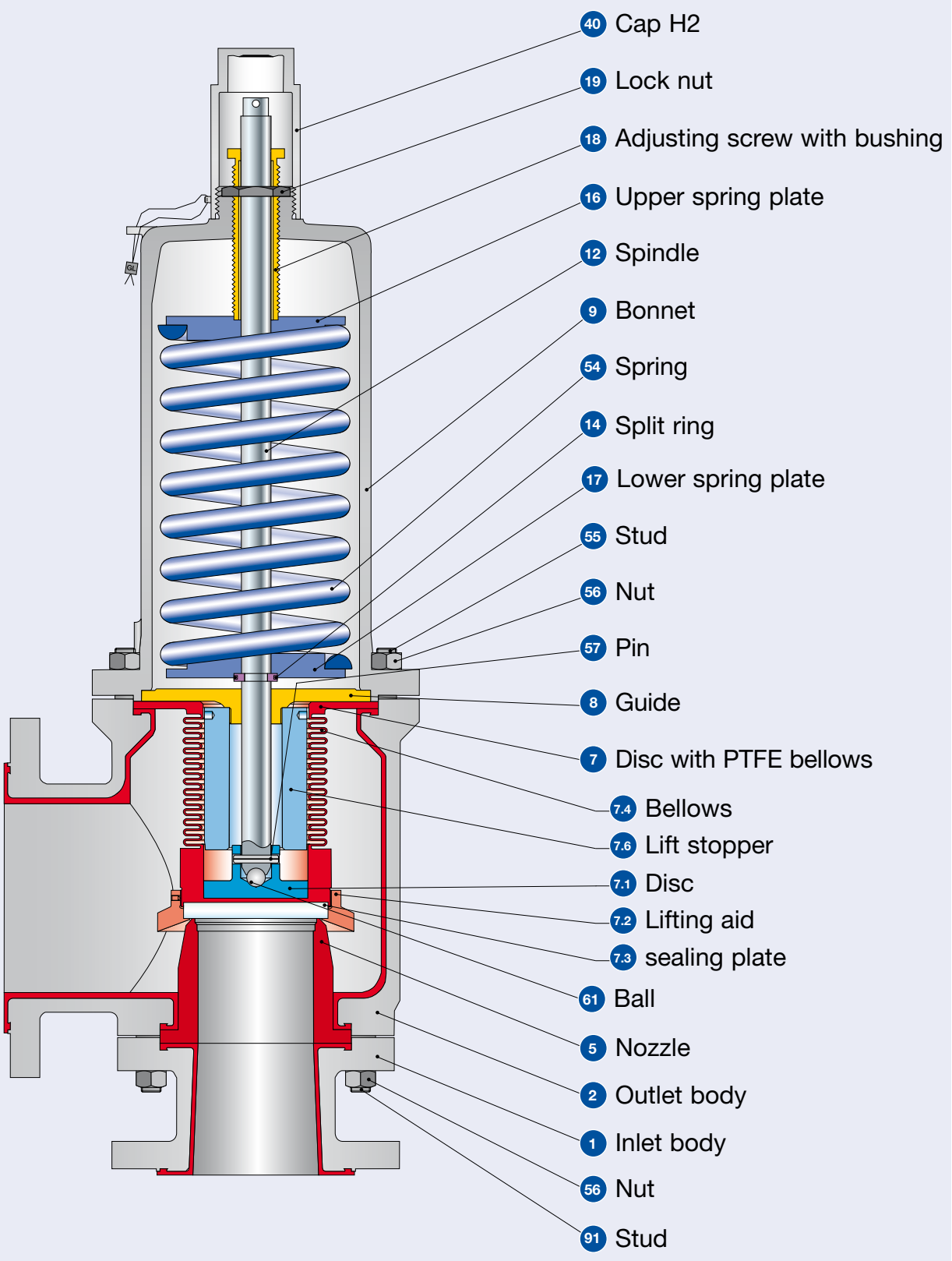
Type 447

Type 447
PTFE-lined
Packed lever H4
Closed bonnet
Bellows design

Flanged Safety Relief Valves – spring loaded

Contents

Conventional design



Conventional design

Materials

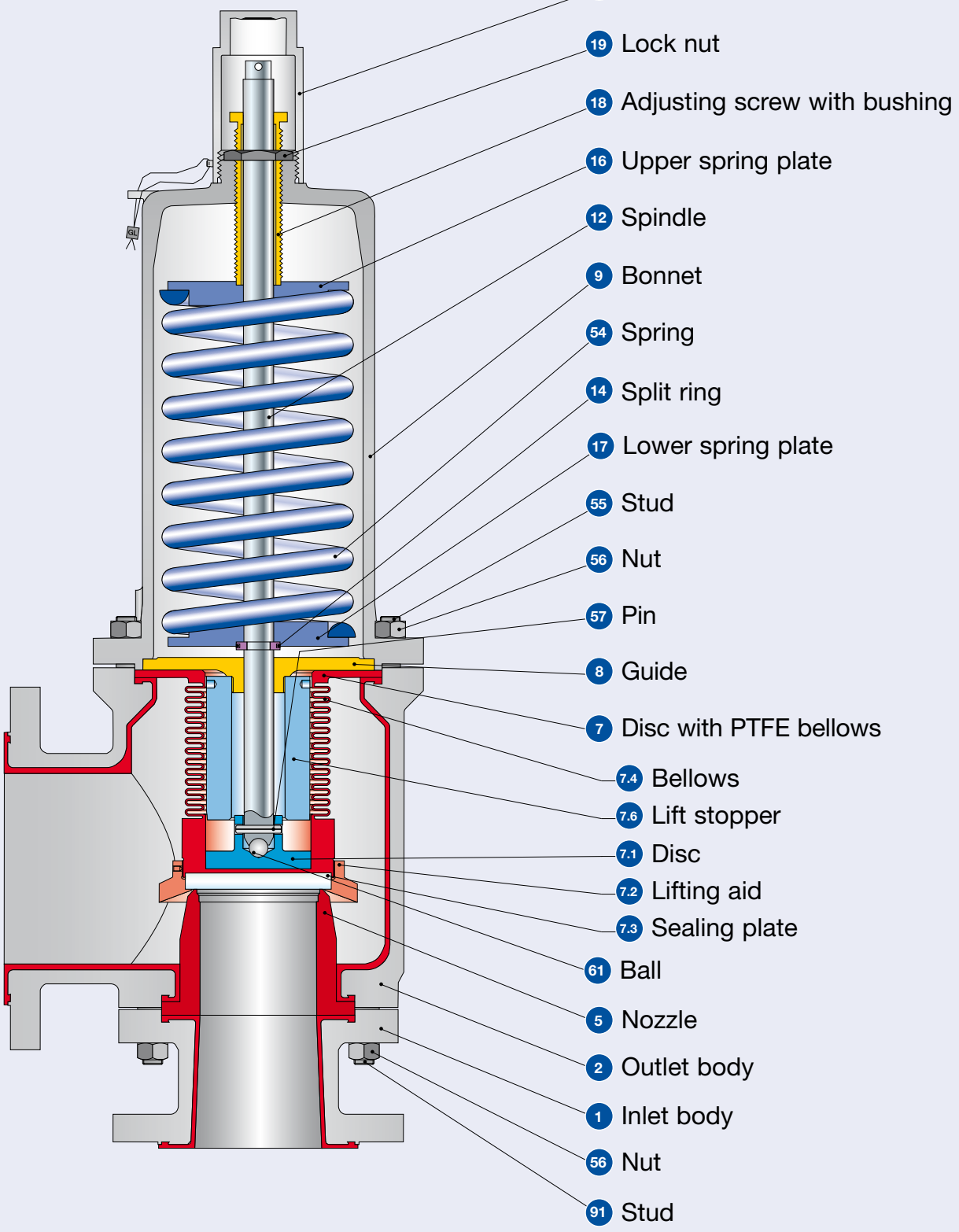
Item.	Components	Type 447
1	**Inlet body**	1.0460 + Virgin PTFE Steel / PTFE-TF
2	**Outlet body**	1.0619 + Virgin PTFE SA 216 WCB / PTFE-TF
5	Nozzle	Virgin PTFE with 25 % glass PTFE-TF with 25 % glass
7	Disc with PTFE bellows	Virgin PTFE / BOROFLOAT glass PTFE-TF / BOROFLOAT glass
7.1	Disc	1.4404 316L
7.2	Lifting aid	Virgin PTFE with 25 % glass PTFE-TF with 25 % glass
7.3	sealing plate	BOROFLOAT glass
7.4	Bellows	Virgin PTFE PTFE-TF
7.6	Lift stopper	1.4404 Stainless steel
8	Guide	1.4404 Stainless steel
9	**Bonnet**	0.7043 Ductile Gr. 60-40-18
12	Spindle	1.4404 Stainless steel
14	Split ring	1.4104 Chrome steel
16/17	Spring plate	1.0718 Steel
18	Adjusting screw with bushing	1.4104 PTFE Chrome steel PTFE
19	Lock nut	1.0718 Steel
40	**Cap H2**	1.0718 12L13
54	Spring, standard	1.1200, 1.8159 Steel
	Spring, optional	1.4310 Stainless steel
55	Stud	1.1181 Steel
56	Nut	1.0501 2H
57	Pin	1.4310 Stainless steel
61	Ball	1.3541 Hardened stainless steel
91	Stud	1.1181 Steel

Please observe:

- LESER reserves the right to make changes.
- LESER may use higher quality materials without giving prior notice.
- Each component can be replaced by another material according to the customer's specification.
- All components exposed to pressure are highlighted in bold.

Chlorine application

Chlorine is one of the most important basic products of the chemicals industry. It is used to manufacture vinyl chloride and PVC as well as other organic chlorine compounds and intermediate products. Furthermore, chlorine is used to make many inorganic products, for example to bleach paper and cellulose as well as for disinfection of drinking water and swimming pools.



Chlorine application

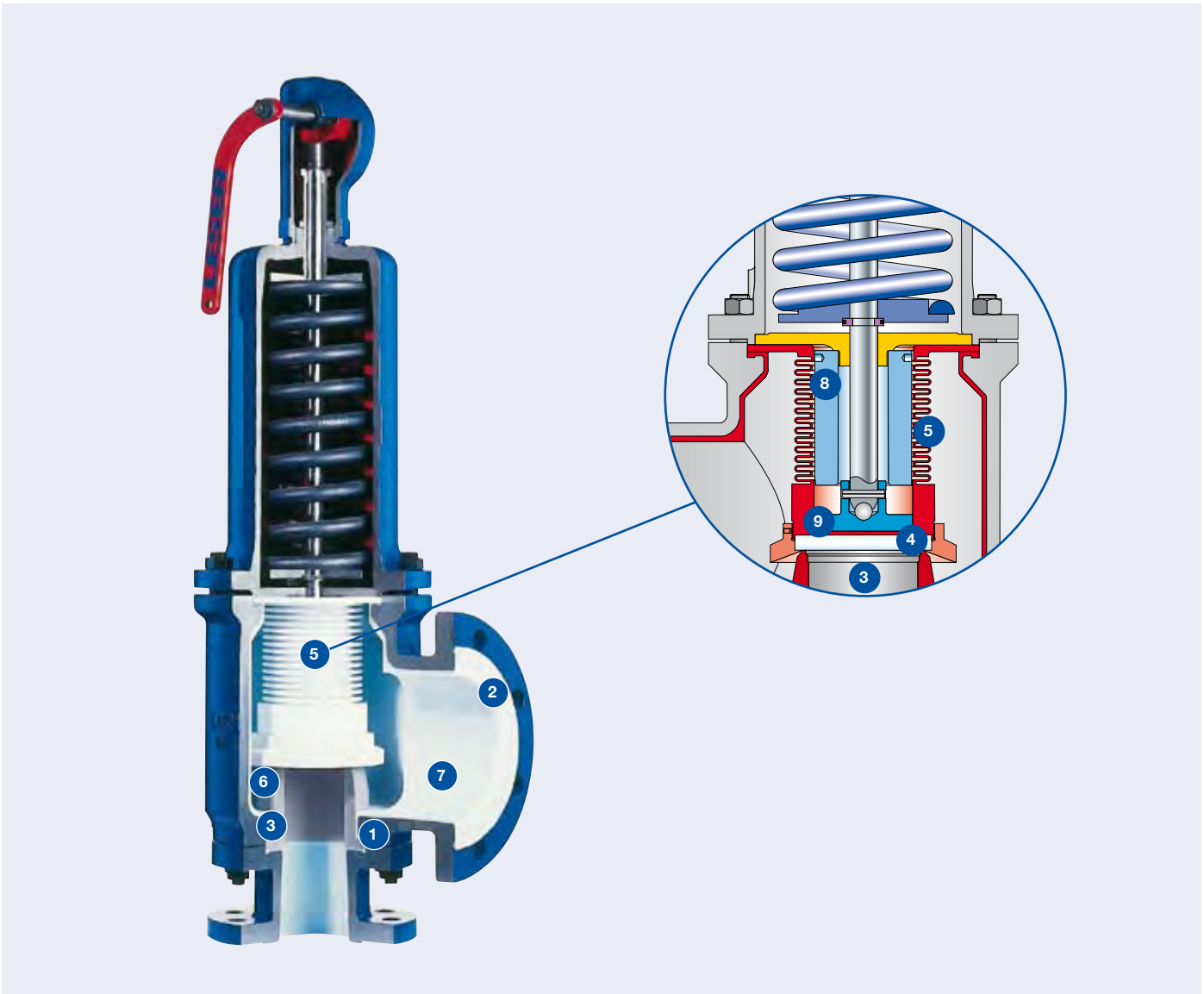
Since chlorine has a reducing effect, only a few metallic materials can be used for chlorine applications (like tantalum for example). LESER offers a cost-effective alternative with Type 447, which is completely lined with PTFE.
Type 447 is realised as follows depending on the available chlorine.

Materials

Application		Chlorine, dry (gaseous)	Chlorine, wet	Order information
		Dry chlorine is understood to be chlorine that is not dissolved in water. Dry chlorine is gaseous, the boiling point is -34.1 °C, and it only attacks metals above the ignition temperature. (Fe: 140 °C, Ni: 500 °C, Cu: 200 °C).	Chlorine dissolved in water is called wet chlorine. It is highly corrosive and forms hydrochloric acid (HCL) with water. Wet chlorine is considerably more aggressive than dry chlorine and attacks almost all metals with formation of chloride (exception: tantalum).	LESER requests information on the application in the inquiry / order
Item.	**Name**			**Statement / Information**
1	Inlet body	1.0570 + Virgin PTFE SA105 + PTFE-TF	1.0570 + Virgin PTFE SA105 + PTFE-TF	Since the permeability of the PTFE compound TF is limited and hence diffusion of chlorine may occur, the compound TFM is used with a permeability of 160 $\frac{cm^3}{m^2 \times d \times bar}$ bar.
2	Outlet body	1.0619 + Virgin PTFE WCB + PTFE-TF	1.0619 + Virgin PTFE WCB + PTFE-TF	
5	Nozzle	PTFE + 25% glass	PTFE + 25% glass	
7	Disc with PTFE bellows	Virgin PTFE PTFE-TF)	PTFE-TFM PTFE-TFM	
7.1	Disc	1.4404 316L	2.4610 Hastelloy C	The standard component of 1.4404 is implemented with material 2.4610 due to the susceptibility to corrosion.
7.2	Lifting aid	PTFE + 25% glass	PTFE + 25% glass	
7.3	Sealing plate	100% nickel-based alloy	Borofloat glass Borofloat glass	
7.4	PTFE bellows	Virgin PTFE PTFE-TF	PTFE-TFM PTFE-TFM	
7.6	Lift stopper	1.4404 Stainless steel	PTFE + 25% glass	
8	Guide with bushing	1.4404 + Virgin PTFE 316L + virgin PTFE	1.4404 + 2.4819 Hastelloy C 316L + 2.4819 Hastelloy C Both sides with chlorine resistant vinyl ester resin coating, coating thickness 160 µm with Carbon CEILCOTE 232 Flakeline	To prevent swelling of the usual PTFE bushing, a bushing made of 2.4819 is used.
9	Bonnet	0.7040 Ductile Gr. 60-40-18	0.7040 Ductile Gr. 60-40-18	In order to protect the bonnet against chlorine attack, the inside is equipped with a chlorine-resistant vinyl ester resin (coating thickness ≥ 160 µm).
		Inside with chlorine-resistant vinyl ester resin coating, coating thickness160µm with SGL Carbon CEILCOTE 232 Flakeline		
12	Spindle	1.4021 420	2.4610 Hastelloy C	Since standard materials are attacked by chlorine, these components are made of 2.4610.
14	Split ring	1.4104 51430F	2.4610 Hastelloy C	
16	Spring plate	1.4404 Stainless steel	1.4404 Stainless steel	
18	Adjusting screw with bushing	1.4104 + PTFE-TF 51430F + PTFE-TF	1.4104 + PTFE-TF 1645 51430F + PTFE-TF 1645	
44	Coupling	1.0718 Steel	1.4404 316L	The standard coupling is subject to corrosion, therefore a coupling of stainless steel is used.
54	Spring	1.4310 Stainless steel	2.4610 Hastelloy C	Since the spring is adequately protected against corrosion by the improved bellows, no Hastelloy spring has to be used.
57	Pin	1.4310 Hardened stainless steel	2.4610 Hastelloy C	
61	Ball	1.3541 Hardened stainless steel	2.4610 twisted onto a spindle Hastelloy C twisted onto a spindle	

Note: Basically, the safety valve configuration must be checked based on the process conditions (temperature, pressure,...)

Configuration Features
Design features



Design features

Item.	Component	Information
1	Inlet body + outlet body	Inlet body of material 1.0460 (SA 105) and outlet body of material 1.0619 (WCB) with PTFE lining for highest corrosion resistance
2	PTFE lining	Vacuum-proof, isostatic full lining of the body components of virgin PTFE with a minimum thickness of ≥ 3 mm. All lined surfaces are mechanically processed and have a smooth surface (R_a = 1.6 µm). This prevents build-ups of the medium.
3	Nozzle	Nozzle of high-quality, inert gas sintered PTFE with 25% glass for high strength.
4	Sealing plate	Sealing plate of BOROFLOAT glass for maximum chemical resistance.
5	PTFE bellows	PTFE bellows protect the bonnet space against corrosive and aggressive media.
6	Inlet body, nozzle and sealing plate	To fulfil individual material requests, the following components are exchangeable: inlet body (Item 1), nozzle (Item 5), and sealing plate (Item 7.3).
7	Outlet body	Self-emptying outlet body prevents collection of the medium in the blow-off chamber.
8	Bellows support	Interior bellows support reduces flow loads resulting in a longer service life.
9	Disc insert	Completely metallic support of the sealing plate with disc insert of 1.4404 (316L).

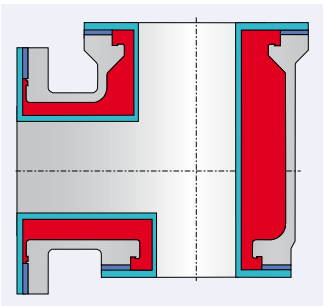
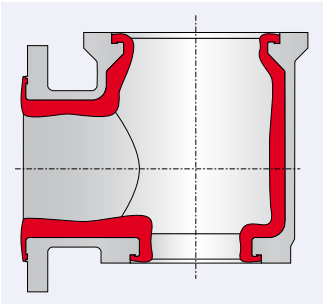
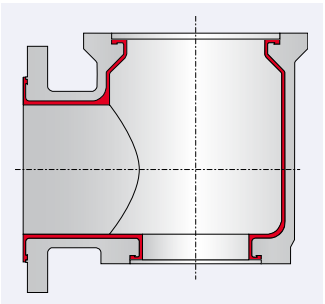
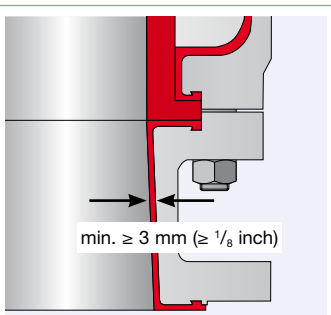
Configuration Features

Lining procedure-Isostatical manufacturing process

Linings made of isostatic PTFE have proven themselves successfully everywhere where extremely aggressive media is processed. The PTFE lining for cast or metal bodies is produced following the isostatic compression moulding process. PTFE-lined bodies are manufactured in three main production steps:

– Preparation of the surfaces on metal bodies to be lined
– Lining with a sintering process
– Final machining

Main production steps

	Information
Preparation for lining	
	Machining of the body surfaces that will be lined / coated. Roughening the surfaces by subsequent sand blasting.
Lining with a sintering process	
	Press moulds are placed over the surfaces to be lined and filled with powdery PTFE.
	The body is put under pressure of > 500 bar acts on all directions in a pressure vessel. This strongly compacts the PTFE powder and presses it onto the roughened surface of the metal. This results in a form-locked and friction-locked connection between the PTFE and metal. Afterwards, the casing is sintered, through which the lining obtains the strength and low permeability.
Final machining	
	Machining of the functional surfaces (flange, support areas, etc.)
	The minimum PTFE wall thickness is ≥ 3 mm (≥ $^1/_8$ inch).

How to order – Numbering system

1 Article number

1	2	3	4
447	2	. 387	2

1 Valve Type 447

2 Material code

Code	Body material
2	1.0619 + PTFE-TF (WCB + PTFE-TF)

3 Valve code

Automatically determines nominal diameter (see page 02/10).

4

Code	Lifting device	
2	Gas-tight cap	H2
4	Packed lever	H4

2 Set pressure

Please enter the units in overpressure!

The specified pressure range may not be exceeded!

3 Connections

See "Flange drillings" table on page 02/13

Please specify the respective option codes for the inlet as well as the outlet.

Article number	Set pressure	Connections	
4472.3872	8 bar	H64	

4 Options

Type 447		Option code
• PTFE-TF lining, virginal		**Standard**
• PTFE-TFM lining, conductive		**Please specify when ordering**
• Stainless steel spring		**X04**
• Lift stopper		**J51**
• Connection for lift indicator	H4	**J39**
• Lift indicator		**J93**
• Test gag		
- cap	H2	**J70**
- gas-tight lifting device	H4	**J69**
• Oil and grease free		**J85**
• Materials		
- NACE		**H01**
• Chlorine applications		
- dry chlorine		
- Chlorine, wet		

Only give the option code for a deviation from the standard.

- For more accessories see: "Extended Ordering and Price Information" LWN 493.08

5 Documentation

Please select the necessary documentation:

Tests, Certifications:	Option code
DIN EN 10204-3.2: TÜV-Nord Certification for set pressure	**M33**
LESER Certificate for Global Application	**H03**

- Acceptance test certificate 3.1 as per DIN EN 10204
- Declaration of conformity as per pressure equipment directive 97/23/EC

Material quality certificate:
DIN EN 10204-3.1

Component	Option code
Inlet body	**H01**
Outlet body	**L34**
Bonnet	**L30**
Cap / lever cover	**L31**
Disc with bellows	**L23**
Studs	**N07**
Nuts	**N08**

6 Code and medium

1	2
2	. 0

1 Rules and regulations
1. ASME Section VIII
2. CE / VdTUEV
3. ASME Section VIII + CE / VdTUEV

2 Medium
.1 Gases
.2 Liquids
.0 steam / gases / liquids
(only applicable for CE / VdTUEV)

J51			
Options			

H01	L30	
Documentation		

2.0
Code and medium

How to order – Article numbers

Type 447						
		DN_I	25	50	80	100
		DN_O	50	80	100	150
		Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
		Actual orifice diameter d_0 [mm]	23	46	60	92
		Actual orifice area A_0 [mm²]	415	1662	2827	6648
Body material 1.0619 + PTFE-TF (WCB + PTFE-TF)						
PTFE fully lined						
Closed bonnet	**H2**	Art. no. **4472.**	**3872**	**3882**	**3892**	**3902**
	H4	Art. no. **4472.**	**3874**	**3884**	**3894**	**3904**

Note on export inspection

Type 447 is subject to an export restriction according to EU regulation No. 1334/2000 as well as regulation No. 1167/2008 Position 2B350g.

In the event of an export project, LESER requests the respective information on the final destination / use in the inquiry / order.

Exception

For direct export by LESER, exception EU 001 can be used for the following countries:
Australia, Japan, Canada, New Zealand, Norway, Switzerland and USA.

Type 447
Cap H2
Closed bonnet
Conventional design

Type 447
Packed lever H4
Closed bonnet
Conventional design

Dimensions and weights

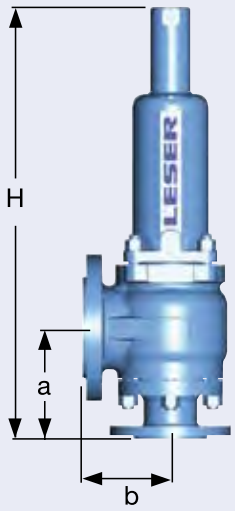
Metric units

	DN_I	25	50	80	100
	DN_O	50	80	100	150
	Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
	Actual orifice diameter d_0 [mm]	23	46	60	92
	Actual orifice area A_0 [mm²]	416	1662	2827	6648
Weight [kg]		15	29	50	105
Centre to face [mm]	Inlet a	105	152	155	220
	Outlet b	100	120	155	200
Height (H4) [mm]		465	605	786	943
Body material 1.0619 + virgin PTFE (WCB + PTFE-TF)					
DIN Flange[1)]	Inlet	PN 16			
	Outlet	PN 16			

US units

	DN_I	25	50	80	100
	DN_O	50	80	100	150
	Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
	Actual orifice diameter d_0 [inch]	0,91	1,81	2,36	3,62
	Actual orifice area A_0 [inch²]	0,645	2,576	4,382	10,304
Weight [lbs]		33	64	110	231
Centre to face [inch]	Inlet a	$4^1/_4$	6	$6^1/_8$	$8^3/_4$
	Outlet b	$3^7/_8$	$4^3/_4$	$6^1/_8$	$7^7/_8$
Height (H4) [mm]		$18^1/_4$	$23^3/_4$	$30^{15}/_{16}$	$37^1/_8$
Body material 1.0619 + virgin PTFE (WCB + PTFE-TF)					
DIN Flange[1)]	Inlet	PN 16			
	Outlet	PN 16			
ASME Flange[1)]	Inlet	Class 150			
	Outlet	Class 150			

[1)] Standard flange class. For other flange drillings, see page 02/13.



Conventional design

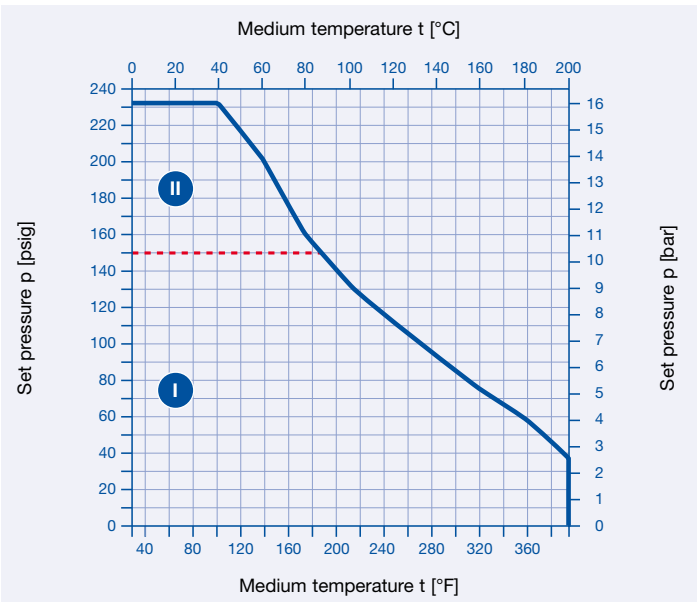
Pressure temperature ratings

Metric units

	DN_I	25	50	80	100
	DN_O	50	80	100	150
	Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
	Actual orifice diameter d_0 [mm]	23	46	60	92
	Actual orifice area A_0 [mm²]	416	1662	2827	6648
Body material 1.0619 + virginal PTFE (WCB + PTFE-TF)					
DIN Flange	Inlet	**PN 16**			
	Outlet	**PN 16**			
Min. set pressure	p [bar_g] S/G/L	0,1			
Max. set pressure	p [bar_g] S/G/L	16			
Temperature acc to. DIN EN[1)]	min. [°C]	-85			
	max. [°C]	+200			

US units

	DN_I	25	50	80	100
	DN_O	50	80	100	150
	Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
	Actual orifice diameter d_0 [mm]	0,91	1,81	2,36	3,62
	Actual orifice area A_0 [mm²]	0,645	2,576	4,382	10,304
Body material 1.0619 + virginal PTFE (WCB + PTFE-TF)					
ASME Flange	Inlet	**Class 150**			
	Outlet	**Class 150**			
Min. set pressure	p [$psig_g$] S/G/L	1,45			
Max. set pressure	p [$psig_g$] S/G/L	232			
Temperature acc to. DIN EN[1)]	min. [°F]	121			
	max. [°F]	+392			



Pressure / temperature ranges

[1)] The pressure/temperature functional ranges of Type 447 are dependent on the PTFE components in the safety valve.

The chart shows the application ranges for:

I Standard safety valve with PTFE/glass nozzle and sealing plate made of BOROFLOAT glass

II Safety valve with metallic nozzle and sealing plate of Hastelloy®, nickel, etc.

Order information – flange drillings + spare parts

Flange drillings

		DN_I	25	50	80	100
		DN_O	50	80	100	150
		Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
		Actual orifice diameter d_0 [mm]	23	46	60	92
		Actual orifice area A_0 [mm²]	415	1662	2827	6648
Body material 1.0619 (WCB)						
Inlet	**DIN EN 1092**	PN 10	H44	H44	H44	H44
		PN 16	*	*	*	*
Outlet	**DIN EN 1092**	PN 10	H50	H50	H50	H50
		PN 16	*	*	*	*
Inlet	**ASME B16.5**	CL150	H64	H64	H64	H64
Outlet	**ASME B16.5**	CL150	H79	H79	H79	H79

Spare parts

DN_I	25	50	80	100
DN_O	50	80	100	150
Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
Actual orifice diameter d_0 [mm]	23	46	60	92
Actual orifice area A_0 [mm²]	416	1662	2827	6648
Nozzle (Item 5):		**Material no. / Art. no.**		
Nozzle PTFE + 25 % glass	207.0659.0000	207.1159.0000	207.1659.0000	207.0359.0000
Disc (Item 7.1):		**Material no. / Art. no.**		
Disc 1.4404	212.1649.000	212.1749.000	212.3649.000	212.1849.000
Lifting aid (Pos. 7.2)		**Material no. / Art. no.**		
Lifting aid PTFE + 25 % glass	341.5759.0000	341.5859.0000	341.2859.0000	341.5659.0000
Sealing plate (Item 7.3)		**Material no. / Art. no.**		
Sealing plate BOROFLOAT glass	236.2459.0000	236.2559.0000	236.1859.0000	236.2359.0000
Bellows (Item 7.4)		**Material no. / Art. no.**		
Bellows PTFE	224.1659.0000	224.1759.0000	224.2259.0000	224.1559.0000
Set screw (Item 7.5)		**Material no. / Art. no.**		
PTFE	2 x 453.0208.0000	2 x 453.0208.0000	2 x 453.0208.0000	2 x 453.0208.0000
Ball (Item 61):		**Material no. / Art. no.**		
Ball BallØ [mm]	9	9	12	15
1.4401	510.0204.0000	510.0204.0000	510.0304.0000	510.0404.0000
Split ring (Item 14):		**Material no. / Art. no.**		
Split ring Spindle Ø [mm]	16	16	24	24
1.4404	251.0249.0000	251.0249.0000	251.0449.0000	251.0449.0000
Pin (Item 57)		**Material no. / Art. no.**		
Pin 1.4310	480.0605.0000	480.0705.0000	480.2605.0000	480.2605.0000

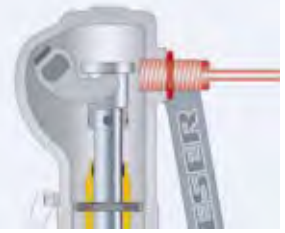
Available options

For futher information, refer to
"Accessories and options", page 99/01.

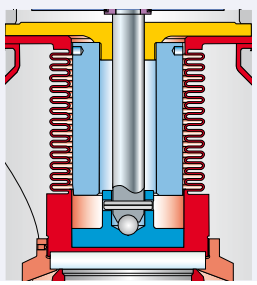
Screwed cap H2
H2

Packed lever H4
H4

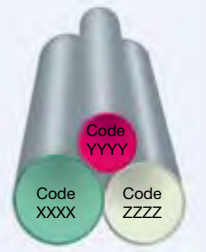
Lift indicator
J39: Connection H4
J93: Lift indicator



Lift stopper
J51



Special materials
2.4610 HASTELLOY® C4
2.4360 MONEL® 400
1.4462 DUPLEX



Approvals

Approvals					
	DN_I	25	50	80	100
	DN_O	50	80	100	150
	Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
	Actual orifice diameter d_0 [mm]	23	46	60	92
	Actual orifice area A_0 [mm²]	416	1662	2827	6648
Europe			**Coefficient of discharge K_{dr}**		
DIN EN ISO 4126-1	Approval no.:		072020111Z0008/0/09		
	S/G	0,70	0,72	0,70	0,65
	L	0,48	0,47	0,51	0,42
Germany			**Coefficient of discharge α_w**		
AD 2000-Merkblatt A2	Approval no.:		SV05-979		
	S/G	0,70	0,72	0,70	0,65
	L	0,48	0,47	0,51	0,42
United States			**Coefficient of discharge K**		
ASME Sec. VIII	Approval no.:		M37123		
	G		0,617		
	Approval no.:		M37134		
	L		0,431		
Canada			**Coefficient of discharge K**		
CRN	Approval no.:		0G1018.9c		
	G		0,617		
	L		0,431		
China			**Coefficient of discharge α_w**		
AQSIQ	Approval no.:		TSF700301-2011		
	S/G	0,70	0,72	0,70	0,65
	L	0,48	0,47	0,51	0,42
Russia			**Coefficient of discharge α_w**		
ROSTECHNADZOR	Approval no.:		PPC 00-18458		
GOST R	Approval no.:		B29896 (is renewed yearly)		
	S/G	0,70	0,72	0,70	0,65
	L	0,48	0,47	0,51	0,42
Belarus			**Coefficient of discharge α_w**		
PROMATOMNADZOR	Approval no.:		15-171-2006		
	S/G	0,70	0,72	0,70	0,65
	L	0,48	0,47	0,51	0,42
Classification societies					
			On request		

Capacities

Calculation of the capacity for steam, air and water acc to. AD 2000 Merkblatt A2 with 10% overpressure at 0 °C and 1013 mbar (air) or alternatively 20 °C (water). Capacities at 1 bar (14,5 psig) and lower are calculated at 0,1 bar (1,45 psig) overpressure.

Metric units — **AD 2000-Merkblatt A2**

	Steam				Air				Water			
DN_I	25	50	80	100	25	50	80	100	25	50	80	100
DN_O	50	80	100	150	50	80	100	150	50	80	100	150
Actual orifice diameter d_0 [mm]	23	46	60	92	23	46	60	92	23	46	60	92
Actual orifice area A_0 [mm²]	415	1662	2827	6648	415	1662	2827	6648	415	1662	2827	6648
$LEO_{S/G/L}$*) [inch²]	0,408	1,630	2,773	6,048	0,408	1,630	2,773	6,048	0,285	1,139	1,937	4,555
Set pressure [bar]	**Capacity** [kg/h]				**Capacity** [m_n^3/h]				**Capacity** [10^3kg/h]			
0,1	115	450	826	1649	133	518	950	1898	4,5	17,8	32,9	63,5
0,2	146	571	1051	2132	169	661	1216	2467	5,6	21,8	40,3	77,8
0,3	173	679	1249	2563	202	790	1452	2981	6,4	25,1	46,5	89,8
0,4	198	777	1424	2950	231	908	1665	3447	7,2	28,1	52,0	100,4
0,5	220	867	1584	3305	259	1018	1859	3880	7,9	30,8	56,9	110,0
0,6	241	952	1729	3631	284	1122	2039	4281	8,5	33,2	61,5	118,8
0,7	260	1030	1862	3931	308	1219	2204	4652	9,1	35,5	65,7	127,0
0,8	279	1104	1987	4212	331	1311	2359	2002	9,6	37,7	69,7	134,7
0,9	297	1178	2109	4490	353	1401	2509	5341	10,1	39,7	73,5	142,0
1,0	315	1252	2230	4763	375	1491	2657	5675	10,6	41,7	77,1	148,9
1,1	335	1332	2361	5058	399	1590	2818	6037	11,2	43,7	80,8	156,2
1,2	354	1413	2491	5353	424	1689	2978	6400	11,7	45,7	84,4	163,2
1,3	374	1492	2620	5643	448	1787	3137	6757	12,1	47,5	87,9	169,8
1,4	393	1573	2748	5933	472	1886	3295	7115	12,6	49,3	91,2	176,2
1,5	413	1653	2875	6221	496	1985	3453	7471	13,0	51,0	94,4	182,4
1,6	432	1733	3001	6505	520	2084	3609	7825	13,5	52,7	97,5	188,4
1,7	452	1812	3127	6790	544	2183	3765	8177	13,9	54,3	100,5	194,2
1,8	471	1891	3251	7070	568	2280	3920	8525	14,3	55,9	103,4	199,8
1,9	490	1971	3375	7351	592	2379	4075	8874	14,7	57,4	106,3	205,3
2,0	510	2051	3500	7633	616	2479	4230	9225	15,1	58,9	109,0	210,6
2,1	529	2129	3623	4353	640	2577	4383	9572	15,4	60,4	111,7	215,8
2,2	548	2209	3746	8189	664	2676	4537	919	15,8	61,8	114,3	220,9
2,3	567	2288	3868	8465	688	2774	4691	10265	16,1	63,2	116,9	225,9
2,4	587	2367	3991	8742	712	2873	4844	10611	16,5	64,6	119,4	230,7
2,5	606	2367	4112	9017	736	2972	4997	10956	16,8	65,9	121,9	235,5
2,6	625	2524	4233	9289	760	3069	5148	11298	17,2	67,2	124,3	240,2
2,7	644	2603	4355	9565	784	3169	5301	11644	17,5	68,5	126,7	244,7
2,8	663	2681	4475	9882	807	3266	5453	12041	17,8	69,7	129,0	249,2
2,9	682	2760	4596	10139	832	3366	5605	12365	18,1	71,0	131,3	253,6
3	701	2838	4716	10396	855	3464	5757	12688	18,4	72,2	133,5	258,0
4					1072	4410	7294	15924	21,3	83,3	154,2	297,9
5					1290	5306	8776	19160	23,8	93,2	172,4	333,0
6					1507	6202	10258	22396	26,1	102,7	188,8	364,8
7					1725	7098	11741	25632	28,2	110,2	203,9	394,1
8					1943	7994	13223	28868	30,1	117,9	218,0	421,3
9					2161	8890	14705	32104	31,9	125,0	231,2	446,8
10					2379	9786	16187	35340	33,6	131,8	243,7	471,0
11					2596	10682	17669	38575	35,3	138,2	255,4	494,0
12					2814	11579	19152	41811	36,9	144,3	267,0	515,9
13					3032	12475	20634	54074	38,4	150,2	277,9	537,0
14					3250	13371	22116	48283	39,8	155,9	288,4	557,3
15					3468	14267	23598	51519	41,2	161,4	298,5	576,8
16					3685	15163	25080	54755	42,6	166,7	308,3	595,8

Application not possible due to the pressure and temperature ranges of the PTFE nozzle.

*) $LEO_{S/G/L}$ = LESER Effective Orifice steam/gases/liquids see page 00/15
"How to use" capacity tables, see page 00/12

Capacities

Calculation of the capacity for steam, air and water according to ASME Section VIII (UV) with10% pressure increase at 16 °C (60°F air) or 21 °C (70°F water).
Capacities at 30 psig (2,07 bar) and lower are calculated at 3 psig (0,207 bar) overpressure.

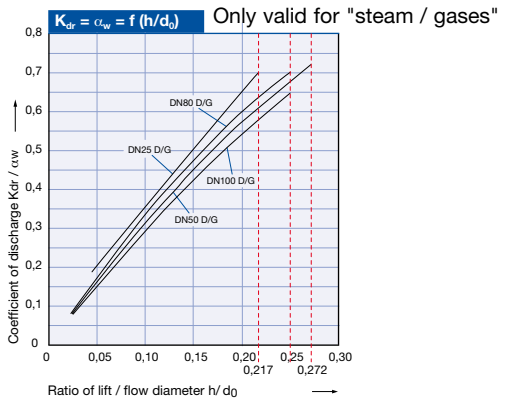
US units	ASME Section VIII											
	Steam				Air				Water			
DN_I	25	50	80	100	25	50	80	100	25	50	80	100
DN_O	50	80	100	150	50	80	100	150	50	80	100	150
Actual orifice diameter d_0 [inch]	0,91	1,81	2,36	3,62	0,91	1,81	2,36	3,62	0,91	1,81	2,36	3,62
Actual orifice area A_0 [inch²]	0,645	2,576	4,382	10,304	0,645	2,576	4,382	10,304	0,645	2,576	4,382	10,304
$LEO_{S/G/L}$*) [inch²]	0,408	1,630	2,773	6,048	0,408	1,630	2,773	6,048	0,285	1,139	1,937	4,555
Set pressure [psig]	**Capacity** [lb/h]				**Capacity**[S.C.F.M.]				**Capacity**[US-G.P.M]			
5												
10					202	679	1256	2868	38,0	152,1	258,8	608,5
15					217	839	1528	3529	44,7	179,0	304,5	716,0
20					257	1000	1794	4175	50,6	202,3	344,2	809,3
25					297	1160	2055	4810	55,8	223,2	379,8	893,0
30					338	1321	2314	5439	60,6	242,4	412,3	969,4
35					382	1498	2596	6124	65,4	261,8	445,4	1047,1
40					426	1674	2876	6806	70,0	279,9	476,1	1119,4
45					468	1850	3155	7484	74,2	296,8	505,0	1187,3
50					508	2026	3433	8125	78,2	312,9	532,3	1251,5
55					548	2192	3728	8766	82,0	328,2	558,3	1312,6
60					588	2352	4001	9407	85,7	342,7	583,1	1371,0
65					628	2512	4274	10048	89,2	356,7	606,9	1427,0
70					668	2672	4547	10689	92,6	370,2	629,8	1480,8
75					708	2833	4819	11331	95,8	383,2	651,9	1532,8
80	**Currently no ASME approval for saturated steam applications**				748	2993	5092	11972	98,9	395,8	673,3	1583,1
85					788	3153	5365	12613	102,0	408,0	694,1	1631,8
90					828	3314	5637	13254	104,9	419,8	714,2	1679,1
95					868	3474	5910	13895	107,8	431,3	733,7	1725,1
100					909	3634	6183	14536	110,6	442,5	752,8	1769,9
110					989	3955	6728	15819	116,0	464,1	789,5	1856,3
120					1069	4275	7274	17101	121,2	484,7	824,7	1938,9
130					1149	4596	7819	18383	126,1	504,5	858,3	2018,0
140					1229	4916	8364	19666	130,9	523,6	890,7	2094,2
150					1309	5237	8910	20948	135,5	541,9	922,0	2167,7
160					1389	5558	9455	22230	139,9	559,7	952,2	2238,8
170					1470	5878	10001	23513	144,2	576,9	981,5	2307,7
180					1550	6199	10546	24795	148,4	593,7	1010,0	2374,6
190					1630	6519	11091	26077	152,5	609,9	1037,7	2439,7
200					1710	6840	11637	27359	156,4	625,8	1064,6	2503,1
210					1790	7160	12182	28642	160,3	641,2	1090,9	2564,9
220					1870	7481	12728	29924	164,1	656,3	1116,6	2625,2
230					1950	7802	13273	31206	167,8	671,1	1141,7	2684,2

*) $LEO_{S/G/L}$ = LESER Effective Orifice for steam, gases, and liquids, see page 00/15
"How to use" capacity tables, see page 00/12

Determination of coefficient of discharge in case of lift restriction or back pressure

h = Lift [mm]
d_0 = Flow diameter [mm] of selected safety valve, see "Article Numbers" table.
h/d_0 = Ratio of lift / flow diameter
p_{ao} = Back pressure [bar_a]
p_0 = Set pressure [bar_a]
p_{ao}/p_0 = Ratio of absolute back pressure / absolute set pressure
K_{dr} = Coefficient of discharge acc to. DIN EN ISO 4126-1
α_w = Coefficient of discharge acc to. AD 2000-Merkblatt A2
K_{dr} = Correction for back pressure acc to. API 520 Section 3.3

Diagram for evaluation of ratio of lift / flow diameter (h/d0) in reference to the coefficient of discharge (K_{dr}/α_w)



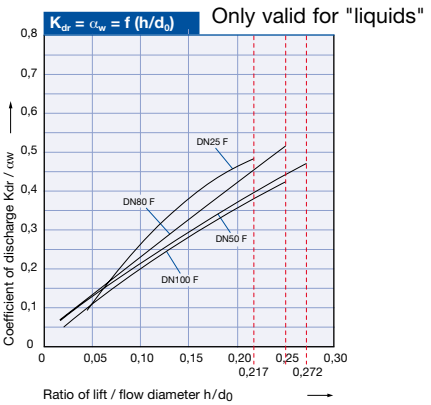
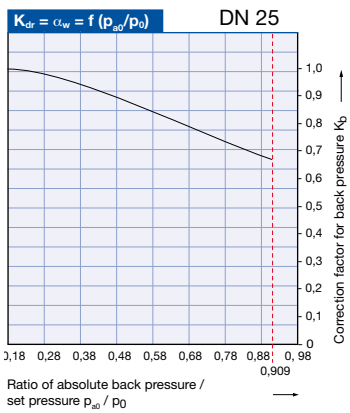
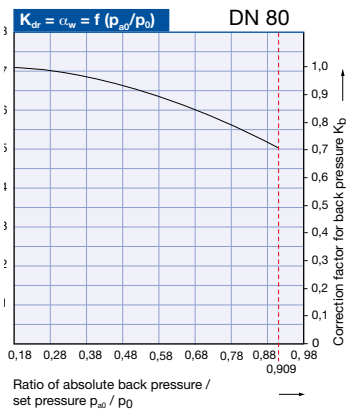
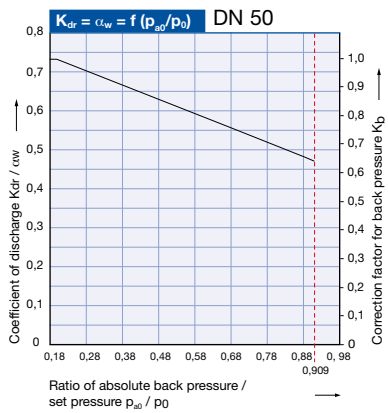
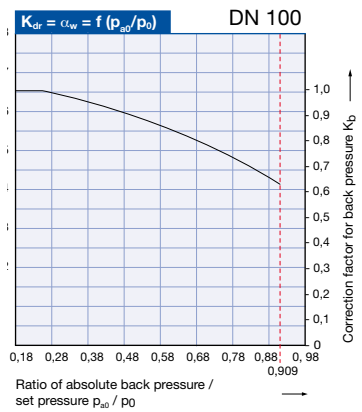


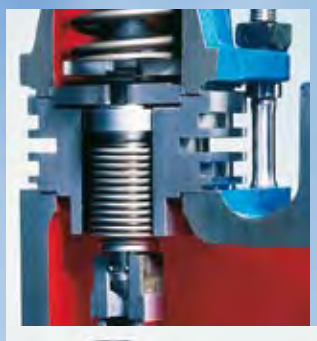
Diagram for evaluation of the coefficient of discharge (K_{dr}/α_w) or K_b in reference with the ratio of absolute back pressure / set pressure (p_{a0}/p_0)











Accessories and Options

Contents

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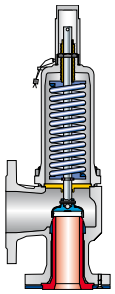
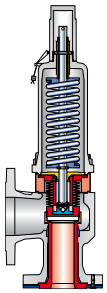
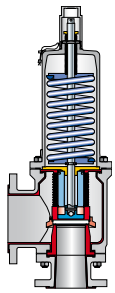
Accessories and Options

LESER

Overview





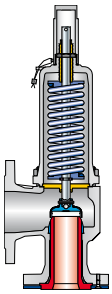


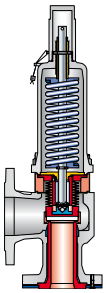
Options

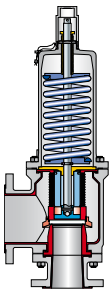
Type		546	5466	447
Body (Item 1)				
Grounding connection		✓	✓	✓
Drainage hole		✓	✓	–
Inlet body (Item 1)				
Lining	Virgin PTFE	–	–	*
	electrically conductive PTFE	–	–	✓
Outlet body (Item 2)				
Lining	Virgin PTFE	–	–	*
	electrically conductive PTFE	–	–	✓
Nozzle (Item 5):				
PTFE + 25% glass		–	–	*
electrically conductive PTFE		–	–	✓
PTFE + 25% carbon		–	*	–
as per customer specification, e.g. Hastelloy®		✓	✓	✓
Disc (Item 7):				
Disc with detachable lifting aid		✓	✓	*
Bull race disc		✓	–	–
Seal type (Item 7)				
Sealing plate	Borofloat glass	*	✓	*
	Virgin PTFE	✓	✓	✓
	PTFE + 25% carbon	✓	*	✓
as per customer specification, e.g. Hastelloy®		✓	✓	✓

Accessories and Options

Overview





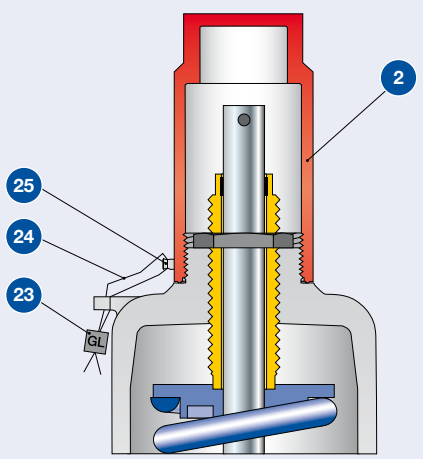


Options

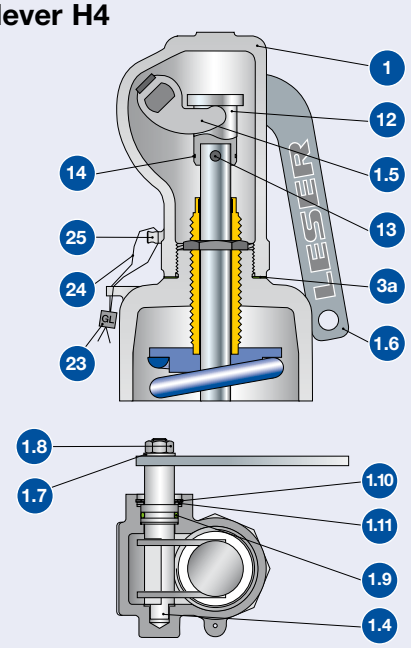
Type	546	5466	447
Bellows (item 15, item 7)			
Balanced bellows	*	–	–
PTFE bellows	✓	*	*
Special material, e.g. Hastelloy®	✓	–	✓
Caps and lifting devices (item 40)			
H2	✓	✓	✓
H4	✓	✓	✓
Test gag			
H2	✓	✓	✓
H4	✓	✓	✓
Bonnet (item 9)			
closed	*	*	*
open	–	–	–
Lift indicator			
Cap H2	–	–	–
Lifting device H4	✓	✓	✓
Lift stoppers			
Sleeve	✓	✓	✓
Set screw	✓	✓	✓

Caps and levers - subassembly item 40

Cap H2

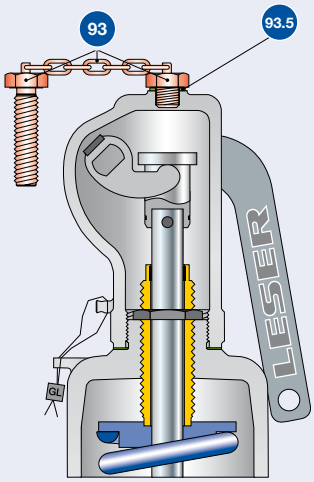


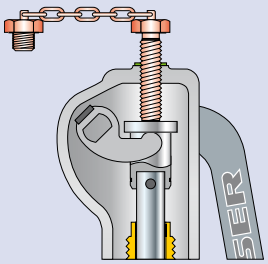
Packed lever H4



Test gag

Cap H2: J70
Packed lever H4: J69





BLOCKED
Remove screw after testing

Test gag

The test gag presses on the spindle and keeps the safety valve closed, even if the system pressure exceeds the set pressure of the valve.

The test gag is used to:

– perform the pressure test in a system without disassembling the safety valve.

– be able to make an adjustment to each individual valve in systems with multiple safety valves The test gag must be removed after testing, otherwise the safety valve will not protect the system against impermissible overpressure.

Caps and levers - subassembly item 40

Materials

		Steel		stainless steel	
Item.	**Components**	**Cap H2**	**Packed lever H4**	**Cap H2**	**Packed lever H4**
1	Lever cover	–	0.7040	–	1.4408
		–	Gr. 60-40-18	–	CF8M
2	Cap	1.0718	–	1.4404	–
		Steel	–	316L	–
3a	Spacer	–	1.4571	–	1.4571
		–	316Ti	–	316Ti
1.4	Shaft/bolt	–	1.0718	–	1.4404
		–	Steel	–	316L
1.5	Lifting fork	–	1.0531	–	1.4571
		–	Steel	–	316Ti
1.6	Lever	–	1.0036	–	1.4301
		–	Steel	–	304
1.7	Washer	–	1.4401	–	1.4301
		–	316	–	304
1.8	Nut	–	A2/Poly	–	1.4401
		–	2H	–	8M
1.9	O-Ring	–	FKM	–	–
		–	-"-	–	–
1.9	Packing ring precast	–	–	–	Graphite
		–	–	–	-"-
1.10	Retaining clip	–	Steel	–	–
		–	-"-	–	–
1.10	Nut	–	–	–	1.4104
		–	–	–	Chromium steel
1.10	Packing gland	–	–	–	1.4404
		–	–	–	316L
1.11	Support ring	–	Steel	–	–
		–	-"-	–	–
12	Spindle cap	–	1.0718	–	1.4404
		–	Steel	–	316L
13	Pin	–	Steel	–	1.4401
		–	-"-	–	8M
14	Securing ring	–	1.4571	–	1.4571
		–	316Ti	–	316Ti
23	Seal	Plastic	Plastic	Plastic	Plastic
		-"-	-"-	-"-	-"-
24	Seal wire	1.4541	1.4541	1.4541	1.4541
		321	321	321	321
25	Sealing nose	1.4435	–	1.4435	1.4435
		316L	–	316L	316L
93	Test gag	1.4401	1.4401	1.4401	1.4401
		B8M	B8M	B8M	B8M
93.5	Washer	Vulcanised fibre	Vulcanised fibre	Vulcanised fibre	Vulcanised fibre
		-"-	-"-	-"-	-"-

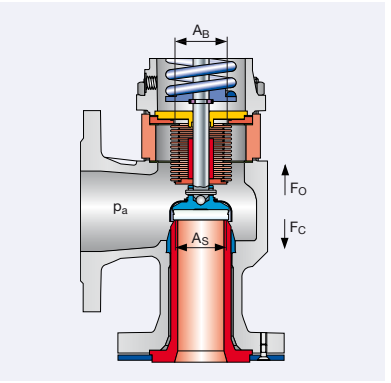
Please note:

- LESER reserves the right to make changes.
- LESER may use higher quality materials without giving prior information.
- Each component can be replaced by another material according to the customer's specification.

Balanced bellows and back pressure compensation

Compensation of the effect of back pressure

The back pressure exerted on the back of the disc causes a force in the closing direction (F_c). The actual amount of the force is dependent on the diameter of the seat and the amount of back pressure. The stainless steel bellows forms a surface opposite the seat that matches the seat area. The back pressure also affects this surface and creates pressure (F_o) in the opening direction, which compensates for the force in the closing direction (F_c).

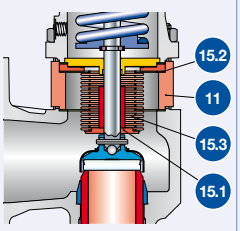
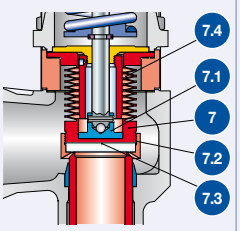
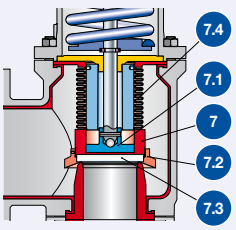


Type 546

The combination of the forces is shown in the following table:

Actual area	Back pressure	Actual force	Direction of force	Compensation criteria
Seat area = A_S	p_a	$F_C = p_a \times A_S$	closing	$A_S = A_B$
Bellows area = A_B	p_a	$F_O = p_a \times A_B$	opening	$F_C = F_O$

Bellows design

		Balanced bellows		PTFE bellows	
Type		**546**		**5466**	**447**
Design					
Bonnet spacer		*		*	–
Control thread	DIN ISO 228-1, G $^1/_4$	*		*	*
	ASME B1.20.1 NPT $^1/_2$	✓		✓	✓

To check the effectiveness of the bellows, an control thread G$^1/_4$ is fitted into the bonnet as per DIN ISO 228-1. For safe discharge, especially of aggressive, toxic media, a discharge pipe G $^1/_4$ can be installed if necessary.

Option code					
Closed bonnet	Bellows	J78		–	–
	Control thread NPT $^1/_2$	J95		–	–

The dimensions and weights for safety valves with a stainless steel bellows construction are to be taken from the respective "Dimensions and Weights" tables. The set pressures as well as the temperature ranges are displayed in the table "Pressure/Temperature ratings" for each type.

Type 546 balanced bellows – subassembly item 15

LESER offers a balanced bellows design for safety valves. Balanced bellows are used for two areas of applications:
– for compensation of the effect of back pressure
– For reliable sealing of the bonnet against the blow-off chamber

Materials

Item.	Components	Type 546
15.1	Lower adator	1.4404 316L
15.2	Upper adator	1.4404 316L
15.3	Balanced bellows	1.4571 316Ti
15.5	Housing	– –
11	Bonnet spacer	1.4404 316L
55	Stud	1.4401 B8M
60	Gasket	Graphite / 1.4401 Graphite / 316

Hastelloy bellows or bellows made of special materials are available on request.

Conversion kits

Item.	Components	Quantity	Materials	Remarks
8	Guide	1	1.4404 316L	
11	Bonnet spacer	1	1.4404 316L	
12	Spindle	1	1.4404 316L	
15	Balanced bellows	1	1.4571 316Ti	
55	Stud	4, 8, 12 dependant on valve size	1.4401 B8M	
60	Gasket	2, 3 dependant on valve size	Graphite / 1.4401 Graphite / 316	
–	Installation Instructions	1		LWN 037.05

Article numbers and spare parts, see the "Spare Parts" section of the respective valve type.

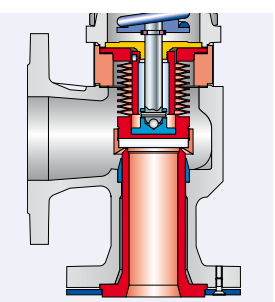
Type 5466 and Type 477 PTFE bellows – subassembly item 7

Besides the stainless steel bellows design, there is a PTFE bellows as an alternative.
PTFE bellows are used as:
– a cost-effective alternative to bellows made of special materials
– sealing the bonnet space from the blow-off chamber

For Type 5466 and Type 447 with PTFE bellows, the maximum pressure that may be exerted on the PTFE bellows is 1,6 bar.
The pressure is comprised of the built-up back pressure that occurs when blowing off the valve, and the external back pressure, which might occur from a blowdown system.

Materials

Item.	Components	5466	447
7	Disc with PTFE bellows	PTFE/BOROFLOAT glass	PTFE/BOROFLOAT glass PTFE/BOROFLOAT glass
7.1	Disc	1.4404 316L	1.4404 316L
7.2	Lifting aid	PTFE + 15% glass PTFE with 15% glass reinforcement	PTFE + 15% glass PTFE with 15% glass reinforcement
7.3	Sealing plate	PTFE/BOROFLOAT glass	PTFE/BOROFLOAT glass
7.4	Bellows	Virgin PTFE PTFE-TF	Virgin PTFE PTFE-TF



Type 5466

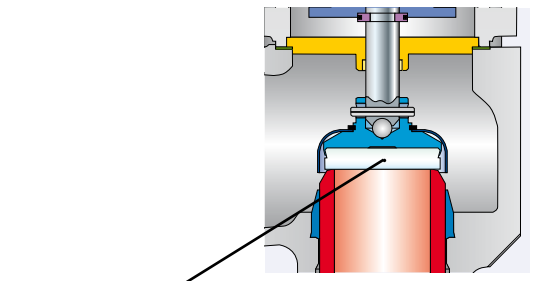
Sealing plate – subassembly item 7

Type 546, 5466 and Type 447

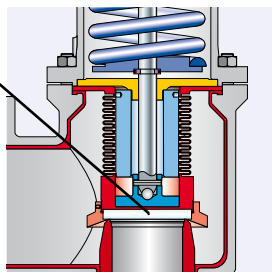
Non-metallic seal seat / nozzle, item 5 and disc - subassembly item 7

For safety valves for chemical processes, LESER uses sealing plates (Item 7.1) made of BOROFLOAT glass as a seat seal.
This glass is produced worldwide using the same method and is characterised by:

– high temperature resistance
– quenching strength
– improved mechanical strength
– high chemical resistance
– surface quality of the sealing surface as per ISO 10110: ◊◊◊ = fine, polished



Type 546



Type 447

Features	BOROFLOAT glass

Optical features		Physical features	
Grieß water resistance as per ISO 719-HGB:	1	Density (at 25°C):	2.23 g/cm³
Grieß water resistance as per ISO 719-HGA:	1	Elasticity module:	63 kN/mm²
Acidity class as per ISO 1776:	1	Knoop hardness HK 0.1/20 (measurement as per EN DIN/ISO 9385:	480
Alkali resistance class as per ISO 695-A:	2	linear therm. coefficient of expansion (20/300 °C):	3.25.10-6/K

The following sealing plates are available

	546	5466	447
Type			
PTFE + 25% carbon	–	*	–
BOROFLOAT glass	*	✓	*
Hastelloy®	✓	✓	✓
as per customer specification	✓	✓	✓

Lift indicator

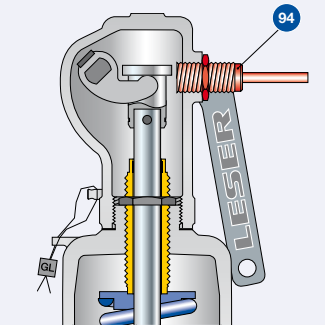
The lift indicator is used in the process technology to monitor the operating condition of a safety valve.

Depending on the type of valve, LESER equips the lifting device H4 or the bonnets with the receptacle for the lift indicator.

For safety valves with lift indicators, the opening of the valve during opening or the lifting operation is signalled as of a specific lift (min. 1mm / 0.04 inch).

LESER uses inductive DC lift indicators with two-wire technology
Type DIN EN 60947-5-6 (NAMUR). The indicators are approved for use in explosion-prone areas of Zone 0 (Ex II 1 D Ex iaD 20 T6).
Other indicators that meet customer specifications can be used.
Technical data for lift indicators can be found on the manufacturer's homepage:
www.pepperl-fuchs.com

Gas-tight construction on request
For installation instructions for lift indicators, see LWN 323.03-D.



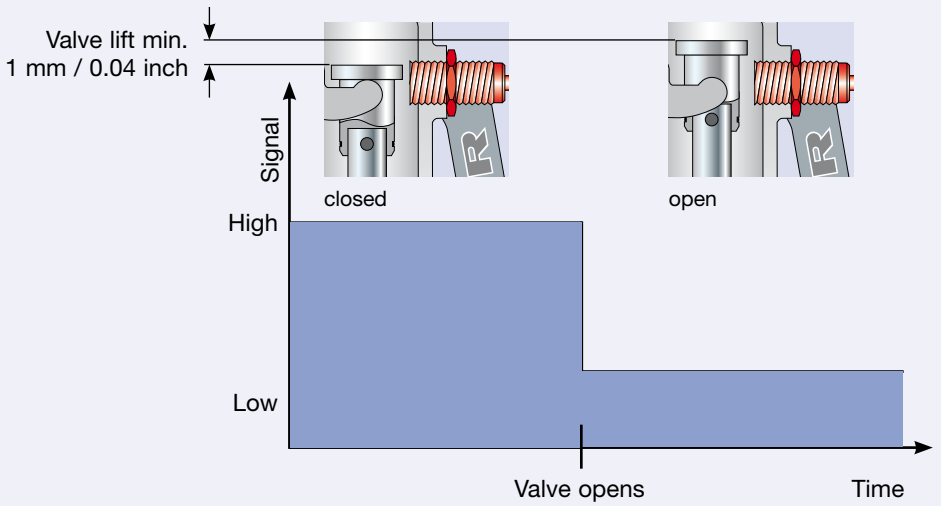
Lifting device H4

Specification

Item.	Component	Option code
40	Lifting device H2 with receptacle for lift indicator M18 x 1 [mm]	J39
94	Lift indicator M18 x 1, used type = PEPPERL+FUCHS NJ5-18GK-N	J93

Functional diagram

A, closed position	B, open position
For a closed valve, the lift indicator is positioned on the side, in front of the coupling or the control sleeve.	If the safety valve opens or if the safety valve is vented **(in both cases, min. 1 mm 0.04 inch)** the lift indicator changes its state and switches. If the lift indicator unscrews, e.g. from vibrations, there is also a switching operation.



Lift restriction

The lift stopper is used to adjust the safety valve to the required discharge mass flow and does not affect the operation of the safety valve.

A lift stopper must meet the requirements of the following rules and regulations and standards.

Requirements

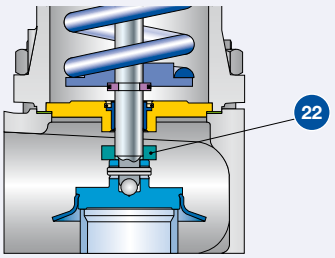
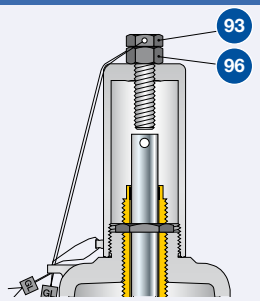
Rules and requirements / standards	EN ISO 4126-1, Section 5.1.3	ASME Code case 1945-4	AD 2000-Merkblatt A2, Section 10.3
Lift	≥ 30% of the full lift not less than 1.0 mm / $^1/_{16}$ inch	≥ 30% of the full lift not less than 0.08 inch / 2.0 mm	not less than 1.0 mm / $^1/_{16}$ inch
Coefficient of discharge	–	–	α_w [D/G] ≥ 0.08
	–	–	α_w [F] ≥ 0.05
Name plate marking	Marking of reduced coefficient of discharge	- Capacity replaced by "Limited capacity" - Limited lift =____ inch / mm	Marking of reduced coefficient of discharge
Design according to EN ISO 4126-1	For valves with a lift stopper to adapt to the required discharge mass flow, this device must not have an adverse effect on the operation of the valve. If it is adjustable, the lift stopper device must be setup such that the adjustable part can be mechanically secured and sealed. The lift stopper device must be installed and sealed by the manufacturer.		

Calculation of the lift stopper

The following resources are available for calculating the lift stopper:

- the "Diagram for evaluation of the ratio of lift / narrowest flow diameter (h/d_0) in reference with coefficient of discharge (K_{dr}/α_w). An example of working with the chart can be found on page 00/14.
- LESER sizing program "VALVESTAR®"
- LESER sizing program in the Internet at www.valvestar.com

Lift restriction

		Lift restriction by bush	Lift restriction by gag
Design			
Option code		J51	Cap H2: J52 Lifting device H4: J50
Availability			
Type 546		✓	✓
Type 447		✓	✓
Materials			
Item.	**Component**		
22	Bush	1.4404	–
		316L	–
93	Stud	–	1.4401
		–	B8M
96	Nut	–	1.4401
		–	8M