Critical Service

Flanged Safety Relief Valves
Series 546
Series 447

CATALOG

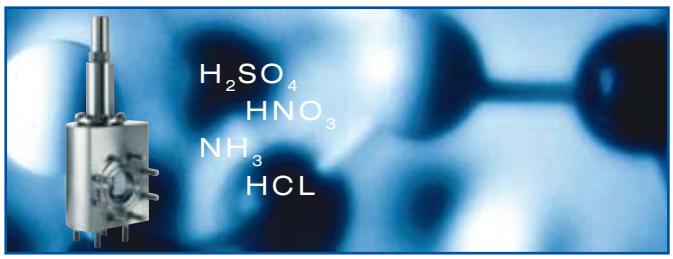
LESER

The-Safety-Valve.com

Product range

LESER

LESER safety valves for every industrial application



Critical Service

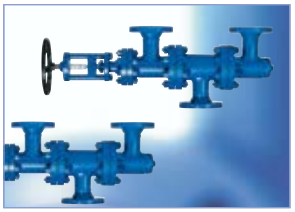
High Performance

Compact Performance

API

Clean Service

Modulate Action



Best Availability

Series 546

Type 546

Type 5466

Series 447

Type 447

Type 449

General

Type 546

DN 25 – DN 100, 1" – 4"
Set pressure 0,5 – 10 bar, 7,2 – 145 psig

Type 5466

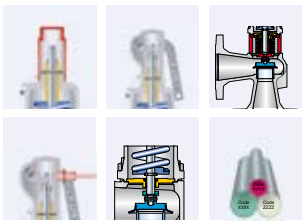
DN 25 + DN 50, 1" + 2"
Set pressure 0,5 – 10 bar, 7,2 – 145 psig

Type 447

DN 25 – DN 100, 1" – 4"
Set pressure 0,1 – 16 bar, 1,5 – 232 psig

Type 449

DN 25 – DN 100, 1" – 4"
Set pressure 0,1 – 16 bar, 1,5 – 232 psig



Options

Contents

LESER

Type 546
Cap H2
Closed bonnet
Conventional design

Type 546
Packed lever H4
Closed bonnet
Balanced bellows design

Type 5466
Cap H2
Closed bonnet
Conventional design

Contents

Type 447
Packed lever H4
Closed bonnet
Conventional design

Type 449
Packed lever H4
Closed bonnet
Conventional design

Type 449
Cap H2
Closed bonnet
Balanced bellows design

General Information

LESER

LESER – Critical Service Safety Valves

The Critical Service product group represents

- ☑ Standardised solutions for special applications with critical media
- ☑ Optimum adaptation to system-specific requirements
- ☑ Alternatives to nickel-based alloys (e.g. Hastelloy®)

LESER's Critical Service Safety Valves

- Are designed and manufactured according to the highest standards.
- Are characterised by longstanding proof in service.
- Are developed and optimised in close cooperation with plant engineers and maintenance specialists to protect processes with highly corrosive and toxic media.
- Type 546 and 447 with PTFE nozzles provide a cost-effective alternative to high alloyed metals.
- Type 449 with duct system for inert gas carriage as an integrated concept to protect people and the environment against highly toxic media.
- Meet the highest requirements of end customers, OEMs and planners.
- Are approved by all important approval organisations worldwide This ensures the worldwide applicability of LESER Critical Service safety relief valves.

Examples of this are:

Type	546	447	449
European Community: CE marking acc. to Pressure Equipment Directives 97/23/EC and DIN EN ISO 4126-1	X	X	X
USA: UV-Stamp acc. to ASME Section VIII Division 1, National Board certified capacities	–	X	–
Germany: VdTÜV approval acc. to Pressure Equipment Directive, EN ISO 4126-1, TÜV SV 100 and AD 2000-Merkblatt A2	X	X	X
Canada: Canadian Registration Number according to the requirements of particular provinces	–	X	–
China: AQSIQ based on the approvals acc. to AD 2000-Merkblatt A2	X	X	X

Furthermore, all LESER Critical Service safety valves are designed, marked, produced and approved acc. to the requirements of following regulations (directives, codes, rules and standards):

ASME Code Sec. II,
ASME B16.34 and ASME B16.5 flange,
API Std. 527

For other type-dependent approvals refer to
Type 546 page 01/19
Type 447 page 02/15

Applications

LESER – Critical Service Safety Valves

provide solutions for protection against highly corrosive and toxic media in all industrial applications with steam, gases, and liquids.

Typical applications for LESER Critical Service safety valves are:

- Chlorine production and processing, especially wet chlorine gas
- Chemical systems and pipelines
- Reducing media such as acids (e.g. hydrochloric acid, acetic acid, etc.)
- Alkaline solutions (like sodium hydroxide applications)
- As well as all intermediate products
  Intermediate products include amines, dioles, and polyalcohol. They are used, among other things, as raw materials for coatings, plastics, pharmaceuticals, textile fibres, detergents and pesticides.

General Design Features

LESER – Critical Service Safety Valves

offer a large variety of types, materials, and options for adaptation to the respective system conditions:

- Valve sizes from DN 25 to DN 100, 1" to 4"
- PTFE use also possible according to ATEX standard through antistatic and electrically conductive PTFE compound
- Large variety of high alloyed materials for all application ranges:
  - Hastelloy®
  - Inconel®
  - Tantalum
  - Zirconium
  - Titanium
  - Monel®
- One design and spring for steam, gases and liquids (SingleTrim) reduces the number of required spare parts and facilitates cost-effective maintenance
- The one-part spindle reduces friction, guarantees optimal guidance and reliable operation under all operating conditions
- The self-emptying casing avoids media residue and reduces corrosion.
- Every part can be replaced by other materials according to customer specifications

LESER – Critical Service Safety Valves

can be individually adapted to the operating conditions with accessories, for example:

- Balanced bellows for compensation of the back pressure and to protect the moving parts
- Lift indicator for detection of opening operations of the safety valve and forwarding the signal to a control room.

Valve finder

LESER

How to find the right product group

Required orifice letter?

Orifice > F → **High Performance**

Orifice < F → **Compact Performance**

No

Steam, gas, and liquid application with low capacity relating to the valve size?

Yes → **Modulate Action**

No

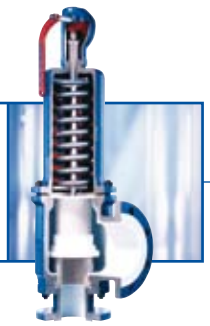
API specified application?

Yes → **API**

No

Critical Service/High Corrosive application?

Yes → **Critical Service**



No

Clean Service application?

Yes → **Clean Service**

How to find the right safety valve product group

Valve finder

How to find the right Critical Service safety valve

	Type	Orifice	Corrosion resistance characteristic	Description
Customized	**449** 	G – N	Inlet ■■■ Outlet ■■■ Bonnet space – Standard with balanced bellows ■■■	Type 449 is a component-tested safety valve for protection against toxic media, often also in connection with corrosion. Type 449 is characterised by: · a duct system for flushing protective gas. Refer to page 03/03 for more detailed explanations. · Balanced bellows for back pressure compensation and to seal the bonnet space. · Manufacture of the body components as well as most inner components of rod or forged material in order to realise customer-specific material requirements, nominal pressure ratings, hole patterns, and branch sizes. Please use the "Specification Sheet" on page 03/04 for this. Naturally, LESER will advise you on the configuration of Type 449 for your application!
Standard	**447** 	G – N	Inlet ■■■ Outlet ■■■ Bonnet space – Standard with PTFE bellows ■■■	Designed to protect against inadmissible overpressure in pressure vessels and systems in which the use of high alloyed metals (e.g. nickel-based alloys) is necessary due to the medium properties. Type 447 is the most economical alternative in applications in which there is also a highly corrosive atmosphere in the blow-off chamber, which makes the best protection through a PTFE lining necessary.
	5466 	G – K	Inlet ■■■ Outlet ■■□ Bonnet space – Standard with PTFE bellows ■■■	Designed to protect against inadmissible overpressure in pressure vessels and systems in which the use of high alloyed metals (e.g. nickel-based alloys) is necessary due to the medium properties. Type 5466 is the solution for applications in which activation of the safety valve rarely occurs and the protective coating together with the bellows provides adequate corrosion protection on the outlet side.
	546 	G – N	Inlet ■■■ Outlet ◪□□ Bonnet space – Standard without bellows ◪□□ – Option with balanced bellows ■■■	Designed to protect against inadmissible overpressure in pressure vessels and systems in which the use of high alloyed metals (e.g. nickel-based alloys) is necessary due to the medium properties. Type 546 is the solution for applications in which activation of the safety valve is very unlikely due to the large difference between the operating and set pressure.

How to find the right Critical Service Safety Valve

Valve selection

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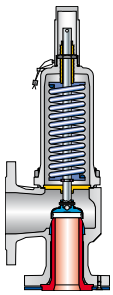
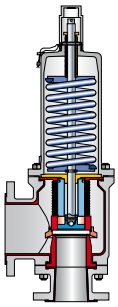
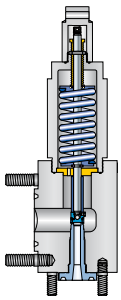






Valve size

Type		546	5466	447	449
min.		DN 25	DN 25	DN 25	DN 25
		1"	1"	1"	1"
max.		DN 100	DN 50	DN 100	DN 100
		4"	2"	4"	4"

Materials

Type		546	5466	447	449
0.7043	Ductile 60-40-18	✓	–	–	–
1.0619	WCB	✓	✓	✓	–
1.4404	316L	–	–	–	✓
Customer-specific alloys		–	–	–	✓

Information on PTFE materials can be found on page 00/07.

Set pressure

Type	546	5466	447	449
Metric units min. [bar]	0,5	0,5	0,1	0,1
US units min. [psig]	7,2	7,2	1,5	1,5
Metric units max. [bar]	10	10	16	16
US units max. [psig]	145	145	232	232

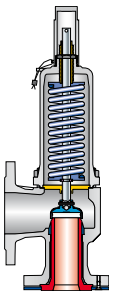
Temperature application range

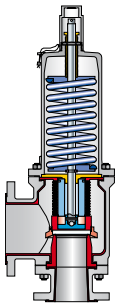
Type		546	5466	447	449
as per DIN EN	min. [°C]	-85		-85	Values correspond to the specifications of Type 447, however they have to be confirmed by LESER as part of the specification on pages 03/04 and 03/05.
	max. [°C]	+200[1)]		+200[1)]	
	min. [°F]	-121		-121	
	max. [°F]	+392		+392	
as per ASME	min. [°C]	Currently no ASME approval		-29	
	max. [°C]			-20[1)]	
	min. [°F]			+200	
	max. [°F]			+392	

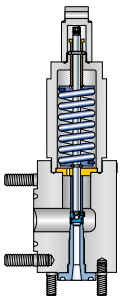
[1)] Application limits depending on pressure and temperature. See Pressure/Temperature chart on page 02/12

Valve selection

LESER







Capacity

Type		546	5466	447	449
$LEO_{S/G}$	min.	0,482	0,482	0,408	Values correspond to the specifications of Type 447, however they have to be confirmed by LESER as part of the specification on pages 03/04 and 03/05.
$LEO_{S/G}$	max.	6,048	1,797	6,520	
$Orifice_{S/G}$	min.	–	–	1.3 x F	
$Orifice_{S/G}$	max.	–	–	1.0 x P	
LEO_L	min.	0,304	0,304	0,285	
LEO_L	max.	3,780	1,139	4,555	
$Orifice_L$	min.	–	–	1.4 x E	
$Orifice_L$	max.	–	–	1.1 x N	

Coefficent of discharge

Type		546	5466	447		449
		K_{dr}/α_w	K_{dr}/α_w	K_{dr}/α_w	K (ASME)	K_{dr}/α_w
Pressure increase acc. to	DIN EN ISO 4126	10%		10%		Values correspond to the specifications of Type 447, however they have to be confirmed by LESER as part of the specification on pages 03/04 and 03/05.
	ASME VIII	–		10%		
K_{dr} / α_w S/G	DN 25 / 1"	0,73	0,76	0,70	0,617 (only for "G")	
	DN 40 / 1½"	0,68	–	–		
	DN 50 / 2"		0,69	0,72	0,617	
	DN 65 / 2½"		–	–		
	DN 80 / 3"	0,64	–	0,70	0,617	
	DN 100 / 4"		–	0,65	0,617	
K_{dr} / α_w L	DN 25 / 1"	0,46	0,51	0,48	0,431	
	DN 40 / 1½"	0,43	–	–		
	DN 50 / 2"		0,46	0,47	0,431	
	DN 65 / 2½"		–	–		
	DN 80 / 3"	0,40	–	0,51	0,431	
	DN 100 / 4"		–	0,42	0,431	

Approvals

Type			546	447	449
Country	Code	Media			
Europe	DIN EN ISO 4126-1 CE marking	S/G/L	072020111Z0008/0/19	072020111Z0008/0/09	Approvals correspond to the specifications of Type 447, however they have to be confirmed by LESER as part of the specification on pages 03/04 and 03/05.
Germany	AD 2000-Merkblatt A2	S/G/L	TÜV SV 496	TÜV SV 979	
United States	ASME VIII	G	–	M37123	
		L	–	M37134	
Canada	CRN	G/L	–	0G1018.9C	
China	ASQSIQ	S/G/L	TSF700301-2011	TSF700301-2011	
Russia	RTN, ROSTECHNADZOR		PPC 00-18458	PPC 00-18458	
Russia	GOST R		B 29896	B 29896	
Belarus	PROMATOMNADZOR		15-171-2006	15-171-2006	
Classification societies				On request	

Lining materials

LESER

Material characteristics

Standard PTFE materials			Optional PTFE materials	
			Application-specific requirements can be met by selecting a specific PTFE. Examples of this are: – explosion-prone areas (ATEX) – Applications in which low permeability of the lining is required (e.g. chlorine applications)	
Virgin PTFE	**PTFE with 25% glass**	**PTFE with 25% carbon**	**PTFE, antistatic and electrically conductive**	**PTFE (PTFE-TFM™)**
Standard material for: Item 1: Inlet body (Type 447) Item 2: Outlet body (Type 447) Item 5: Nozzle (Type 546) Item 7: Disc with bellows (Type 5466)	**Standard material for:** Item 5: Nozzle (Type 447)	**Standard material for:** Item 5: Nozzle (Type 5466) Item 7: Sealing plate (Type 5466)	**Optional material for:** Item 1: Inlet body (Type 447) Item 2: Outlet body (Type 447) Item 5: Nozzle (Type 447)	**Optional material for:** Item 7: Disc with bellows (Type 447)
Characteristics of virgin PTFE-TF – Colour: white – Resistant to almost all chemicals – Temperature range of -200 °C / -328 °F to +260 °C / +500 °F – Outstanding insulation properties and specific volume resistivity > 10^{18} Ω x cm – light and water resistant – good ageing resistance – Physiologically stable up to +200 °C / +392 °F – Outstanding antifrictional properties; no "stick-slip" effect (build-ups) – non-flammable – doesn't absorb water	**Characteristics of PTFE with 25% glass** – Colour: grey-beige – Very good impact and pressure resistance (higher than virgin PTFE, antistatic and electrically conductive PTFE as well as PTFE-TFM). – low compression strain – high tensibility – resistant to wear – Low dimensional tolerance deviations compared to virgin PTFE due to reduced thermal expansion. – Temperature range of -200 °C / -328 °F to +260 °C / +500 °F – light and water resistant – high ageing resistance – Outstanding antifrictional properties; no "stick-slip" effect (build-ups) – Self-lubricating properties – non-flammable – Recommended for high temperatures and demands due to high dimensional accuracy	**Characteristics of PTFE with 25% carbon** – Colour: black – Very good impact and pressure resistance (higher than virgin PTFE, antistatic and electrically conductive PTFE as well as PTFE-TFM), components are more stable. – low deformation – high tensibility – resistant to wear – Temperature range of -200 °C / -328 °F to +260 °C / 500 °F – light and water resistant – high ageing resistance – Outstanding antifrictional properties; no "stick-slip" effect (build-ups) – Self-lubricating properties – non-flammable – Recommended for high temperatures and demands due to high dimensional accuracy – Volume resistivity as per DIN 53482 < 10^6 Ω/cm[1)]	**Characteristics of antistatic and electrically conductive PTFE** – Colour: black – Electrically conductive material with a specific volume resistance < 10^6 Ω/cm[1)] – Surface resistance 10^3 Ω[1)], no electrostatic charging possible – Good chemical resistance, however the coating may be attacked by extremely oxidising media – Temperature range of -200 °C / -328 °F to +260 °C / +500 °F – light and water resistant – high ageing resistance – Outstanding antifrictional properties; no "stick-slip" effect (build-ups) - Self-lubricating properties – non-flammable – doesn't absorb water – Compound is suitable for use in explosion-prone areas (ATEX)	**Characteristics of PTFE (TFM™ PTFE)** The molecular structure of PTFE changes by adding less than 1% PPVE. As a result, the high quality of PTFE-TFM is achieved. The advantages of PTFE-TFM compared to virgin PTFE are: – High dimensional stability under operating conditions – Highly gas-tight due to the denser polymer structures with miniscule cavities – Increased demand repetition, especially at high temperatures – Better surface quality than PFA – Recommended for low gas penetration and high dimensional stability under loading – Recommended for high dimensional accuracy and / or for high temperatures and loading – Permeability as per DIN 53380, film thickness 1mm and chlorine gas at +54 °C: 160 $\frac{cm^3}{m^2 \times d \times bar}$

[1)] Materials with a volume resistance ≤ 10^6 Ω/cm are considered to be electrically conductive. Materials with a surface resistance ≤ 10^3 Ω are regarded as antistatic.

Quality information

	PTFE products used by LESER
Full lining of body parts	Casing components of Type 447 are fully lined exclusively with high-quality virgin PTFE-TF with the reliable isostatic process. Compared to other lining processes like injection moulding methods, the process reliability of the isostatic process guarantees to avoid lining flaws like stress cracks, pores, blow-holes, internal flaws due to varying shrinkage and internal stress. Conditional on the isostatic manufacturing method, lined parts have an outstanding vacuum seal with low permeability, even with small wall thicknesses. The level of quality is checked by the high-voltage breakdown test as per DIN 28055-T2.
Inner parts:	Nozzles, sealing plates, etc. are manufactured exclusively from compression-moulded, sintered semi-finished products (rods) made of virgin PTFE with 25% glass, 25% carbon or electrically conductive pigment compounds. To maintain the good quality properties, bellows are manufactured exclusively of virginal, compression-pressed and sintered semi-finished products made of the material PTFE-TF or PTFE-TFM. **Comment:** LESER doesn't use any semi-finished products to manufacture the components for Type 447 that haven't been made using the sinter press forming process.

The different requirements are listed in the following and relevance for LESER safety valves is explained.
They define LESER as follows:

REACH – EU Chemicals Regulation No. 1907/2006

The EU Chemicals Law REACH (English: REACH – **R**egistration, **E**valuation and **A**uthorisation of **Ch**emicals) registers, evaluates and checks the composition of chemical materials.

The PTFE materials used in the safety valves of the LESER Critical Service product group are assigned to the polymers and preparations materials groups according to REACH, and according to today's perspective of our suppliers, they comply with EU Regulation 1907/2006 for later registration, evaluation and approval.

ATEX

ATEX Guideline 94/9/EC (equipment guideline)

The ATEX guideline (Atmosphères Explosibles = explosive atmospheres) 94/9/EC went into force on 01.07.2003 as a national European standard DIN EN 13463. The ATEX guideline regulates the explosion protection of non-electric systems, equipment and components in explosion prone areas and hence the obligations for equipment manufacturers.

What is an explosion prone area?

Atmospheres are designated to be potentially explosive if they tend to be explosive through ambient and operating conditions. The ATEX guideline defines an explosive atmosphere as "a mixture of combustible materials in the form of gases, steam, mist or dust and air under atmospheric conditions in which the combustion process is transferred to the entire unburned mixture after ignition."

ATEX conformity certification refers to equipment and components. Corresponding certification is not necessary for materials, however raw materials manufacturers provide relevant material characteristics that support the ATEX applications.

Definition of materials and characteristics.

Besides obtaining the EC declaration of conformity, the manufacturer's priority is to select suitable materials. An important criterion of the choice of material is, for example, the electrostatic discharge process (ElectroStatic Discharge = ESD) is to be avoided between objects with different electrical potential. During discharge processes, electric arcs are created that cause an explosive atmosphere to ignite. One of the measures to prevent this is to use materials with special physical properties, especially with specific electrostatic discharge behaviour. In chemistry, materials are considered to be conductive if the specific volume resistivity as per DIN 53482 doesn't exceed $\leq 10^6$ Ω/cm. The charge carriers are discharged from the fittings casing to a ground potential point by grounding (e.g. grounding bolts).

For these application cases, LESER uses the antistatic and electrically conductive PTFE compound with Type 447
(see page 02/08).

Summary

With proper use, there is no danger to explosion prone areas from safety valves. Safety valves have no potential sources of ignition of their own.

Safety valves are not used to protect atmospheres. They have a protective function against inadmissible overpressure and hence meet the requirements of the Pressure Equipment Directive 97/23/EC. Nevertheless, they can be used within an explosive atmosphere.

PTFE and PTFE compounds in the presence of O_2

Guidelines

"Non-metallic materials" made of PTFE and PTFE compounds are tested and evaluated for applications in oxygen systems by the Federal Institute for Materials Research and Testing (BAM). The following table is an excerpt of BAM-tested materials including the BAM test methods that were used.

They are:

1. Ignition temperature at +450 °C and oxygen at 50 – 150 bar
2. Ageing resistance 100h at $t_{\text{ignition temperature}}$ -100 °C
3. Effect of oxygen pressure surges, reactivity determined according to Poisson 's equation
4. Test of flange seals for flange connections
5. Reactivity with liquid oxygen with surge loading

Note:
The latest testing and evaluation foundations as well as the resulting safety-related assessment are listed in the BG Merkblatt M 034
and BG Merkblatt M 034-1.

For specific applications, the respective expert's report must be obtained from the raw material manufacturer.

	BAM test method					BAM Listing
Product description	**1**	**2**	**3**	**4**	**5**	
Virgin PTFE	✓	✓	✓	✓	–	✓
PTFE conductivity compound)	✓	✓	✓	✓	–	✓
PTFE-carbon compound	✓	✓	✓	✓	–	✓
PTFE-glass reinforcement compound	✓	✓	✓	✓	✓	✓

Note:
The given resistances and functional ranges are only "guidelines" and do not absolve the customer of the responsibility of conducting separate tests to evaluate the suitability.

What is the difference between an antistatic lining and grounding a safety valve?

Pure fluoro-plastics are electrical insulators. If this material property is not desired, then by adding a component of approx. 2 to 4% graphite, soot or charcoal you end up with an antistatic lining. It is conductive and removes electric charge carriers from the plastic surface in contact with the medium, through the plastic wall to the metallic fittings casing. The charge carriers are discharged from the fittings casing to a ground potential point by grounding (e.g. grounding bolts).

For what chemical applications are lined LESER safety valves preferably used?

Chemical, pharmaceutical, petrochemical and industrial process technology

- with corrosive and highly corrosive media
- with hazardous media of all types
- with electronic chemicals and other pure media
- if metal-free surfaces are needed, e.g. media that is reactive to metal
- with media for which stainless steel, Hastelloy etc. is not adequately chemically resistant
- with media for which exotic metals would be needed resulting in very high investment costs
- if anti-adhesive surfaces are needed

Comparison of PTFE / PFA

LESER

LESER covers the inlet body and outlet body with virgin PTFE in an isostatic compressing procedure with a sintering process.This process results in an extraordinary chemical, mechanical and thermal molecular structure.

The following "Comparison of the lining materials PRFE / PFA" compares the properties and shows possibilities of the adaptation properties through different compounds.

Comparison of the lining materials PTFE / PFA

PTFE – Isostatic lining [Polytetrafluorethylene]

- Semi-crystalline fluoro-plastic
- Processing in an isostatic compression moulding process followed by a gas-tight sintering process

as a result:

- Process-reliable isostatic lining
- High diffusion resistance with highly permeating liquids
- Thinner wall thicknesses adequate compared to PFA
- Very good ageing resistance
- Low water absorption
- Good vacuum seal
- No fatigue cracks
- No susceptibility to stress cracking

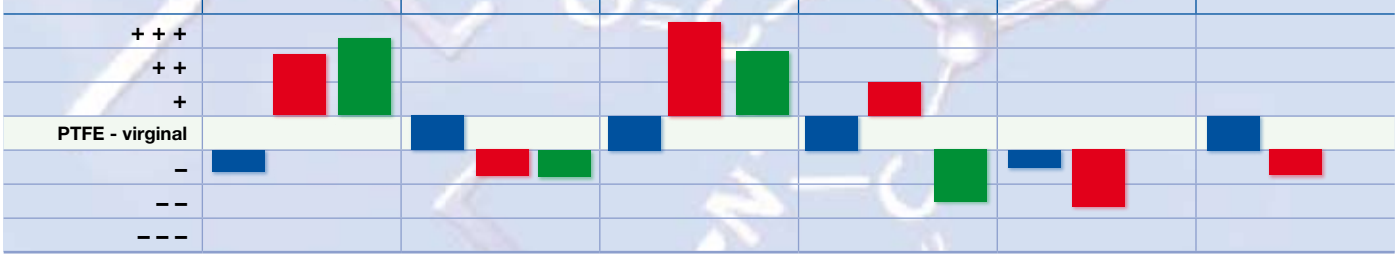
PFA [Perfluoralkoxy-Copolymere]

- Semi-crystalline copolymere
- Processing in melted state– injection mouldable

as a result:

- High degree of shrinkage due to process, therefore low vacuum fastness
- Susceptible to fatigue cracks
- High degree of shrinkage cavity formation from manufacturing process
- Higher water absorption compared to isostatic PTFE
- Permeability greater than with isostatic PTFE
- Greater wall thicknesses required
- Higher material and lining costs
- Greater susceptibility to stress cracks

Influencing variable	Mechanical properties	Thermal Properties		Electrical properties	Permeation	Chemical resistance
		- C°	+ C°			
+ + +						
+ +						
+						
PTFE - virginal						
–						
– –						
– – –						



Materials:

- PFA
- PTFE-carbon
- PTFE-glass

Note:
Compared to standard PTFE materials, the optional PTFE materials given on page 00/07 are not included:
– PTFE, antistatic and electrically conductive
– PTFE (PTFE-TM™) for chlorine applications

How to use

LESER

General signs and symbols	
*	Standard
✓	Available
–	Not possible

Signs and symbols for flange drillings and flange facings	
*	Standard construction, specification of an option code not necessary
(*)	Flange dimensions with exception of flange thickness as per flange standards (e.g. ASME B16.5) Flange thickness is less (max. 2 mm), see "Hole patterns valid for different pressure ratings"
–	Flange hole pattern / sealing surface not possible

Option code for flange drillings and dimensions, e.g. H50	
H50	Flange drilling as specified in flange standard. Outer flange diameter, flange thickness, and height of flange facing may be larger, see "Dimensions".
(H50)	Flange dimensions except flange thickness are in accordance with standards (e.g. ASME B16.5). Flange thickness is smaller (max. 2 mm), see “Multiple pressure rating”.
Stock Finish	Flange drilling as specified in standard. Flange thickness may be less than the flange outer diameter as specified. in the standard, however complete nut support area is available.
Option code for flange sealing surfaces, e.g. L36	
L36	Flange facing as specified in standard.

General information concerning flange drillings and flange facings

Multiple pressure rating	The flange standard shows the same drilling, facing and outer diameter for several pressure ratings, e.g. from PN 16 to PN 40. Due to the pressure rating of the body, LESER fulfills the requirements for flange thickness, e.g. PN 16 but not PN 40.
Smooth Finish	In the applicable MSS SP-6 (Edition 2001), “Smooth Finish” is no longer mentioned. In MSS SP-6 (Edition 1980), “Smooth Finish” was defined as the surface quality of the flange with “250 µinch (6.3 µm) AARH max.”. LESER supplies flange sealing surfaces according to ASME B16.5 - 1996, Paragraph 6.4.4.3: “Either a serrated concentric or serrated spiral finish resulting in service finish from 125 to 250 µinch average roughness shall be furnished”. This finish meets the requirements of MSS SP-6 (Edition 1980), which is not valid anymore!
Stock Finish	“Stock Finish” is not defined in any technical standard. If “Stock Finish” is specified in the order, then LESER delivers standard flange sealing surfaces as per DIN or ASME (marked with * in the “Flange sealing surfaces” table for each series).

Pressures – Symbols in use

Symbols	Name	Metric units
p	Set pressure	bar
p_0	Absolute pressure in vessel	
	= p · 1,1 + 1,013	bar_a
	= p · 1,1 + 14,5	psi_a
	The overpressure is 10% of the set pressure, but at least 0,2 bar	
p_a	Back pressure	bar
p_{a0}	Absolute back pressure	
	(= p_a + 1,013)	bar_a
	(= p_a + 14,5)	psi_a

Materials

In the table below, you will find a list of the LESER material codes. Please take into consideration that:
– Material quality certificate 3.1 as per EN 10204 is available for each body material.
– Material quality certificate 3.1, which certifies different materials, is available for many materials.

Material code	Valve body with flanges	Body material is certified acc. to 3.1 (EN 10204) for the following materials	
		acc to. EN	acc to. ASME
2	Cast steel	1.0619	WCB, WCC
4	Stainless steel	1.4404, 1.4571	316L, 316TI
5	Nodular cast iron	0.7043	Ductile Gr. 60-40-18

How to use

Sample capacity table –
How to select capacities for gas: Type 447 DN 50

Capacity table – air

Calculation of the capacity for gasses as per AD 2000 Merkblatt A2 with 10% overpressure at 0 °C and 1013 mbar.
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 [m_n^3/h]			
DN_E	25	50 (2)	80	100
DN_A	50 (3)	80	100	150
Narrowest flow diameter d_0 [mm]	23	46 (4)	60	92
Narrowest flow area A_0 [mm^2]	415 (5)	1662	2827	6648
$LEO_{D/G}$*) [$inch^2$]	0,408	1,630 (6)	2,773	6,048
(7) Set pressure [bar]	Capacity [kg/h]			
0,1	133	518	950	1898
0,2	169	661	1216	2467
0,3	202	790 (8)	1452	2981

US units	ASME Section VIII [S.C.F.M.]			
DN_E	25	50	80	100
DN_A	50	80	100	150
Narrowest flow diameter d_0 [inch]	0,91	1,81	2,36	3,62
Narrowest flow area A_0 [$inch^2$]	0,645	2,576	4,382	10,304
$LEO_{D/G}$*) [$inch^2$]	0,408	1,630	2,773	6,048
Set pressure [psig]	Capacity [S.C.F.M.]			
10	202	679	1256	2868
15	217	839	1528	3529

*) $LEO_{D/G/F}$ = LESER Effective Orifice for steam, gases, and liquids, see page 00/15

Explanation — Type 447 DN 50

No.	Name		Metric units	US units	Example
1	Code				AD 2000-Merkblatt A2
2	Nominal diameter inlet x outlet	DN_{IxO}			50 x 80
3	Valve size				2" x 3"
4	Actual orifice diameter	d_0	[mm]	[inch]	46
5	Actual orifice area	A_0	[mm^2]	[$inch^2$]	1662
6	LESER Effective Orifice	$LEO_{S/G}$	[$inch^2$]	[$inch^2$]	1,630
7	Set pressure		[bar_g]	[psig]	0,3
8	Capacity		[kg/h]	[lb/h]	790
9	Calculation basis		See table on page 00/13		

How to use

LESER

9

Calculation basis

		Metric units		US units	
Code		Capacity calculation acc. to AD 2000-Merkblatt A2		Capacity calculation acc. to ASME Section VIII (UV)	
Medium					
Steam (Saturated steam)	Standard conditions	Steam table IAPWS-IF97 IAPWS Industrial Formulation for the Thermodynamic Properties of Water and Steam	[kg/h]	Steam table IAPWS-IF97 IAPWS Industrial Formulation for the Thermodynamic Properties of Water and Steam	[lb/h]
Air	Standard conditions	0 °C and 1013 mbar	[m_n^3/h]	16 °C and (60 °F)	[S.C.F.M.]
Water	Standard conditions	20 °C	[10^3 kg/h]	21 °C (70 °F)	[US-G.P.M.]
All media					
	Calculation pressure	Set pressure plus 10% overpressure		Set pressure plus 10% overpressure	
	Calculation pressure for low set pressures	Capacities at 1 bar and below are calculated with 0,1 bar overpressure.		Capacities at 2,07 bar (30 psig) and lower are calculated at 0,207 bar (3 psig) overpressure.	

Example — Determining the design pressure

Metric units	
Set pressure	Design pressure
10 bar	10 bar + 10% overpressure = 11 bar
0,5 bar	0,5 bar + 0,1 bar overpressure = 0,6 bar

6

LESER Effective Orifice

Safety devices against pressure overshoot should be determined using the equations as per API RP 520, Section 3.6 to3.10 for steam, gases, liquids, or dual-phase flow. These equations use the coefficient of discharge (D/G 0.975, F 0.650) and the effective "Orifice" (as per API Std. 526, Fifth Edition, June 2002, table 1), which are independent of the valve construction.

This way, the system planner can determine a preliminary valve size. By using the LEO, the system planner can select the safety valve directly according to the calculation.
A verification with the selected actual flow area and the accorded coefficient of discharge is not necessary.

$LEO_{S/G}$	**LESER Effective Orifice (for steam and gasses)**	**[inch²]**	see page 00/15
LEO_L	**LESER Effective Orifice (for liquids)**	**[inch²]**	see page 00/15

See the LESER Engineering Manual for more information.

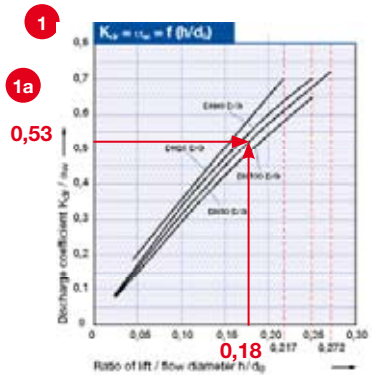
Example of determination of K_{dr}/α_w: Type 447 DN 50

Type 447

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

h = Lift [mm]
d_0 = Narrowest flow diameter [mm] of the selected safety valve, see "Article Numbers" table.
h/d_0 = Ratio of lift / narrowest flow diameter
p_{a0} = Absolute back pressure [bar_a]
p_0 = Absolute set pressure [bar_a]
p_{a0}/p_0 = Ratio of absolute back pressure / absolute set pressure
K_{dr} = Coefficient of discharge as per DIN EN ISO 4126-1
α_w = Coefficient of discharge as per AD 2000-Merkblatt A2
K_{dr} = Correction for back pressure as per 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)



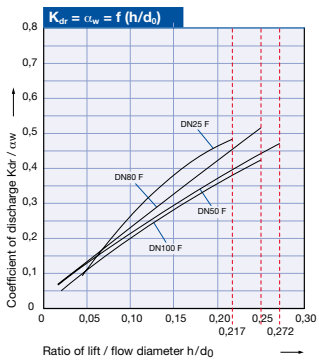
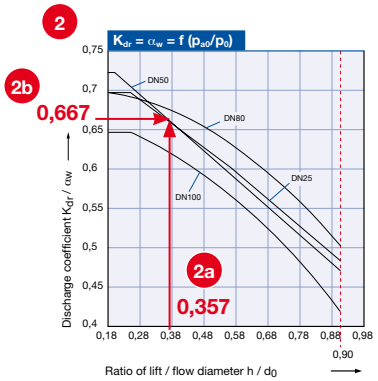


Diagram for evaluation of coefficient of discharge (K_{dr}/α_w) or K_b in reference to the ratio of back pressure / set pressure (pa_0/p_0)



Explanation

Example – Type 447, flow diameter d_0 = 46 mm, Lift h = 8.2 mm, K_{dr}/α_w D/G = 0.667

1 Diagram 1
Determining the restricted lift due to reduced K_{dr}/α_w

Step	Description	Example
1	Calculation of the necessary coefficient of discharge for the selected safety valve. The applicable formulas are to be taken from the rules and regulations.	1a K_{dr}/α_w = 0.53
2	Choose the starting point (0,53) on the Y-axis of the chart.	
3	Draw a horizontal line to determine the intersection point of the curves.	
4	Draw a vertical line through the intersection point on the X-axis to determine the ratio of lift / flow diameter (h/d_0).	1b h/d_0 = 0.18
5	Calculation of the lift restriction with the formula $h = d_0 \times h/d_0$. (To order the lift restriction, please choose option code J51; see page 99/10).	h = 46 x 0,18 h = 8,2 mm

2 Diagram 2
Determination of reduced K_{dr}/α_w or K_b[1] due to back pressure

Step	Description	Example
1	Calculation of the back pressure p_{a0}/p_0 with the use of the set pressure p_0 [bar_a] 2,1 and the back pressure p_{a0} [bar_a] 0,75	2a p_{a0}/p_0 = 0.357
2	Choose the starting point (0,357) on the X-axis of the chart.	
3	Draw a vertical line to determine the intersection point of the curves.	
4	Draw a horizontal line through the intersection point on the Y-axis to determine the reduced coefficient of discharge K_{dr}/α_w.	2b K_{dr}/α_w = 0.667
5	Calculation of the valve with the established coefficient of discharge K_{dr}/α_w or the correction factor for back pressure K_b.	

[1] Correction factors for back pressure K_b as per API 520 Section 3.3. See the LESER Engineering Manual for more information.

LEO$_{S/G/L}$

LESER

The table is based on the accorded coefficient of discharge for steam and gases for ASME certified LESER safety valves.
The associated K-values can be seen in the "K_{dr}/α_w values" column.

$LEO_{S/G}$ [inch²] = A_0 [inch²] · $\left(\frac{K}{0.975}\right)$

$LEO_{S/G}$ LESER Effective Orifice (for steam, gas and vapor)

Orifice acc to. API 526	LESER series	DN	Inlet size	d_0 [inch]	d_0 [mm]	K_{dr}/α_w values[1]	$LEO_{D/G}$ [inch²]	% of the larger orifice	% of the smaller orifice
D							**0,110**	**100,0%**	**100,0%**
E							**0,196**	**100,0%**	**100,0%**
F							**0,307**	**100,0%**	**100,0%**
	447	25	1"	0,906	23,0	0,617	**0,408**	81,0%	132,7%
	546	25	1"	0,906	23,0	0,703	**0,482**	95,5%	157,1%
G							**0,503**	**100,0%**	**100,0%**
H							**0,785**	**100,0%**	**100,0%**
	546	40	1 1/2"	1,457	37,0	0,680	**1,162**	90,3%	148,1%
Y							**1,287**	**100,0%**	**100,0%**
	447	50	2"	1,811	46,0	0,617	**1,630**	88,7%	126,7%
	546	50	2"	1,811	46,0	0,680	**1,797**	97,7%	139,6%
K							**0,838**	**100,0%**	**100,0%**
	447	80	3"	2,362	60,0	0,617	**2,773**	97,2%	150,9%
L							**2,853**	**100,0%**	**100,0%**
	546	65	2 1/2"	2,362	60,0	0,680	**3,057**	84,9%	107,1%
M							**3,600**	**100,0%**	**100,0%**
	546	80	3"	2,835	72,0	0,640	**4,143**	95,4%	115,1%
N							**4,340**	**100,0%**	**100,0%**
	546	100	3"	3,425	74,0	0,130	**6,048**	94,8%	139,4%
P							**6,380**	**100,0%**	**100,0%**
	447	100	4"	3,622	92,0	0,617	**6,520**	59,0%	102,2%
Q							**11,050**	**100,0%**	**100,0%**

The table is based on the accorded coefficient of discharge for liquids for ASME certified LESER safety valves.
The associated K-values can be seen in the "K_{dr}/α_w values“ column.

LEO_F [inch²] = A_0 [inch²] · $\left(\frac{K}{0.975}\right)$

LEO_L LESER Effective Orifice (for liquids)

Orifice acc to. API 526	LESER series	DN	Inlet size	d_0 [inch]	d_0 [mm]	K_{dr}/α_w values[1]	LEO_F [inch²]	% of the larger orifice	% of the smaller orifice
D							**0,110**	**100,0%**	**100,0%**
E							**0,196**	**100,0%**	**100,0%**
	447	25	1"	0,906	23,0	0,431	**0,285**	92,7%	69,9%
	546	25	1"	0,906	23,0	0,460	**0,304**	99,0%	74,6%
F							**0,307**	**100,0%**	**100,0%**
G							**0,503**	**100,0%**	**100,0%**
	546	40	1 1/2"	1,496	38,0	0,430	**0,775**	98,8%	60,2%
H							**0,785**	**100,0%**	**100,0%**
	447	50	2"	1,811	46,0	0,431	**1,139**	88,5%	69,9%
	546	50	2"	1,811	46,0	0,430	**1,136**	88,3%	69,7%
Y							**1,287**	**100,0%**	**100,0%**
K							**1,838**	**100,0%**	**100,0%**
	546	65	2 1/2"	2,362	60,0	0,430	**1,933**	67,7%	67,7%
	447	50	3"	2,362	60,0	0,431	**1,937**	67,9%	67,9%
	546	80	3"	2,853	72,0	0,400	**2,589**	90,7%	90,7%
L							**2,853**	**100,0%**	**100,0%**
M							**3,600**	**100,0%**	**100,0%**
	546	100	4"	3,425	87,0	0,400	**3,780**	87,1%	59,3%
N							**4,340**	**100,0%**	**100,0%**
	447	100	4"	3,622	92,0	0,431	**4,555**	71,4%	69,9%
Q							**6,380**	**100,0%**	**100,0%**

[1] There is no ASME approval for LESER Type 449. LEO values correspond to the specifications of Type 447, however they have to be confirmed by LESER as part of the specification on pages 03/04 and 03/05.

LESER

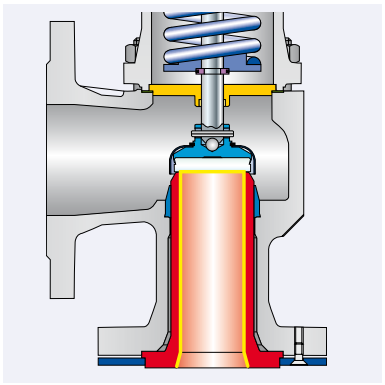
Type 546

Type 546
Packed lever H4
Closed bonnet
Conventional design

Flanged Safety Relief Valves – spring loaded

Contents — Chapter/Page

Design features



Area of application

Developed to protect against inadmissible overpressure in pressure vessels and systems in which the use of high alloyed metals (e.g. nickel-based alloys) is necessary due to the medium properties.

Type 546 is the solution for applications in which activation of the safety valve is very unlikely due to the large difference between the operating and set pressure.

Design features

Nozzle of gas-tight sintered PTFE with low permeability of atoms, molecules and ions (low permeability) for the prevention of corrosion in the inlet of the body.

Metallic support of the nozzle prevents flowing of the PTFE under pressure.

Pore-free surface of the nozzle prevents product build-ups.

Sealing plate of BOROFLOAT glass for high chemical resistance.

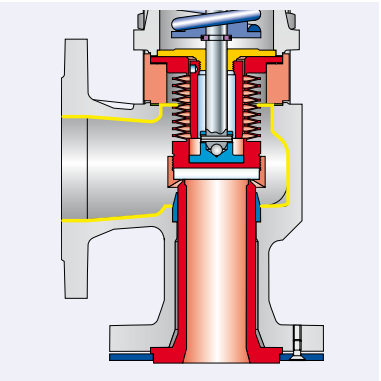
Metallic support of the sealing plate of BOROFLOAT glass for high mechanical strength of the disc.

Coupling of materials PTFE-nozzle – disc with sealing plate of BOROFLOAT glass for high tightness.

Possible to protect the bonnet space and the sliding components against corrosion with balanced bellows.

The nozzle, disc, spindle, and spring plate can be made of alternative materials in order to adapt Type 546 to the service conditions.

Design features



Area of application

Developed to protect against inadmissible overpressure in pressure vessels and systems in which the use of high alloyed metals (e.g. nickel-based alloys) is necessary due to the medium properties.

Type 5466 is the solution for applications in which activation of the safety valve rarely occurs and the protective coating together with the bellows provides adequate corrosion protection on the outlet side.

An electrostatically conductive PTFE-carbon compound with a specific resistance of ≤ 10^6 Ω/cm is recommended for explosion prone areas.

Design features

Nozzle of gas-tight sintered PTFE-carbon compound with low permeability of atoms, molecules and ions (low permeability) for the prevention of corrosion in the inlet of the body.

Metallic support of the nozzle prevents flowing of the PTFE-carbon compound under pressure.
Pore-free surface of the nozzle prevents product build-ups.

Additional corrosion protection through coating of the blow-off chamber of the body with conductive two-component paint SikaCor Zinc ZS.

Conductive PTFE-carbon compound together with the conductive two-component paint SikaCor Ainc ZS in the blow-off chamber prevent sparking from electrostatic discharge.

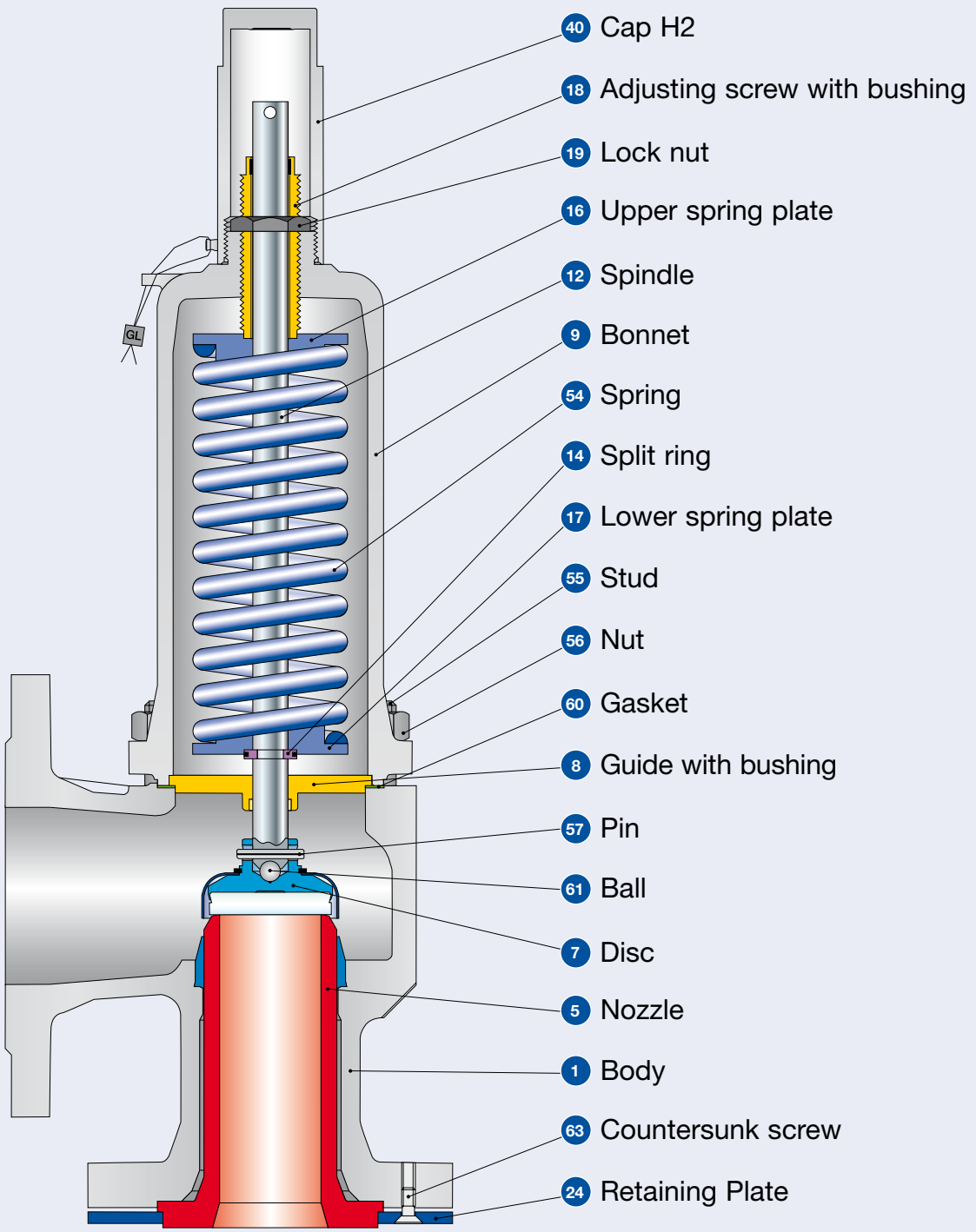
PTFE bellows with integrated plate hermetically seals the bonnet space and that way protects against soiling and corrosion. The set pressure range with the PTFE bellows starts at 0,5 bar.

The sealing plate of PTFE + 25% carbon compound is distinguished against virgin PTFE by its higher temperature and pressure operation limits as well as improved mechanical strength due to the metallic support.

The nozzle, disc, spindle, and spring plate can be made of alternative materials in order to adapt Type 5466 to the service conditions.

LESER

Conventional design



Conventional design

Materials

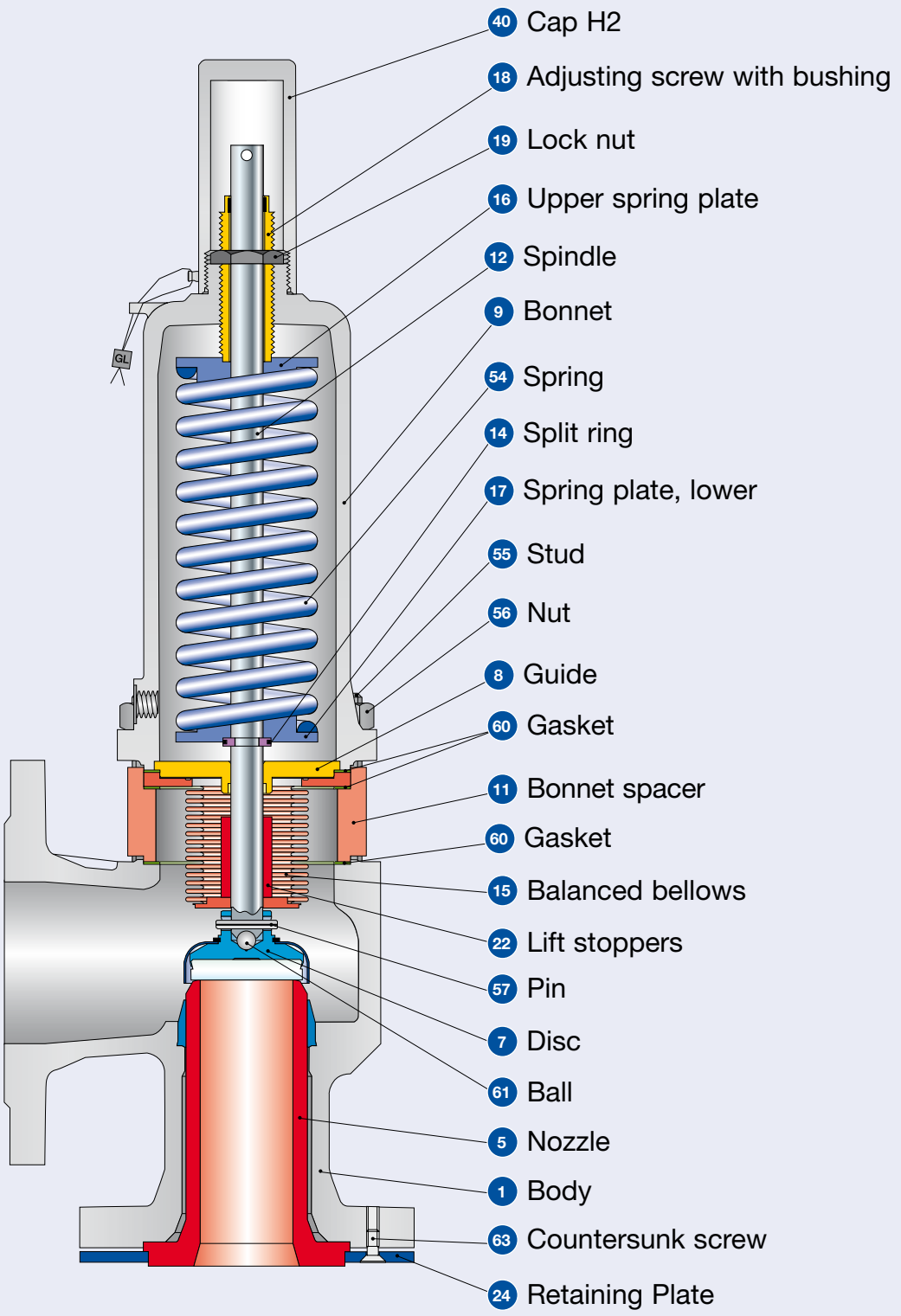
Item.	Component	Type 5462	Type 5465
1	**Body**	1.0619 SA 216 WCB	0.7043 Ductile Gr. 60-40-18
5	Nozzle	Virgin PTFE PTFE-TF	Virgin PTFE PTFE-TF
7	Disc	1.4404 / BOROFLOAT glass 316L / BOROFLOAT glass	1.4404 / BOROFLOAT glass 316L / BOROFLOAT glass
8	Guide	1.4404 Stainless steel	1.4404 Stainless steel
9	**Bonnet**	0.7040 Ductile Gr. 60-40-18	0.7040 Ductile Gr. 60-40-18
12	Spindle	1.4404 Stainless steel	1.4404 Stainless steel
14	Split ring	1.4104 Chrome steel	1.4104 Chrome steel
16/17	Spring plate	1.0718 Steel	1.0718 Steel
18	Adjusting screw with bushing	1.4104 PTFE Chrome steel PTFE	1.4104 PTFE Chrome steel PTFE
19	Lock nut	1.0718 Steel	1.0718 Steel
24	Retaining Plate	1.0036 Steel	1.0036 Steel
40	**Cap H2**	1.0718 12L13	1.0718 12L13
54	Spring, standard	1.1200, 1.8159, 1.7102 Steel	1.1200, 1.8159, 1.7102 Steel
	Spring, optional	1.4310 Stainless steel	1.4310 Stainless steel
55	Stud	1.1181 Steel	1.1181 Steel
56	Nut	1.0501 2H	1.0501 2H
57	Pin	1.4310 Stainless steel	1.4310 Stainless steel
60	Gasket	Graphite / 1.4401 Graphite / 316	Graphite / 1.4401 Graphite / 316
61	Ball	1.3541 Hardened stainless steel	1.3541 Hardened stainless steel
63	Countersunk screw	1.4401 Chrome steel	1.4401 Chrome steel

Please note:

- 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.

Type 546

Balanced bellows design



Balanced bellows design

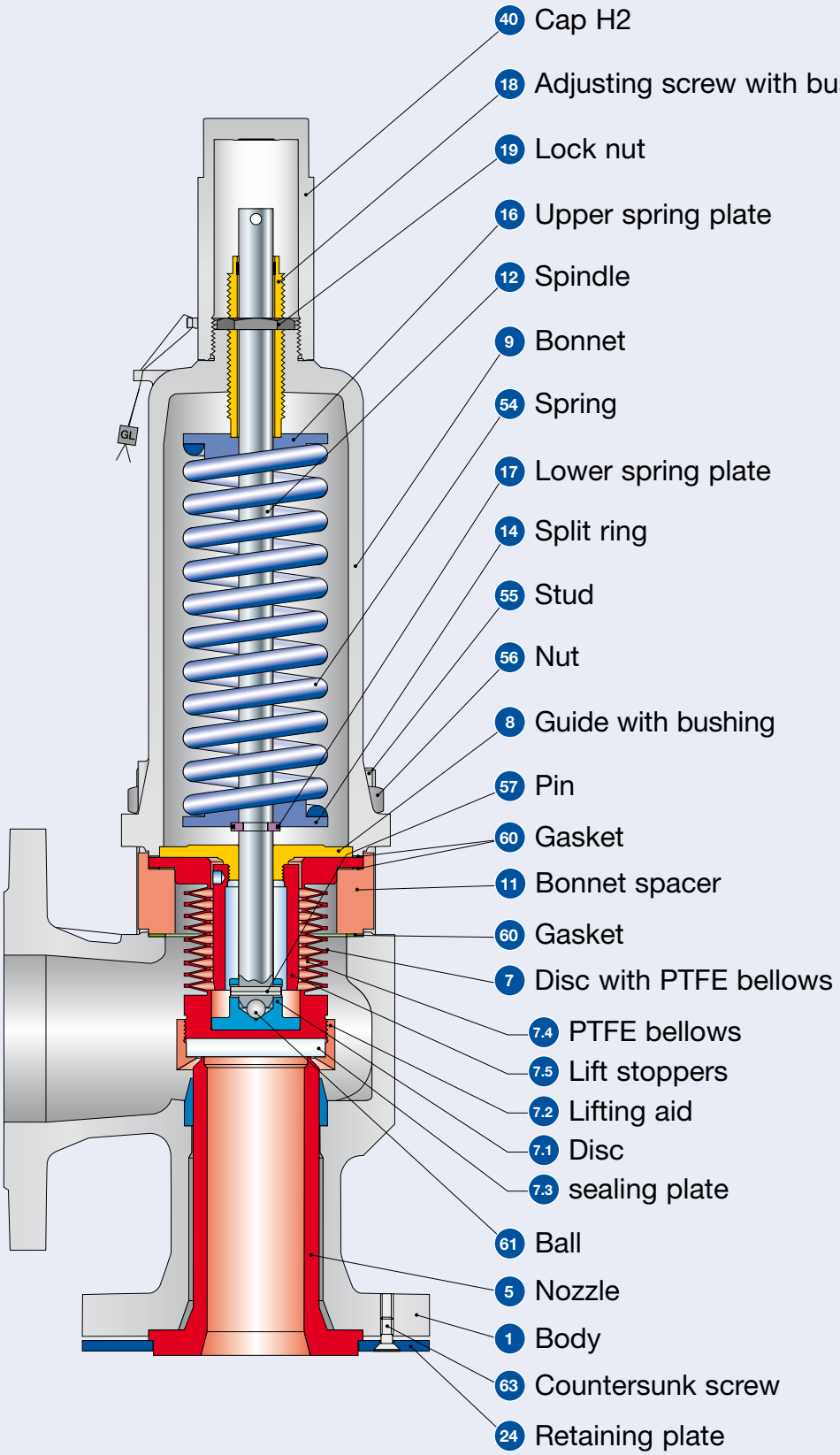
Materials

Item.	Components	Type 5462	Type 5465
1	**Body**	1.0619 SA 216 WCB	0.7043 Ductile Gr. 60-40-18
5	Nozzle	Virgin PTFE PTFE-TF	Virgin PTFE PTFE-TF
7	Disc	1.4404 / BOROFLOAT glass 316L / BOROFLOAT glass	1.4404 / BOROFLOAT glass 316L / BOROFLOAT glass
8	Guide	1.4404 Stainless steel	1.4404 Stainless steel
9	**Bonnet**	0.7040 Ductile Gr. 60-40-18	0.7040 Ductile Gr. 60-40-18
11	Bonnet spacer	1.4404 Stainless steel	1.4404 Stainless steel
12	Spindle	1.4404 Stainless steel	1.4404 Stainless steel
14	Split ring	1.4104 Chrome steel	1.4104 Chrome steel
15	Stainless steel bellows	1.4571 316Ti	1.4571 316Ti
16	Spring plate	1.0718 Steel	1.0718 Steel
18	Adjusting screw with bushing	1.4104 PTFE Chrome steel PTFE	1.4104 PTFE Chrome steel PTFE
19	Lock nut	1.4104 Chrome steel	1.4104 Chrome steel
22	**Lift stoppers**	1.4404 316L	1.4404 316L
24	Retaining Plate	1.0036 Steel	1.0036 Steel
40	**Cap H2**	1.0718 12L13	1.0718 12L13
54	Spring, standard	1.1200, 1.8159, 1.7102 Steel	1.1200, 1.8159, 1.7102 Steel
	Spring, optional	1.4310 Stainless steel	1.4310 Stainless steel
55	Stud	1.1181 Steel	1.1181 Steel
57	Pin	1.4310 Stainless steel	1.4310 Stainless steel
56	Nut	1.0501 2H	1.0501 2H
60	Gasket	Graphite / 1.4401 Graphite / 316	Graphite / 1.4401 Graphite / 316
61	Ball	1.3541 Hardened stainless steel	1.3541 Hardened stainless steel
63	Countersunk screw	1.4401 Chrome steel	1.4401 Chrome steel

Please note:
- 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.

LESER

Conventional design



Conventional design

Materials

Item.	Components	Type 5466
1	**Body**	1.0619[1)] SA 216 WCB
5	Nozzle	PTFE + 25% carbon
7	Disc with PTFE bellows	Virgin PTFE / BOROFLOAT glass PTFE (TF) / BOROFLOAT glass
7.1	Disc	1.4404 316L
7.2	Lifting aid	PTFE + 25% glass PTFE (TFM)
7.3	sealing plate	PTFE + 25% carbon
7.4	PTFE bellows	Virgin PTFE PTFE (TF)
7.5	Lift stoppers	1.4404 316L
8	Guide	1.4404 Stainless steel
9	**Bonnet**	0.7043 Ductile Gr. 60-40-18
11	Bonnet spacer	1.4404 316L
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	1.4104 Chrome steel
24	Retaining plate	1.0036 Steel
40	**Cap H2**	1.0718 12L13
54	Spring, standard	1.1200, 1.8159, 1.7102 Steel
	Spring, optional	1.4310 Stainless steel
55	Stud	1.4401 B8M
56	Nut	1.4401 8M
57	Pin	1.4310 Stainless steel
60	Gasket	Graphite / 1.4401 Graphite / 316
61	Ball	1.3541 Hardened stainless steel
63	Countersunk screw	1.4401 Chrome steel

[1)] With SikaCor Zinc ZS coating in the outlet area

Please note:
- 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.

Type 546

LESER

How to order – Numbering system

1 Article number

1	2	3	4
546	2	. 380	2

1 **Valve type 546, 5466**

Type 546

2 **Material code**

Code	Body material
2	1.0619 (WCB)
5	0.7043 (Ductile Gr. 60-40-18)
6	1.0619 (WCB) with SikaCor Zinc ZS coating

3 **Valve code**

Automatically determines nominal diameter and body material (see page 01/13).

4

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

2 Set pressure

Please enter the units (in gauge)!

The specified pressure range may not be exceeded!

3 Connections

See page 01/16.

5462.3802	5 bar	H44	
Article number	Set pressure	Connections	

LESER

4 Options

Type 546, 5466		Option code
• Balanced bellows Type 546 - Bonnet closed		J78
• High temperature alloy spring		X01
• Stainless steel spring		X04
• Adaptor for lift indicator	H4	J39
• Lift indicator		J93
• Oil and grease free		J85
• Drain hole	G 1/4	J18
	G 1/2	J19

Option code applies only if not 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 CGA (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
Body	H01
Bonnet	L30
Cap / lever cover	L31
Disc	L23
Screws	N07
Nuts	N08

6 Code and medium

1 1
1 . 0

1 Code
1. CE / VdTUEV

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

J78				H01	L30		1.0
Options				Documentation			Code and medium

Type 546

How to order – article numbers

Type 546
Cap H2
Closed bonnet
Conventional design

Type 546
Packed lever H4
Closed bonnet
Balanced bellows design

Type 5466
Packed lever H4
Closed bonnet
Conventional design

How to order – article numbers

Type 546

		DN_i	25	40	50	65	80	100
		DN_O	40	65	80	100	125	150
		Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5SDSq	4" x 6"
		Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
		Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Body material 0.7043 (Ductile Gr. 60-40-18)								
PTFE nozzle								
Bonnet closed	**H2**	Art. no. **5465.**	**–**	**3722**	**–**	**3742**	**–**	**3762**
	H4	Art. no. **5465.**	**–**	**3724**	**–**	**3744**	**–**	**3764**
Body material 1.0619 (WCB)								
PTFE nozzle								
Bonnet closed	**H2**	Art. no. **5462.**	**3802**	**–**	**3812**	**–**	**3822**	**–**
	H4	Art. no. **5462.**	**3804**	**–**	**3814**	**–**	**3824**	**–**

Type 5466

		DN_i	25	40	50	65	80	100
		DN_O	40	65	80	100	125	150
		Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
		Flow diameter d_0 [mm]	23	37	46	60	72	87
		Narrowest flow area A_0 [mm²]	416	1075	1662	2827	4072	5945
Body material 1.0619 (WCB)								
PTFE-carbon nozzle								
Bonnet closed	**H2**	Art. no. **5466.**	**3832**	**–**	**3842**	**–**	**–**	**–**
	H4	Art. no. **5466.**	**3834**	**–**	**3844**	**–**	**–**	**–**

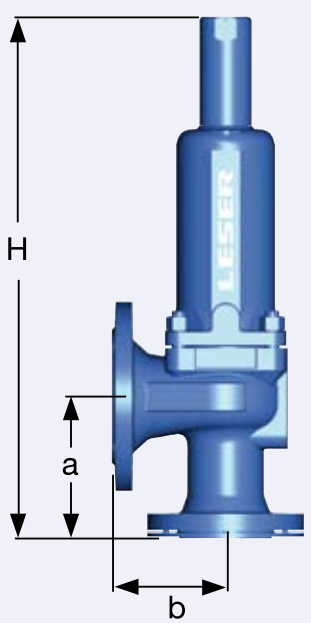
Dimensions and weights

Metric units

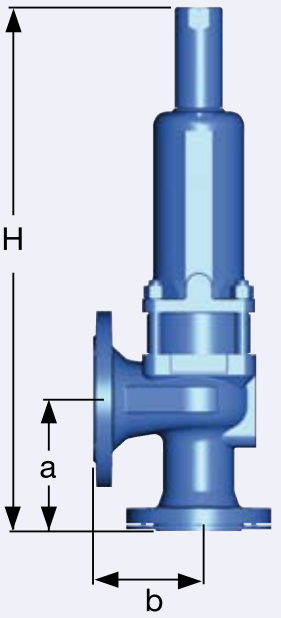
	DN_i	25	40	50	65	80	100
	DN_O	40	65	80	100	125	150
	Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
	Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
	Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Weight [kg]		9	19	22	27	39	55
	with bellows	10	20	24	31	43	63
Centre to face [mm]	Inlet a	105	140	150	170	195	220
	Outlet b	100	115	120	140	160	180
Height (H4) [mm]	Standard H max.	327	486	538	565	743	796
	Bellows H max.	395	605	590	615	840	885

Body material 0.7043 (Ductile Gr. 60-40-18)		
DIN Flange[1)]	Inlet	PN 16
	Outlet	PN 16
Body material 1.0619 (WCB)		
DIN Flange[1)]	Inlet	PN 16
	Outlet	PN 16

[1)] Standard flange class For other flange drillings, see page 01/16.



Conventional design



Balanced bellows design

Pressure / temperature ratings

Metric units

	DN_I	25	40	50	65	80	100
	DN_O	40	65	80	100	125	150
	Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
	Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
	Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Body material 0.7043 (Ductile Gr. 60-40-18)				**Type 5465**			
DIN Flange	Inlet	–	**PN 16**	–	**PN 16**	–	**PN 16**
	Outlet	–	**PN 16**	–	**PN 16**	–	**PN 16**
Min. set pressure	p [bar_g] S/G/L	–	0,5	–	0,5	–	0,5
Max. set pressure	p [bar_g] S/G/L	–	10	–	10	–	10
Temperature acc to. DIN EN	min. [°C]	–	-60	–	-60	–	-60
	max. [°C]	–	+200	–	+200	–	+200

Body material 1.0619 (WCB)				**Type 5462**			
DIN Flange	Inlet	**PN 16**	–	**PN 16**	–	**PN 16**	–
	Outlet	**PN 16**	–	**PN 16**	–	**PN 16**	–
Min. set pressure	p [bar_g] S/G/L	0,5	–	0,5	–	0,5	–
Max. set pressure	p [bar_g] S/G/L	10	–	10	–	10	–
Temperature acc to. DIN EN	min. [°C]	-85	–	-85	–	-85	–
	max. [°C]	+200	–	+200	–	+200	–

Body material 1.0619 (WCB)				**Type 5466**			
DIN Flange	Inlet	**PN 16**	–	**PN 16**	–	–	–
	Outlet	**PN 16**	–	**PN 16**	–	–	–
Min. set pressure	p [bar_g] S/G/L	0,1	–	0,1	–	–	–
Max. set pressure	p [bar_g] S/G/L	10	–	10	–	–	–
Temperature acc to. DIN EN	min. [°C]	-85	–	-85	–	–	–
	max. [°C]	+200	–	+200	–	–	–

Order information – Flange drillings

Flange drillings

		DN_I	25	40	50	65	80	100
		DN_O	40	65	80	100	125	150
		Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
		Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
		Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Body material 0.7043 (Ductile Gr. 60-40-18)					**Type 5465**			
Inlet	**DIN EN 1092**	PN 10	–	H44	–	H44	–	H44
		PN 16	–	*	–	*	–	*
	ASME B16.5	CL 150	–	(H64)	–	(H64)	–	(H64)
Outlet	**DIN EN 1092**	PN 10	–	H50	–	H50	–	H50
		PN 16	–	*	–	*	–	*
	ASME B16.5	CL 150	–	(H79)	–	(H79)	–	(H79)
Body material 1.0619 (WCB)					**Type 5462**			
Inlet	**DIN EN 1092**	PN 10	H44	–	H44	–	H44	–
		PN 16	*	–	*	–	*	–
	ASME B16.5	CL 150	(H64)	–	(H64)	–	(H64)	–
Outlet	**DIN EN 1092**	PN 10	H50	–	H50	–	H50	–
		PN 16	*	–	*	–	*	–
	ASME B16.5	CL 150	(H79)	–	(H79)	–	(H79)	–
Body material 1.0619 (WCB)					**Type 5466**			
Inlet	**DIN EN 1092**	PN 10	H44	–	H44	–	–	–
		PN 16	*	–	*	–	–	–
	ASME B16.5	CL 150	(H64)	–	(H64)	–	–	–
Outlet	**DIN EN 1092**	PN 10	H50	–	H50	–	–	–
		PN 16	*	–	*	–	–	–
	ASME B16.5	CL 150	(H79)	–	(H79)	–	–	–

For signs and symbols refer to page 00/11.
Note: Flange drilling and facings meet always the requirements of mentioned flange standards.
Flange thickness and outer diameter may vary from flange standard.

Order information - spare parts

Spare parts							
	DN_I	25	40	50	65	80	100
	DN_O	40	65	80	100	125	150
	Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
	Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
	Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Nozzle (Item 5): Type 5462 + 5465				**Material no. / Art. no.**			
Nozzle PTFE-TF		206.4659.0000	206.4759.0000	206.4859.0000	206.4959.0000	206.5059.0000	206.5159.0000
Nozzle (Item 5): Type 5466				**Material no. / Art. no.**			
Nozzle PTFE + 25% carbon		207.1869.0000	–	207.1769.0000	–	–	–
Disc (Item 7): Type 546				**Material no. / Art. no.**			
Disc Detachable lifting aid 1.4404 with sealing plate (BOROFLOAT glass)		220.2949.0000	220.3149.0000	220.3049.0000	220.3249.0000	220.3349.0000	220.3449.0000
Disc (Item 7): Type 5466				**Material no. / Art. no.**			
Disc Detachable lifting aid 1.4404 with sealing plate (PTFE+25% carbon)		220.3559.0000	–	220.3659.0000	–	–	–
Bellows (Item 15): Type 546 (1.4571)				**Material no. / Art.no.**			
Standard bellows		400.2949.0000	400.3049.0000	400.3149.0000	400.3249.0000	400.3349.0000	400.3449.0000
Bellows (Item 7): Type 5466 (PTFE-TF				**Material no. / Art.no.**			
PTFE bellows		224.3059.0000	–	224.1759.0000	–	–	–
Conversion kit, standard[1)]		5021.1081	–	5021.1082	–	–	–
Gasket (Item 60) body / bonnet. . .Material no. / Art. no.							
Gasket	Graphite + 1.4401	500.0607.0000	500.1007.0000	500.1207.0000	500.1207.0000	500.1607.0000	500.1907.0000
Option code L68	Gylon (PTFE compliance)	500.0605.0000	500.1005.0000	500.1205.0000	500.1205.0000	500.1605.0000	500.1905.0000
Ball (Item 61):				**Material no. / Art. no.**			
Ball	Ball Ø [mm]	6	9	9	9	12	12
	1.4401	510.0104.0000	510.0204.0000	510.0204.0000	510.0204.0000	510.0304.0000	510.0304.0000
Split ring (Item 14):				**Material no. / Art. no.**			
Split ring	Spindle Ø [mm]	12	16	16	16	20	24
	1.4404	251.0149.0000	251.0249.0000	251.0249.0000	251.0249.0000	251.0349.0000	251.0449.0000
Roll pin (Item 57)				**Material no. / Art. no.**			
Roll Pin	1.4310	480.0705.0000	480.2305.0000	480.2305.0000	480.2305.0000	480.1005.0000	480.1005.0000

[1)] Pressure range, see page 01/15.

A conversion kit includes the following components:

Item.	Components	No.
8	Guide with bushing	**1**
11	Bonnet spacer	**1**
12	Spindle	**1**
15	Bellows	**1**
55	Stud	**4**
60	Gasket	**3**
	Installation instruction LWN 037.05	**1**

Refer to page 01/06

Available options

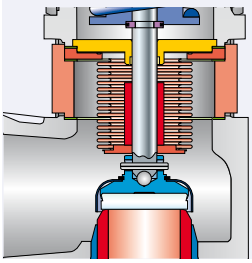
For further information, refer to
"Accessories and Options", page 99/01

Screwed cap H2
H2

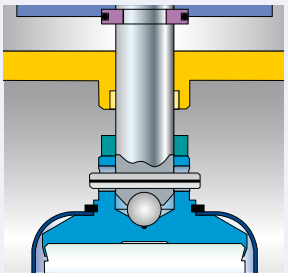
Packed lever H4
H4

Lift indicator
J39: Connection H4
J93: Lift indicator

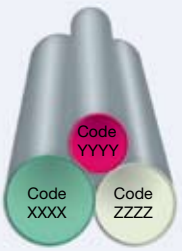
Balanced bellows
J78: Closed bonnet



Lift stopper
J51



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



Approvals

Approvals							
	DN_I	25	40	50	65	80	100
	DN_O	40	65	80	100	125	150
	Valve size	1" x 1 1/2"	1 1/2" x 2 1/2"	2" x 3"	2 1/2" x 4"	3" x 5"	4" x 6"
	Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87
	Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945
Europe				**Coefficient of discharge K_{dr}**			
DIN EN ISO 4126-1	Approval no.:			072020111Z0008/0/19			
	Type 5462 + 5465 S/G	0,73	0,68	0,68	0,68	0,64	0,64
	5466 S/G	0,76	–	0,69	–	–	–
	Type 5462 + 5465 L	0,46	0,43	0,43	0,43	0,40	0,40
	5466 L	0,51	–	0,46	–	–	–
Germany				**Coefficient of discharge α_w**			
AD 2000-Merkblatt A2	Approval no.:			TÜV SV 496			
	Type 5462 + 5465 S/G	0,73	0,68	0,68	0,68	0,64	0,64
	5466 S/G	0,76	–	0,69	–	–	–
	Type 5462 + 5465 L	0,46	0,43	0,43	0,43	0,40	0,40
	5466 L	0,51	–	0,46	–	–	–
China				**Coefficient of discharge α_w**			
AQSIQ	Approval no.:			TSF700301-2011			
	Type 546 S/G	0,73	0,68	0,68	0,68	0,64	0,64
	Type 546 L	0,46	0,43	0,43	0,43	0,40	0,40
Russia				**Coefficient of dischargeα_w**			
ROSTECHNADZOR	Approval no.:			PPC 00-18458			
GOST R	Approval no.:			B29896 (is renewed yearly)			
	Type 546 S/G	0,73	0,68	0,68	0,68	0,64	0,64
	Type 546 L	0,46	0,43	0,43	0,43	0,40	0,40
Belarus				**Coefficient of dischargeα_w**			
PROMATOMNADZOR	Approval no.:			PPC 00-18458 (is renewed yearly)			
	Type 546 S/G	0,73	0,68	0,68	0,68	0,64	0,64
	Type 546 L	0,46	0,43	0,43	0,43	0,40	0,40
Classification societies							
				On request			

Capacities

Calculation of the capacity for air and water as per AD 2000 Merkblatt A2 with 10% overpressure at 0 °C and 1013 mbar (air) or alternatively 20 °C (water). Capacities at 1 bar and below are calculated at 0,1 bar overpressure.

Metric units — AD 2000-Merkblatt A2

	Steam						Air						Water					
DN_I	25	40	50	65	80	100	25	40	50	65	80	100	25	40	50	65	80	100
DN_O	40	65	80	100	125	150	40	65	80	100	125	150	40	65	80	100	125	150
Actual Orifice diameter d_0 [mm]	23	37	46	60	72	87	23	37	46	60	72	87	23	37	46	60	72	87
Actual Orifice area A_0 [mm²]	416	1075	1662	2827	4072	5945	416	1075	1662	2827	4072	5945	416	1075	1662	2827	4072	5945
$LEO_{S/G/L}$*) [bar]	0,482	1,162	1,797	3,057	4,143	6,048	0,482	1,162	1,797	3,057	4,143	6,048	0,304	0,775	1,136	1,933	2,589	3,780
Set pressure [bar]	**Capacity** [kg/h]						**Capacity** [m_n^3/h]						**Capacity** [10^3kg/h]					
0,5	250	615	951	951	2110	3081	293	722	1116	1899	2477	3616	7,53	18,22	28,20	47,90	64,20	93,90
0,6	272	668	1033	1033	2303	3363	320	788	1218	2072	2715	3964	8,13	19,67	30,40	51,70	69,30	101,2
0,7	292	717	1108	1108	2480	3621	346	849	1312	2231	2935	4286	8,69	21,03	32,50	55,30	74,10	108,2
0,8	311	762	1178	1178	2646	3863	369	905	1399	2380	3142	4587	9,22	22,31	34,50	58,70	78,60	114,7
0,9	330	807	1247	1247	2809	4101	392	960	1484	2524	3341	4878	9,72	23,52	36,30	61,80	82,80	120,9
1,0	348	851	1315	1315	2969	4335	415	1014	1567	2666	3538	5166	10,2	24,7	38,1	64,9	86,9	126,8
1,1	368	899	1389	1389	3143	4589	439	1073	1658	2820	3752	5478	10,7	25,9	40,0	68,0	91,1	133,0
1,2	388	946	1463	1463	3317	4843	464	1131	1749	2974	3965	5790	11,2	27,0	41,8	71,0	95,2	139,0
1,3	408	993	1535	1535	3488	5092	488	1189	1838	3127	4806	6098	11,6	28,1	43,5	73,9	99,1	144,6
1,4	428	1040	1607	1607	3658	5341	513	1247	1928	3279	4387	6406	12,7	29,2	45,1	76,7	103,0	150,1
1,5	447	1086	1679	1679	3828	5589	537	1305	2017	3431	4597	6713	12,5	30,2	46,7	79,4	106,0	155,4
1,6	467	1133	1751	1751	3996	5835	561	1362	2105	3581	4806	7017	12,9	31,2	48,2	82,0	110,0	160,5
1,7	486	1179	1822	1822	4164	6079	585	1419	2194	3731	5014	7320	13,3	32,2	49,7	84,6	113,0	165,4
1,8	505	1224	1892	1892	4329	6321	609	1476	2281	3881	5220	7621	13,7	33,1	51,1	87,0	117,0	170,2
1,9	524	1270	1962	1962	4495	6563	633	1533	2369	4030	5426	7923	14,1	34,0	52,5	89,4	120,0	174,8
2,0	543	1315	2033	2033	4661	6805	657	1589	2457	4179	5633	8225	14,4	34,9	53,9	91,7	123,0	179,4
2,1	562	1360	2102	2102	4825	7044	680	1646	2544	4328	5838	8524	14,8	35,7	55,2	94,0	126,0	183,8
2,2	581	1405	2172	2172	4989	7284	704	1702	2631	4476	6043	8823	15,1	36,6	56,5	96,2	129,0	188,1
2,3	600	1450	2241	2241	5152	7522	728	1758	2718	4624	6247	9121	15,5	37,4	57,8	98,4	132,0	192,4
2,4	619	1495	2310	2310	5315	7760	751	1814	2804	4771	6452	9420	15,8	38,2	59,1	100,5	135,0	196,5
2,5	638	1539	2379	2379	5477	7997	775	1870	2891	4918	6655	9717	16,1	39,0	60,3	102,5	137,0	200,6
2,6	657	1584	2448	2448	5639	8233	798	1926	2977	5065	6858	10013	16,4	39,8	61,5	104,6	140,0	204,5
2,7	675	1628	2517	2517	5801	8470	822	1982	3064	5212	7062	10311	16,8	40,5	62,6	106,6	143,0	208,4
2,8	694	1672	2585	2585	5960	8701	845	2038	3149	5358	7262	10602	17,1	41,3	63,8	108,5	145,0	212,3
2,9	712	1716	2652	2652	6144	8927	868	2092	3234	5502	7457	10887	17,4	42,1	64,9	110,4	148,0	216,0
3	730	1759	2719	2719	6269	9153	891	2147	3319	5646	7652	11172	17,7	42,7	66,0	112,3	150,0	219,7
4							1118	2695	4165	7086	9603	14021	20,4	49,3	76,2	129,7	174,0	254,0
5							1345	3242	5011	8526	11555	16870	22,8	55,2	85,2	145,0	194,0	284,0
6							1572	3790	5857	9965	13506	19719	25,0	60,4	93,4	158,9	213,0	311,0
7							1799	4337	6704	11405	15457	22569	27,0	65,3	100,9	171,6	230,0	336,0
8							2026	4884	7550	12845	17409	25418	28,8	69,8	107,8	183,4	246,0	359,0
9							2253	5432	8396	14285	19360	28267	30,6	74,0	114,4	194,6	261,0	381,0
10							2481	5980	9242	15725	21312	31116	32,2	78,0	120,6	205,1	275,0	402,0

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 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 and below are calculated at 0,1 bar overpressure.

Metric units	AD 2000-Merkblatt A2					
	Steam		Air		Water	
DN_I	25	50	25	50	25	50
DN_O	40	80	40	80	40	80
Actual Orifice diameter d_0 [mm]	23	46	23	46	23	46
Actual Orifice area A_0 [mm²]	416	1662	416	1662	416	1662
$LEO_{S/G/L}$*) [bar]	0,482	1,797	0,482	1,797	0,304	1,136
Set pressure [bar]	**Capacity** [kg/h]		**Capacity** [m_n^3/h]		**Capacity** [10^3kg/h]	
0,1	133	513	153	590	4,35	16,30
0,2	168	645	194	747	5,32	19,90
0,3	198	759	231	883	6,15	23,00
0,4	225	860	263	1005	6,87	25,70
0,5	250	951	293	1116	7,53	28,20
0,6	272	1033	320	1218	8,13	30,40
0,7	292	1108	346	1312	8,69	32,50
0,8	311	1178	369	1399	9,22	34,50
0,9	330	1247	392	1484	9,72	36,30
1,0	348	1315	415	1567	10,2	38,1
1,1	368	1389	439	1658	10,7	40,0
1,2	388	1463	464	1749	11,2	41,8
1,3	408	1535	488	1838	11,6	43,5
1,4	428	1607	513	1928	12,7	45,1
1,5	447	1679	537	2017	12,5	46,7
1,6	467	1751	561	2105	12,9	48,2
1,7	486	1822	585	2194	13,3	49,7
1,8	505	1892	609	2281	13,7	51,1
1,9	524	1962	633	2369	14,1	52,5
2,0	543	2033	657	2457	14,4	53,9
2,1	562	2102	680	2544	14,8	55,2
2,2	581	2172	704	2631	15,1	56,5
2,3	600	2241	728	2718	15,5	57,8
2,4	619	2310	751	2804	15,8	59,1
2,5	638	2379	775	2891	16,1	60,3
2,6	657	2448	798	2977	16,4	61,5
2,7	675	2517	822	3064	16,8	62,6
2,8	694	2585	845	3149	17,1	63,8
2,9	712	2652	868	3234	17,4	64,9
3	730	2719	891	3319	17,7	66,0
4	**Application not possible due to the pressure and temperature ranges of the PTFE nozzle.**		1118	4165	20,4	76,2
5			1345	5011	22,8	85,2
6			1572	5857	25,0	93,4
7			1799	6704	27,0	100,9
8			2026	7550	28,8	107,8
9			2253	8396	30,6	114,4
10			2481	9242	32,2	120,6

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

Type 546

LESER

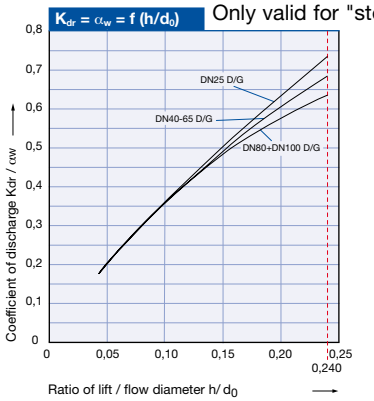
Determination of the coefficient of discharge in case of lift restriction or back pressure

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 back pressure / 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} = Back pressure correction factior acc. to API 520 Section 3.3

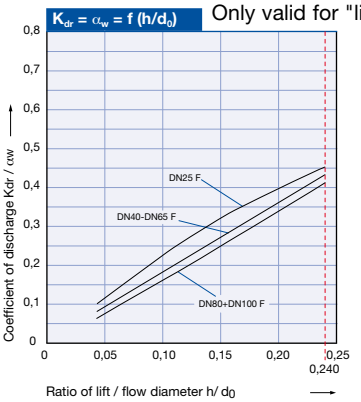
Diagram for evaluation of ratio of lift / flow diameter (h/d_0) in reference to the coefficient of discharge (K_{dr}/α_w)

Type 5462 + 5465

$K_{dr} = \alpha_w = f(h/d_0)$ Only valid for "steam/gases"

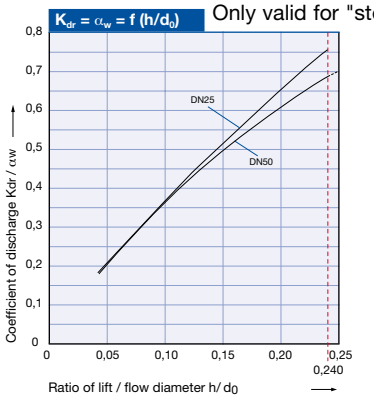


$K_{dr} = \alpha_w = f(h/d_0)$ Only valid for "liquids"



Type 5466

$K_{dr} = \alpha_w = f(h/d_0)$ Only valid for "steam/gases"



$K_{dr} = \alpha_w = f(h/d_0)$ Only valid for "liquids"

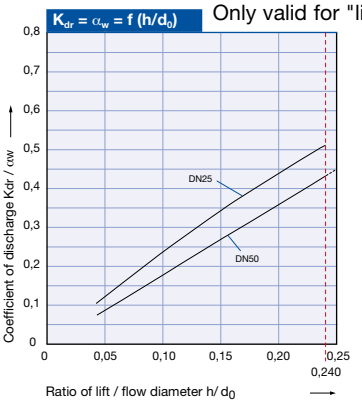
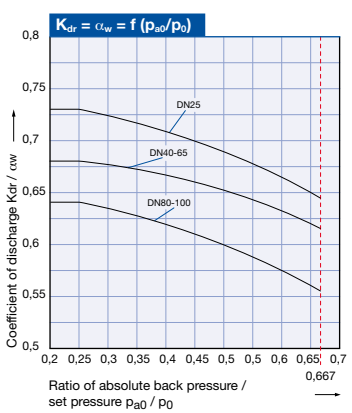


Diagram for evaluation of the coefficient of discharge (K_{dr}/α_w) or K_b in reference with the ratio of absolute back pressure / set pressure (p_{a0}/p_0)

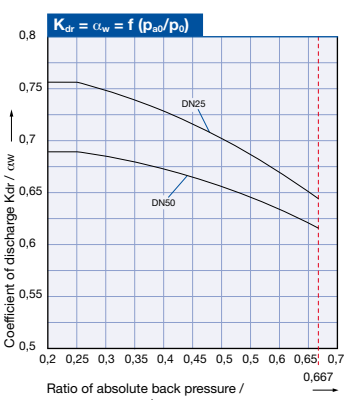
Type 546

$K_{dr} = \alpha_w = f(p_{ao}/p_0)$



Type 5466

$K_{dr} = \alpha_w = f(p_{ao}/p_0)$



"How to use" see page 00/14

LESER

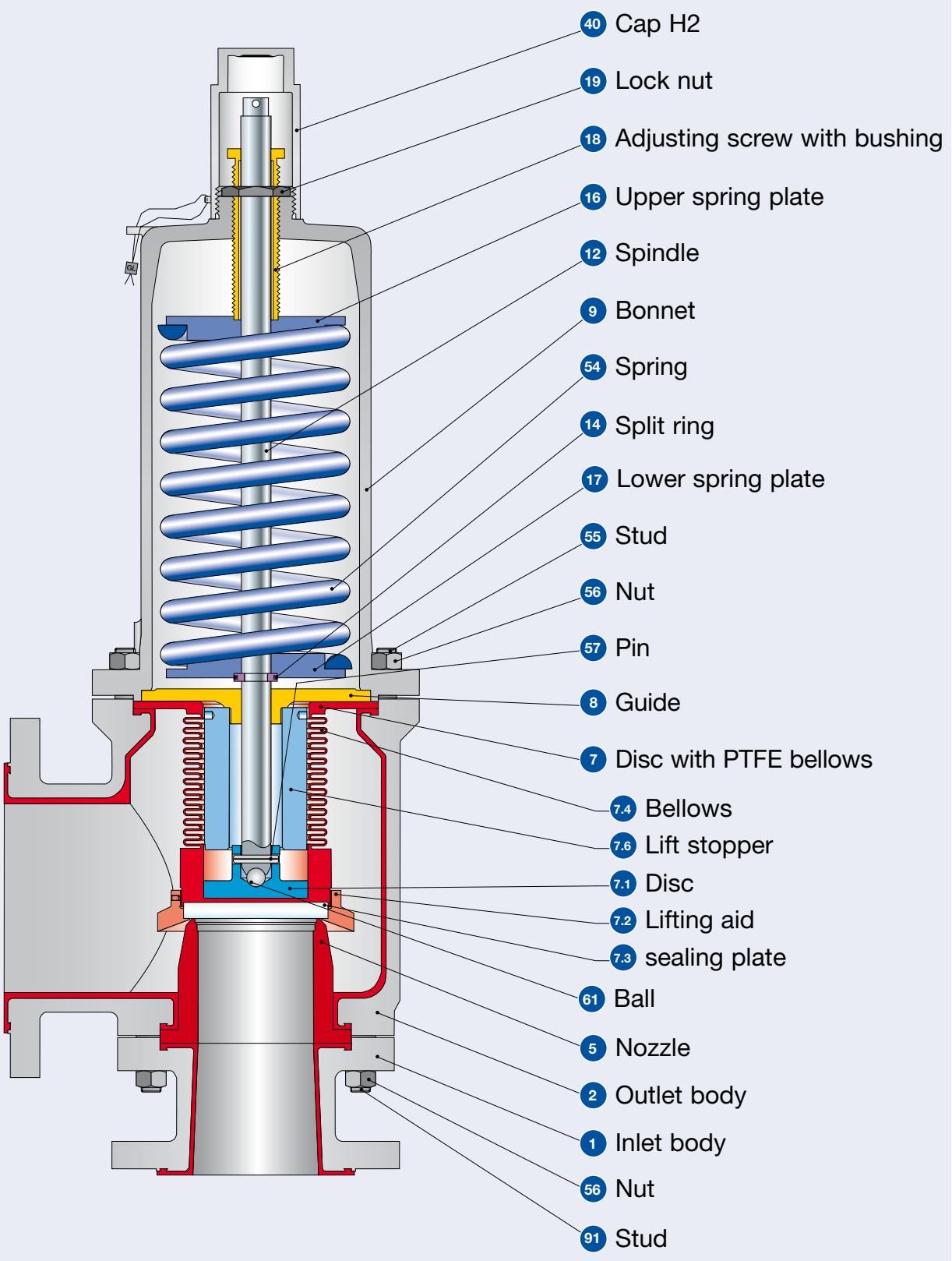
Type 447

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

Flanged Safety Relief Valves – spring loaded

Contents Chapter/Page

Conventional design



Conventional design

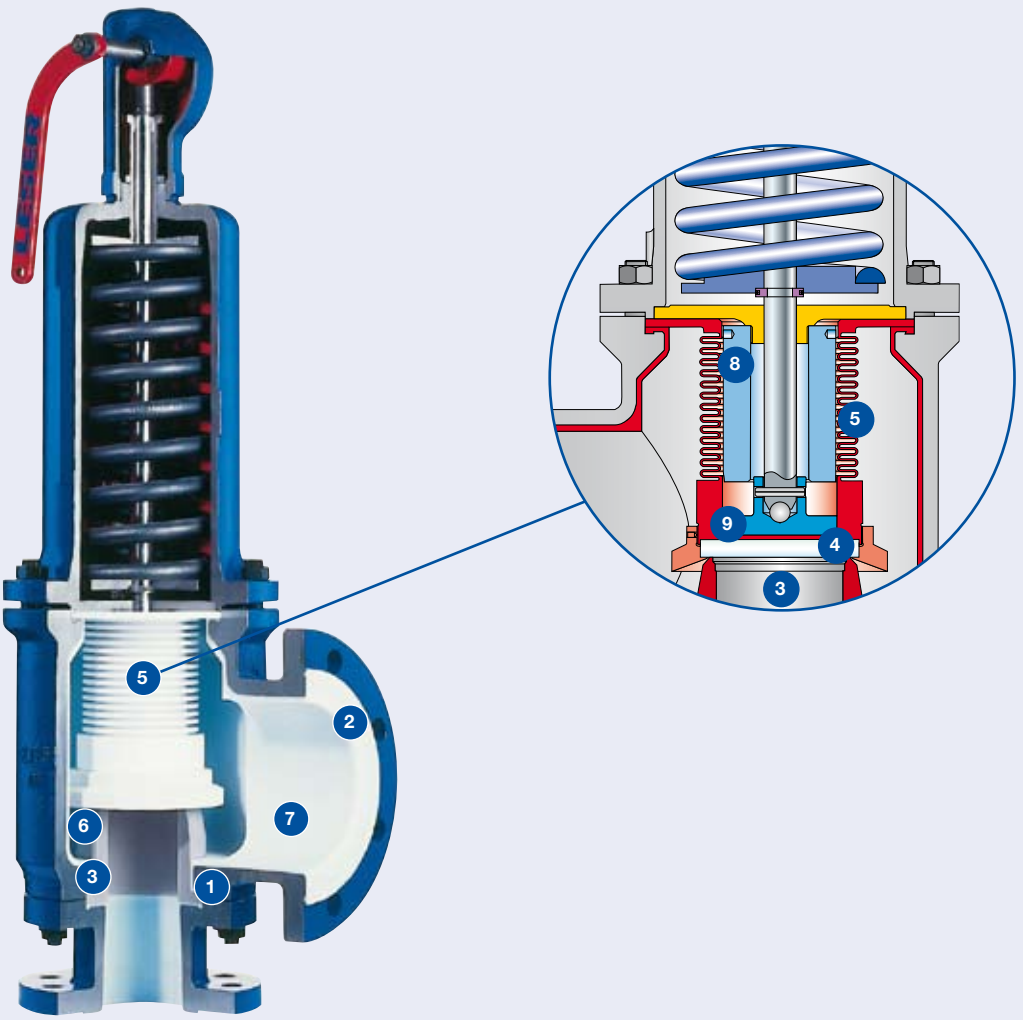
Materials

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.

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).

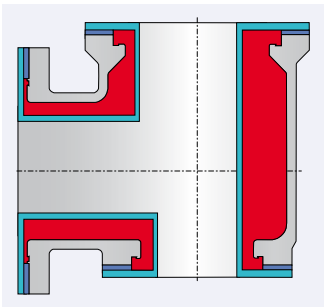
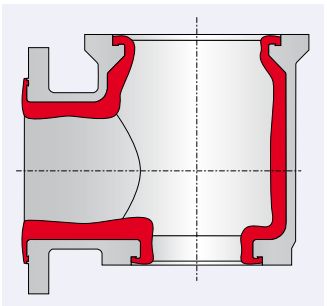
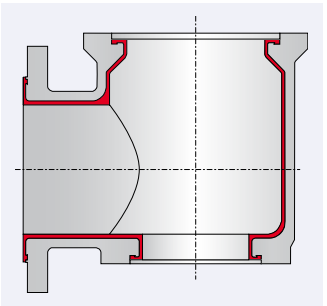
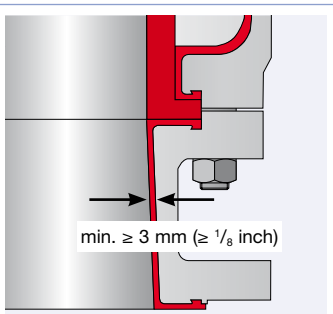
Configuration Features

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

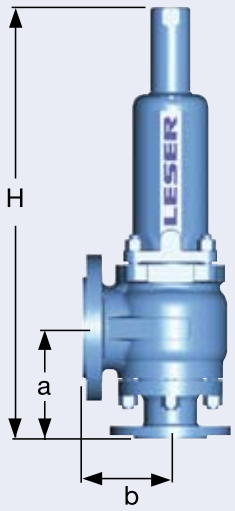
Metric units

	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

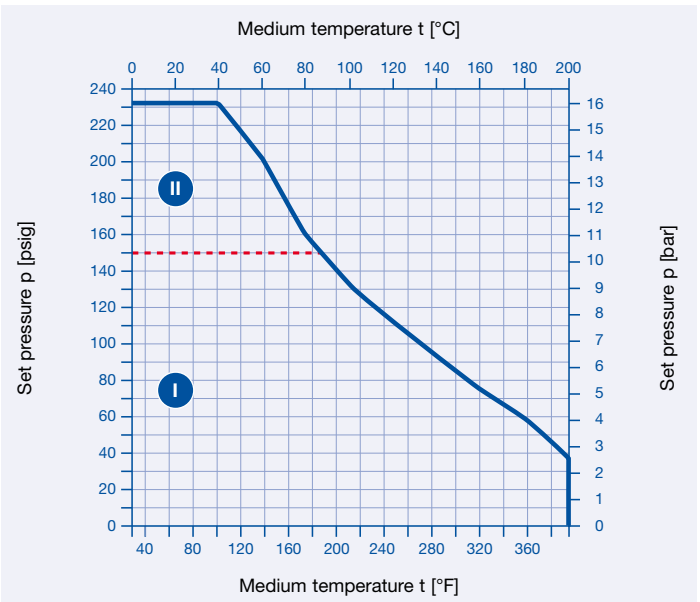
Pressure temperature ratings

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

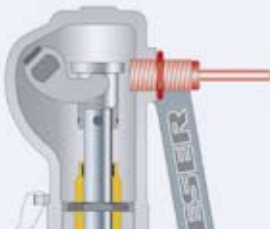
Available options

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

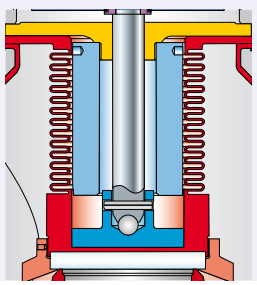
Screwed cap H2
H2

Packed lever H4
H4

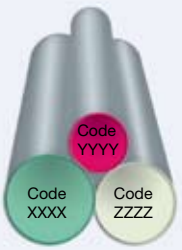
Lift indicator
J39: Connection H4
J93: Lift indicator



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

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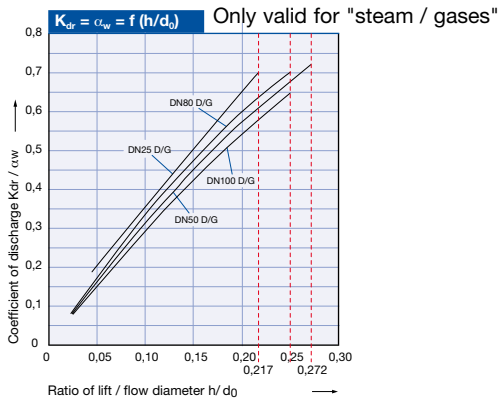
Determination of coefficient of discharge in case of lift restriction or back pressure

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)



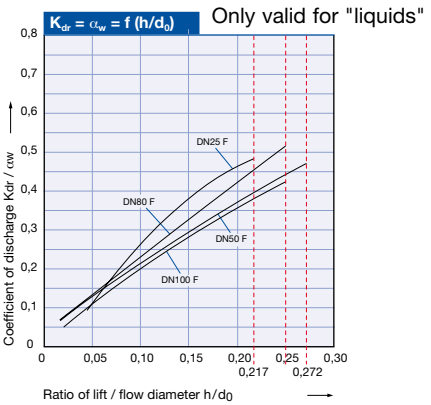
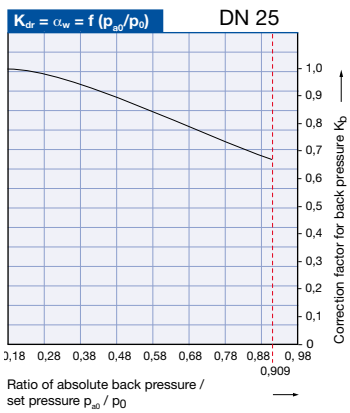
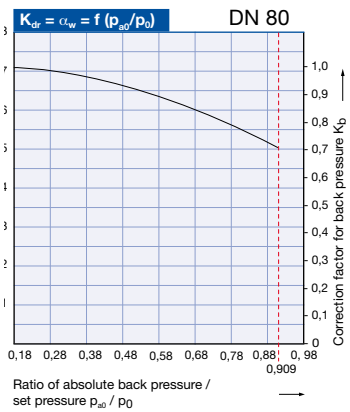
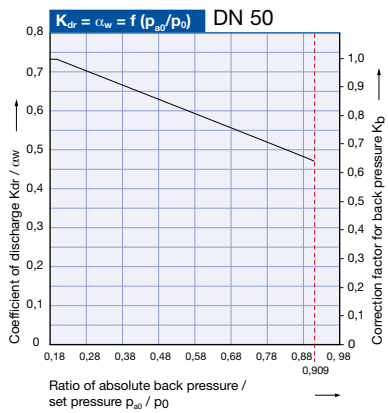
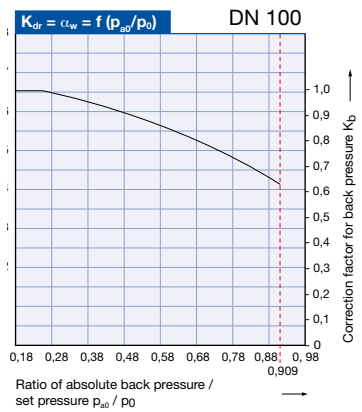


Diagram for evaluation of the coefficient of discharge (K_{dr}/α_w) or K_b in reference with the ratio of absolute back pressure / set pressure (p_{ao}/p_0)









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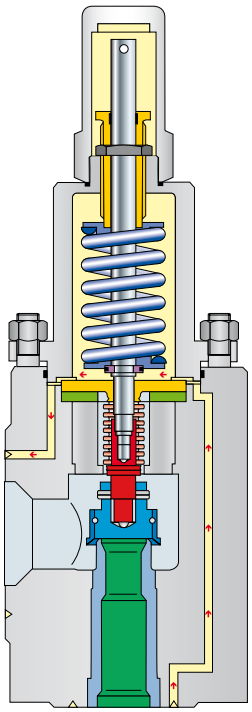
Type 449

Flanged Safety Relief Valves – spring loaded

Type 449
Cap H2
Closed bonnet

Contents

Design features



Area of application

Type 449 is a component-tested safety valve for protection against toxic media, often also in connection with corrosion.

Type 449 is characterised by:

– a duct system for flushing with protective gas
  for more detailed explanation, see page 03/03.
– Balanced bellows for back pressure compensation and to protect the bonnet space.
– Manufacture of the body components as well as most inner components of rod or forged material in order to realise customer-specific material requirements, nominal pressure ratings, flange drillings and facings, and centre to face dimensions.
  Please use the "Specification Sheet" on page 03/04 and 03/05 for this.

Naturally, LESER will advise you on the configuration of Type 449 for your application.

Protective gas flushing design

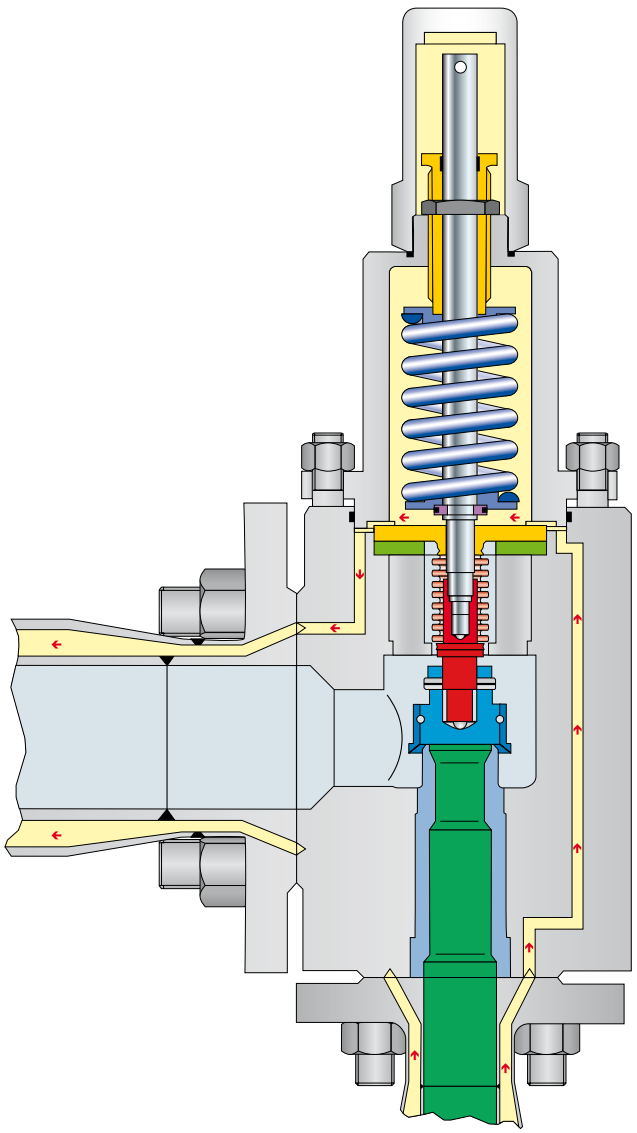
If highly toxic media form in systems, then suitable measures must be taken so that neither people nor the environment are endangered by that media.
One way to avoid any endangering is the installation of a duct system for flushing protective gas.

Here, a duct system is built around all safety valve components that carry highly toxic media.
A protective gas flows through this duct system, which has the following task:

– neutralisation of the highly toxic medium in the event of a leak.
– Residue from the neutralisation reaction is detected by detectors in the protective gas duct system and communicated to the control room where any necessary steps can be initiated.

Type 449 can be directly integrated into these duct systems. Through the appropriate connection flange and a special duct system, the protective gas is channelled from the inlet to the outlet side. The duct system design ensures that all possible leakage points are contacted by the protective gas.

Protective gas flushing design



Type 449

LESER

How to order – Specification Sheet

Please fax your inquiry to: **+49 40 25165-500** or contact your local LESER-Representative - refer to www.leser.com

Company:	Phone:	Fax:	E-mail:
Name:	Date:	Sheet 1 of:	Rev.:
Contract/Reference:	Spec.-No.:	Rev.:	Request:

General

1	Quantity:	of
2	Item-no.:	
3	Tag-no.:	
4	Service:	
5	Line no./Vessel no.:	
6	VALVESTAR calc. Area:	
7	Selected area:	
8	Orifice designation:	

Service conditions

9	Fluid and state	
10	Oper. pressure	bar
11	Set pressure	bar
12	Oper. temperature	°C
13	Rel. temperature	°C
14	Back pressure total	bar
15	Allowable overpress.	%
16	Inert gas pressure	bar

Connections

17	**Inlet**	Size	DN
18		Pressure rating	PN
19		Type of facing	
20		Centre to face a	mm
21	**Outlet**	Size	DN
22		Pressure rating	PN
23		Type of facing	
24		Centre to face b	mm

Duct System

25	Duct system	yes ☐	no ☐
26	Inert gas pressure		bar
27	Jacketed flange comply with		
28	☐ BAYER Standard 594 edition 02.2003		
29	☐ Other:		

Additional design data

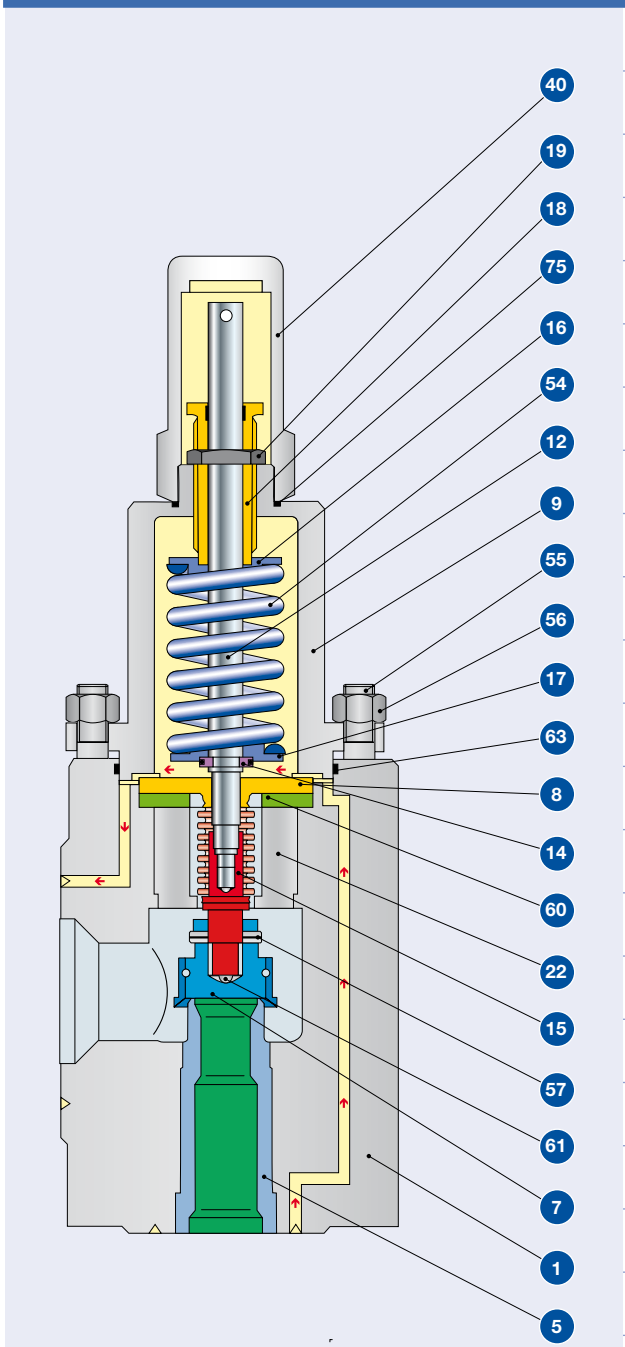
Required approvals

LESER

How to order – Specification Sheet

Please fax your inquiry to: **+49 40 25165-500** or contact your local LESER-Representative - refer to www.leser.com

Material Specification



	Item	Description	Qty.	Material specification	MTC	
30	**1**	Body	1		*	☐
31	**5**	Nozzle	1		*	☐
32	**7**	Disc, metal to metal	1		*	☐
33	**8**	Guide	1		–	–
34	**9**	Bonnet	1		*	☐
35	**12**	Spindle	1		–	–
36	**14**	Split ring	2		*	☐
37	**15**	Ballanced bellows	1		–	
38	**16**	Upper spring plate	1		–	–
39	**17**	Lower spring plate	1		–	–
40	**18**	Adjusting screw	1		–	–
41	**19**	Lock nut	1		–	–
42	**22**	Lift stopper	1		–	–
43	**40**	Cap H2	1		*	☐
44	**54**	Spring	1		*	☐
45	**55**	Stud	4		*	☐
46	**56**	Nut	4		*	☐
47	**57**	Pin	1		–	–
48	**60**	Gasket	1		–	–
49	**61**	Ball	1		–	–
50	**63**	O-ring	1		–	–
51	**75**	O-ring	1		–	–

MTC: Material Test Certificate 3.1 acc. DIN EN 10204
* = Default is 3.1
– = Not available
☐ = Editable is 3.2

Dimensions and weights

You receive the complete technical specification sheet together with the LESER order confirmation.

How to order – Article numbers

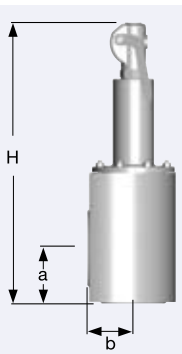
Article numbers						
		DN_I	25	50	80	100
		DN_O	50	80	100	150
		Valve size	1" x 2"	2" x 3"	3" x 4"	4" x 6"
		Actual orifice diameter d_0 [mm]	23	46	60	92
		Actual orifice area A_0 [mm²]	416	1662	2827	6648
Closed bonnet	**H2**	Art. no. **4492.**	**3362**	**3372**	**3382**	**3392**
	H4	Art. no. **4494.**	**3364**	**3374**	**3384**	**3394**

Type 449
Cap H2
Closed bonnet
Conventional design

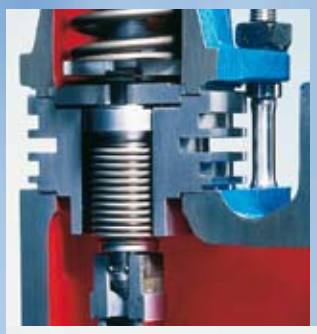
Type 449
Packed lever H4
Closed bonnet
Conventional design

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]	415	1662	2827	6648
Weight [kg]			**Specifications dependent on customer specification**			
Centre to face [mm]		Inlet a Outlet b				
Height (H4) [mm]		H max.				
DIN Flange		PN inlet PN outlet	**Specifications dependent on customer specification**			
ASME B16.5 Flange		Class inlet Class outlet				



Conventional design



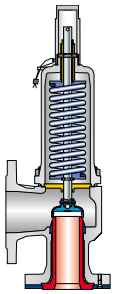
Accessories and Options

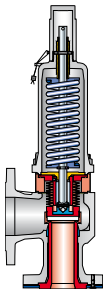
Contents	Chapter/Page
Overview	99/**02**
Caps and levers	99/**04**
Bellows design	99/**06**
Disc	99/**08**
Lift indicator	99/**09**
Lift stoppers	99/**10**
First in safety Information	

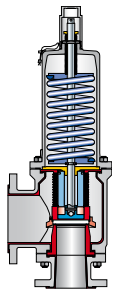
Accessories and Options

LESER

Overview



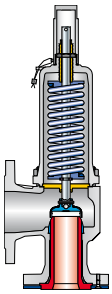


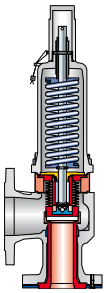


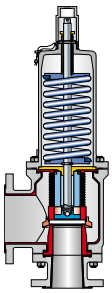
Options

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®		✓	✓	✓

Overview





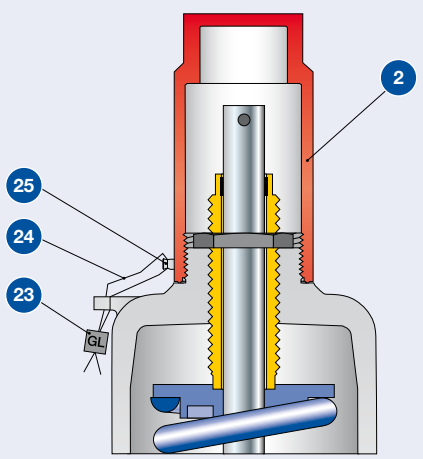


Options

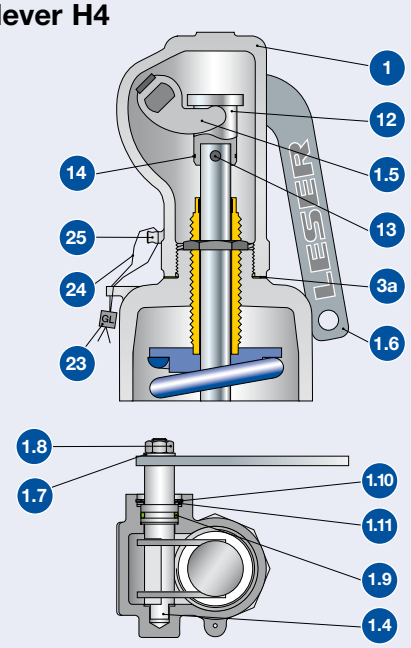
Type	546	5466	447
Bellows (item 15, item 7)			
Balanced bellows	*	–	–
PTFE bellows	✓	*	*
Special material, e.g. Hastelloy®	✓	–	✓
Caps and lifting devices (item 40)			
H2	✓	✓	✓
H4	✓	✓	✓
Test gag			
H2	✓	✓	✓
H4	✓	✓	✓
Bonnet (item 9)			
closed	*	*	*
open	–	–	–
Lift indicator			
Cap H2	–	–	–
Lifting device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

Caps and levers - subassembly item 40

Cap H2

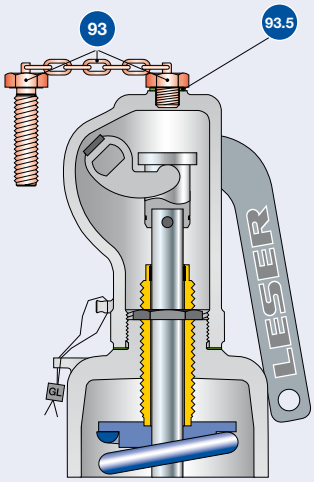


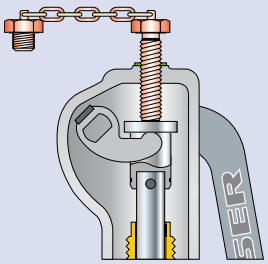
Packed lever H4



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
		-"-	-"-	-"-	-"-

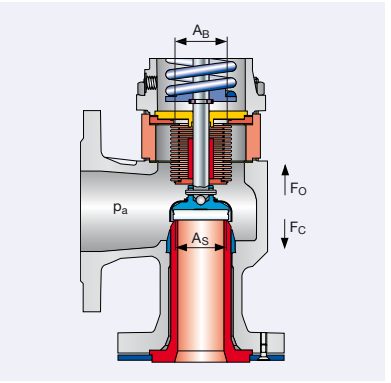
Please note:

- 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).

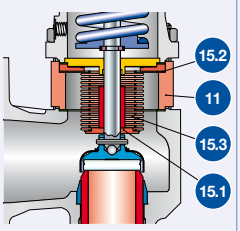
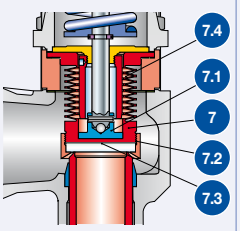
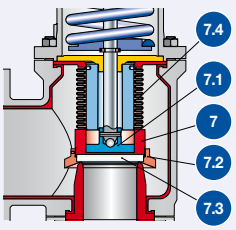


Type 546

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.

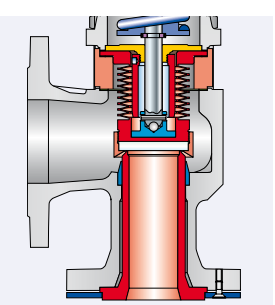
Type 5466 and Type 477 PTFE bellows – subassembly item 7

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

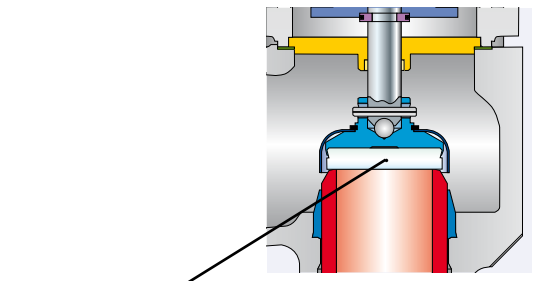
Sealing plate – subassembly item 7

Type 546, 5466 and Type 447

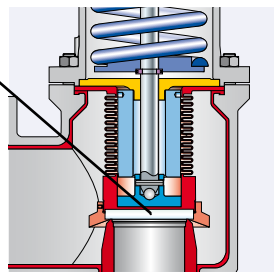
Non-metallic seal seat / nozzle, item 5 and disc - subassembly item 7

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

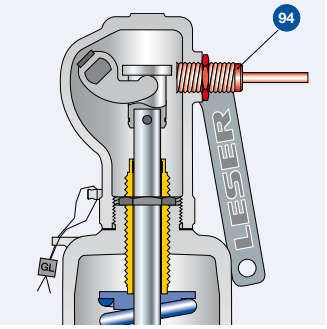
The lift indicator is used in the process technology to monitor the operating condition of a safety valve.

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.



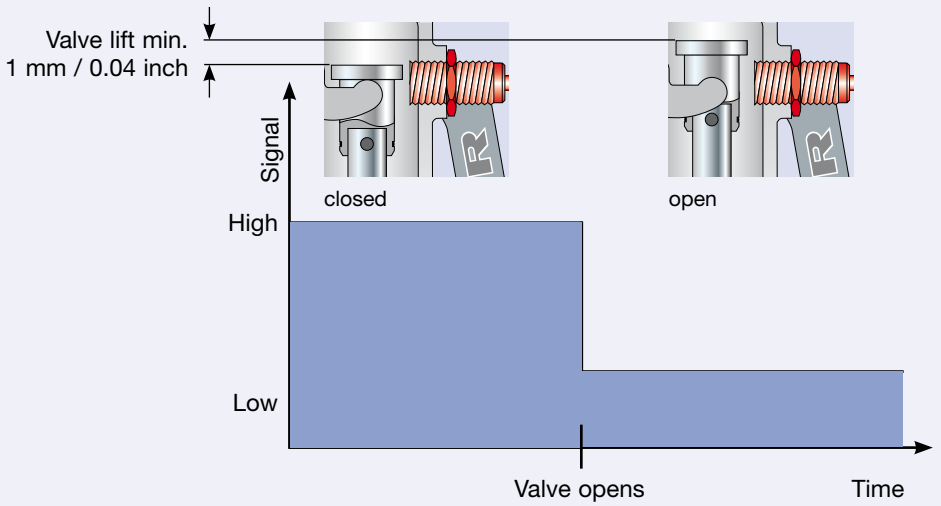
Lifting device H4

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

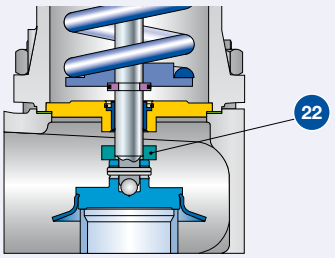
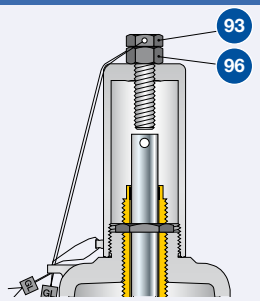
Rules and requirements / standards	EN ISO 4126-1, Section 5.1.3	ASME Code case 1945-4	AD 2000-Merkblatt A2, Section 10.3
Lift	≥ 30% of the full lift not less than 1.0 mm / $^1/_{16}$ inch	≥ 30% of the full lift not less than 0.08 inch / 2.0 mm	not less than 1.0 mm / $^1/_{16}$ inch
Coefficient of discharge	–	–	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

First in safety

History

The company, with more than 400 employees, its head office in Germany and one of the most modern factories, is one of the world's leading manufacturers of quality safety valves.

Since 1818, the family-owned company now in the 5th generation, has developed into one of the leading suppliers of safety valves worldwide following the motto of "Loyalty through Change". It is considered as a pace setter of technical progress in this fittings segment.

Specialisation in safety valves has been consistently pursued since the 70s of the last century. The company's success confirms the path that it has taken, which has been supported by highly motivated employees.

The worldwide usability of LESER safety valves is guaranteed by the numerous component tests and approvals by classification societies.

Safe solution from specialists

Today, LESER's product range includes 7 product groups with 38 types of safety valves.
A diversity of materials and valve sizes from DN 10 to DN 400 - $^1/_2$" to 16" provides safe solutions for all industrial applications.

High Performance:
Safety valves of this design are usually used to secure pressure vessels and systems for industrial applications (gases, steam and liquids) for fast discharge of the maximum possible mass flow rates.

API:
Safety valves compatible with API standard 526 are mainly used in the petrochemical as well as chemicals industry.

Compact Performance:
Safety valves for securing small and medium mass flow rates for general applications such as pumps and compressors, but also suitable for Cryo applications as well.

Clean Service:
Safety valves for securing systems with special cleanliness requirements, such as those required in the food, beverage and pharmaceuticals industries.

Critical Service:
Safety valves that can also be used even for highly corrosive media due to the materials that are employed.

Modulate Action:
Safety valves for securing small mass flow rates based on the nominal size, primarily used for liquids, in order to guarantee minimisation of media loss. They are also used for thermal expansion.

Best Availability
Supplemental products such as pneumatic additional load, change-over valves, and bursting discs complete the LESER product range.

Information

LESER catalogs contain all the product-related information that you need:

- Applications
- Construction features
- How to order
- Rule groups and standards
- Materials
- Dimensions and weights
- Pressure ranges
- Temperature functional ranges
- Accessories
- Spare parts
- Approvals
- Capacity tables

Please specify the number of copies or order the pdf file.

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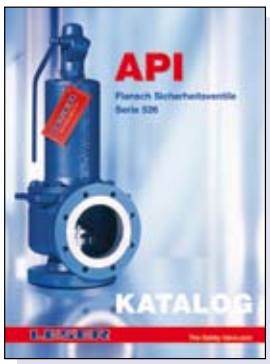

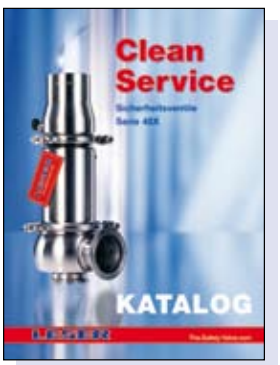

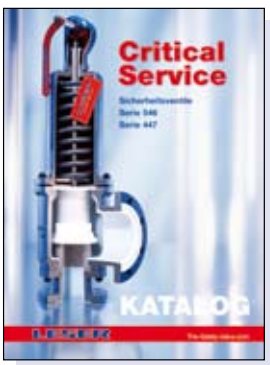

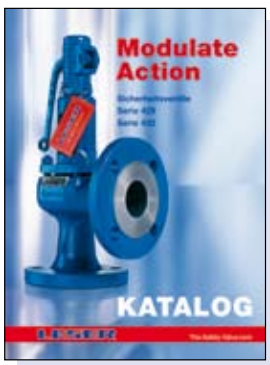

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