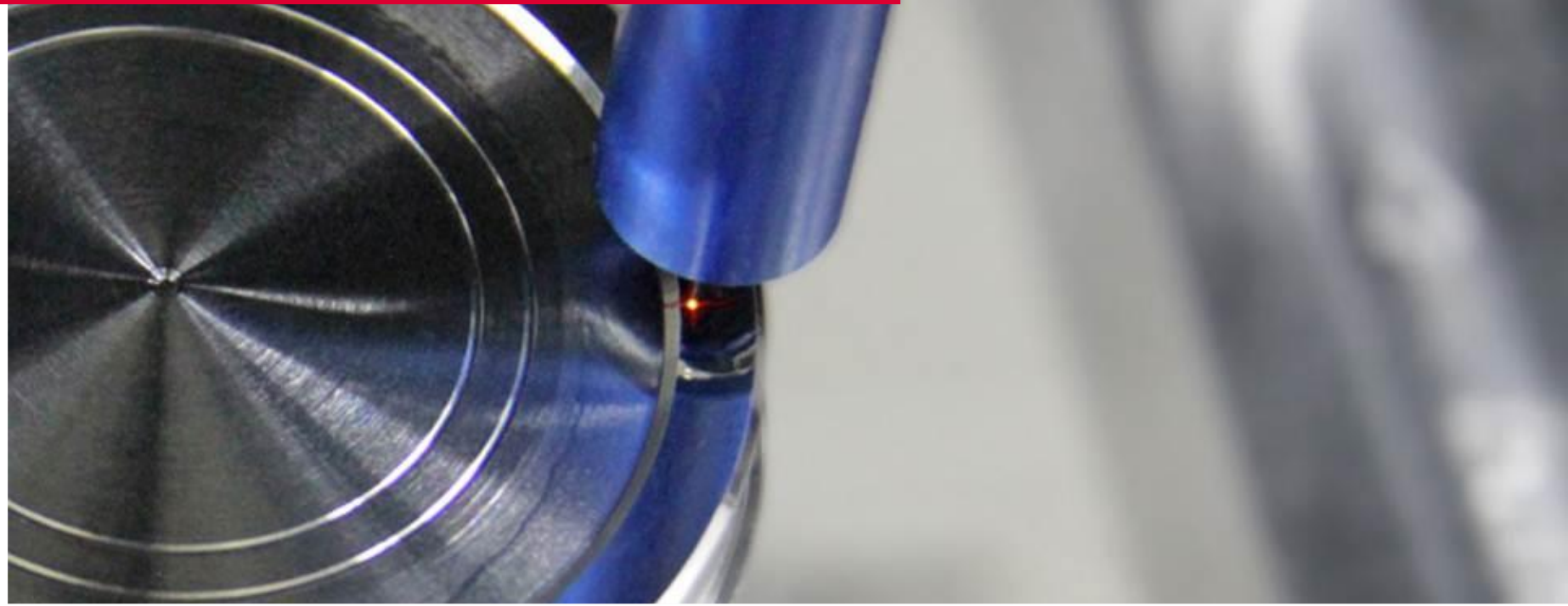
Tightness
of Safety Valves



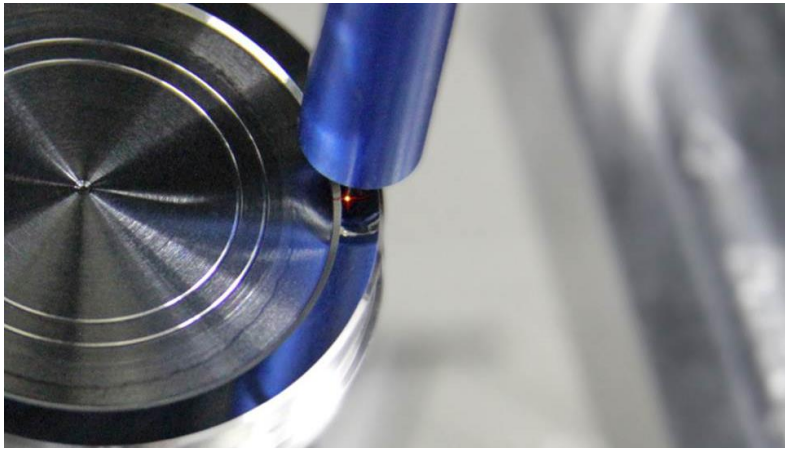
Objectives of this Presentation. Expand specialized knowledge.

The objective of this presentation is to explain **valve seat tightness with its definitions and test procedures**.

In the process, the following will be differentiated:

- Tightness of the body to the outside
- Functional tightness between the disc and seat

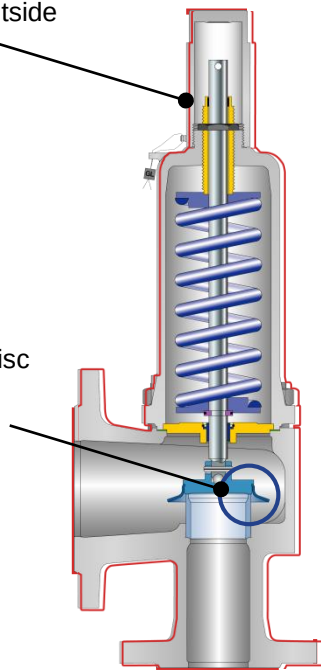
→ LESER Nanotightness



Definition.

Body tightness = tightness to the outside

Functional tightness = seat tightness between the disc and seat



Tightness to the Outside. Shell tightness test of the pressure retaining body.

Requirements

DIN EN 12266-1, Test P11

Test method

Inspection of the inlet nozzle

- Adjusted to the test pressure the inlet nozzle of the body is sprayed with a leak detector solution.
- If there is no foaming, then the inlet area that was tested is okay.

Testing the Tightness to the Outside.

Use

- Testing the back seat tightness, called the “tightness to the outside” by LESER, is performed for all LESER safety valves in a gas-tight design.
- The tightness to the outside refers to testing the tightness the valve cover including its connections.

Specifications

- DIN EN 12266-2, Test P21
- ASME Code, Section VIII, Part UG-136(d) (3).
- LGS 0201

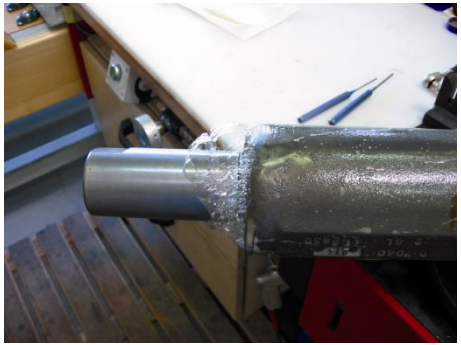
Testing the Tightness to the Outside. Flange Connections.

Test pressure

- Test standard: DIN EN 12266-2
- It will be tested at 6 bar
- Exception elastomer bellows: Test pressure at 2 bar

Procedure with leak detector solution (DIN EN 1593)

- Use with flange valves
- After testing the seat tightness and the set pressure, the outlet side of the safety valve is clamped onto the test bench and the test pressure is applied.
- Afterwards, the safety valve is sprayed with a leak detector solution on the connecting points and the outlet area.
- If no foaming can be seen, then the tested areas are okay.



LESER
The-Safety-Valve.com

Testing the Tightness to the Outside. Threaded Connections.

Test pressure

- Test standard: DIN EN 12266-2
- It will be tested at 6 bar

Submersion method (DIN EN 1593)

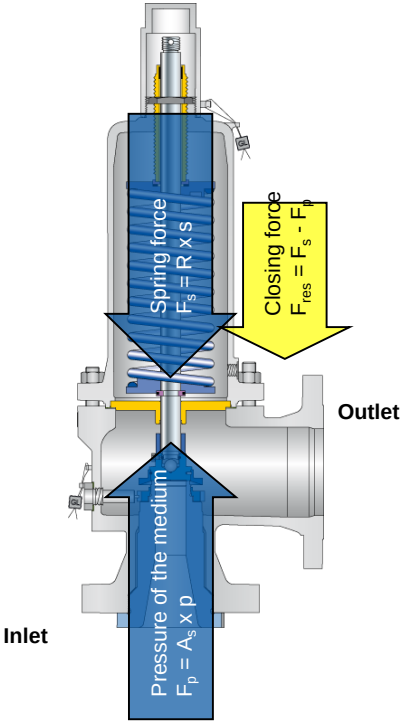
- Use for threaded valves (e.g. Compact Performance safety valves).
- The inlet side of the safety valve is sealed with a sealing cap.
- The outlet side of the safety valve is then clamped
  in the testing device, submersed in an immersion basin (water) and the test pressure is applied.
- If no bubbles form on the outer contour of the safety valve, then the tested safety valve is okay.

LESER
The-Safety-Valve.com

Functional Tightness. Excursus: Closing force for spring-loaded safety valves.

- **Spring force F_s acting from above** pushes the disc onto the seat of the safety valve and holds it closed.
- The **opening force of the medium F_p** under the disc
  acts against the spring force.
- The **resulting closing force $F_{res} = R_s – F_p$** on the disc decreases with increasing pressure under the disc.
- When the set pressure is reached, **$F_s = F_p$** and the **resulting closing force F_{res}** = 0.

The seat tightness of the safety valve decreases as the set pressure is approached.

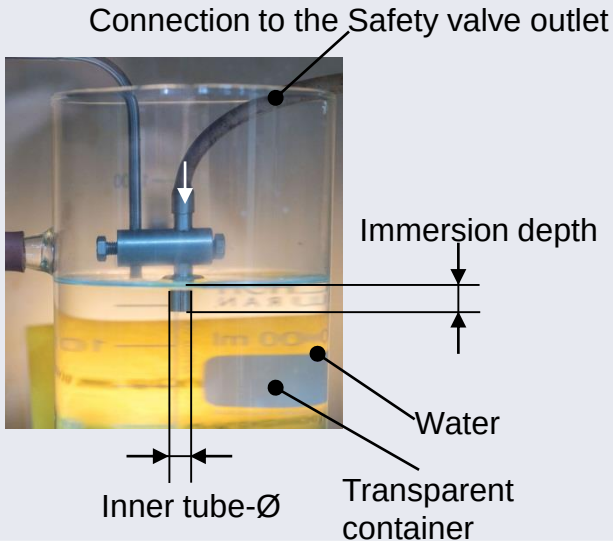


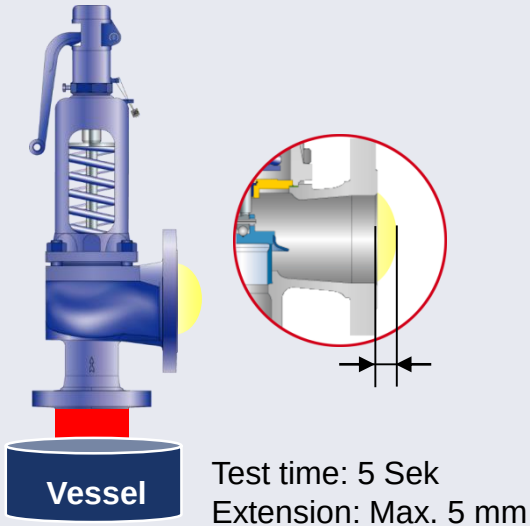
Specifications

- DIN EN ISO 4126-1, 6.6 Seat leakage test: no specific requirement regarding the leak rate
- DIN EN 12266-1, A.4 Seat tightness, Test P12: no specific requirement regarding the leak rate
- ASME Code Section VIII Vessels, Part UG- 136(d) (5): reference to the requirements of API 527
- API 527: the only internationally recognised standard for the seal tightness of safety valves including requirements of the leak rate and testing method.
- LGS 0201: LESER company standard derived from API 527

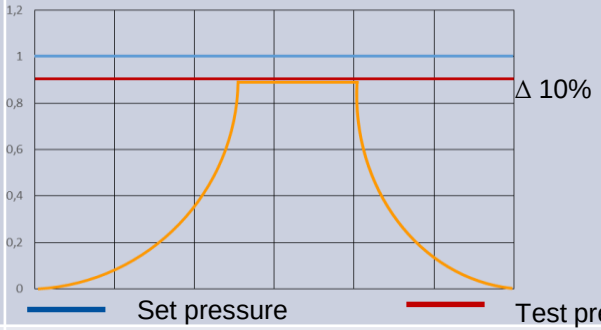
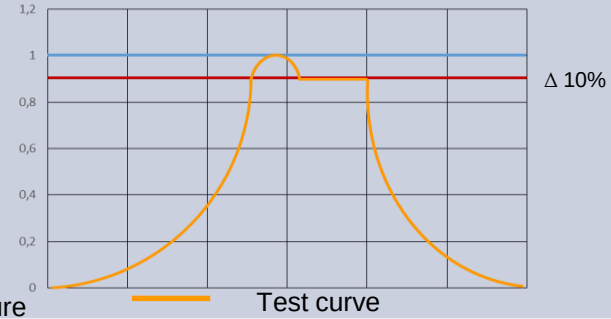
Functional Tightness. Test methods for functional tightness.

Gas-tight valves	Valves with an open bonnet
Blasentest (Kellog Test) Helium leak test	**Seat tightness test procedure with air, applying of test fluid**





Functional Tightness. Bubble test - procedure API 527 – LGS 0201.

	API 527	LESER LGS 0201
Test		
Waiting time	1 – 5 minutes	10 seconds
Test time	1 minute	10 seconds

Benefits of the LESER test method:

- More demanding test conditions as there is no setting of the disc before the test
- Realistic simulation of the behaviour of the valve after the first opening

Functional Tightness. In accordance with LESER LGS 0201.

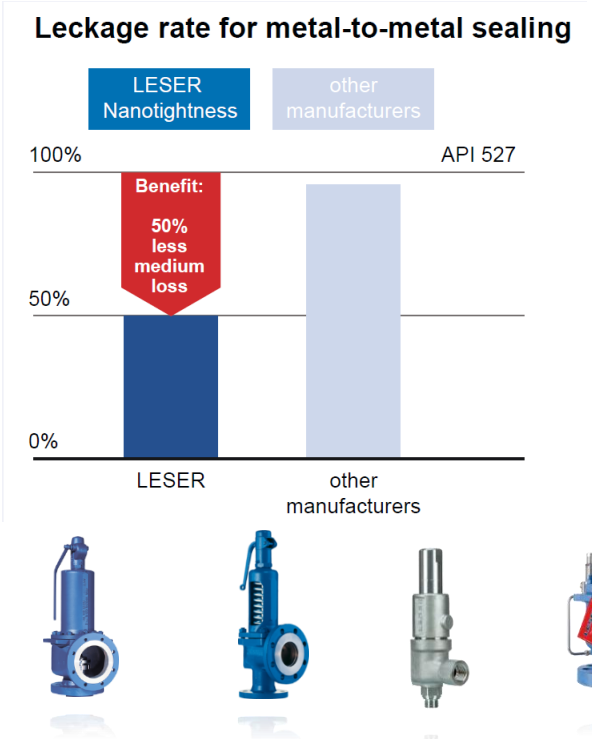
Bubble test – Increased tightness by LESER Nanotightness

Max. permissible leakage rate for metallic seals (bubbles/min.)						
Set pressure		**Leak rate as per**				
			LGS 0201		**API 527**	
[psi]	**[bar]**		**$d_0 \leq 18$mm**	**$d_0 > 18$ mm**	**d0 ≤ 18 mm**	**$d_0 > 18$ mm**
1,5-957	**0,1-66**	1)	**20**	**10**	40	20
		2)	**$9{,}4 \times 10^{-2}$**	**$4{,}7 \times 10^{-2}$**	$1{,}9 \times 10^{-1}$	$9{,}4 \times 10^{-2}$
>957-2393	**>66-165**	1)	**30**	**15**	60, 80, 100	30, 40
		2)	**$1{,}4 \times 10^{-1}$**	**$7{,}0 \times 10^{-2}$**	$4{,}7 \times 10^{-1}$	$2{,}3 \times 10^{-1}$
>2393-10150	**>165-700**	1)	**40**	**20**	100	50, 60, 80, 100
		2)	**$1{,}8 \times 10^{-1}$**	**$9{,}4 \times 10^{-1}$**	$4{,}7 \times 10^{-1}$	$4{,}7 \times 10^{-1}$

1) Bubbles/ Min. 2) mbarl/s

LESER Nanotightness. Product features.

- LESER Nanotightness **exceeds the requirements of API 527 by 50% for air and gas service**
- Available **as a standard** for all safety valves with metal-to-metal sealing ex works Germany
- Leakage rates (50% of API 527) are documented in new LDeS 0201.02

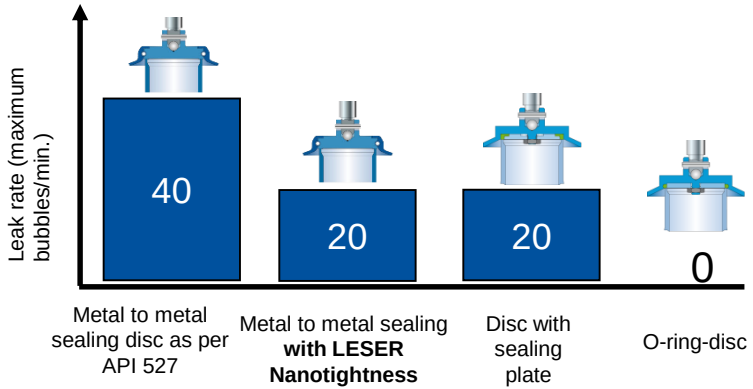


LESER Nanotightness. LESER Tight Finish concept to reduce medium loss.

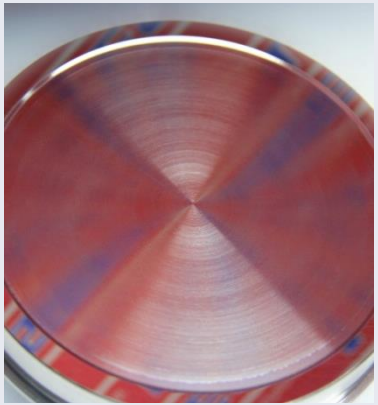
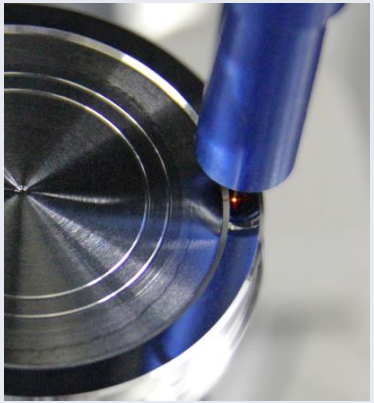
Seal type	Feature and benefit
Metal-to-metal sealing with LESER Nanotightness	LESER Nanotightness exceeds the API 527 requirements for functional seat tightness by 50%.
O-ring discs	Optional: 10 different O-ring materials for zero bubbles in a sturdy disc design
Sealing plates	For temperature- and pressure ranges beyond possibilities of O-ring discs

The testing conditions for increased seat tightness are described in LGS 0201. The seat tightness requirements are dependent on the nominal diameter and pressures.

Example is based is on $d_0 \leq 18$ mm / Orifice F or bigger

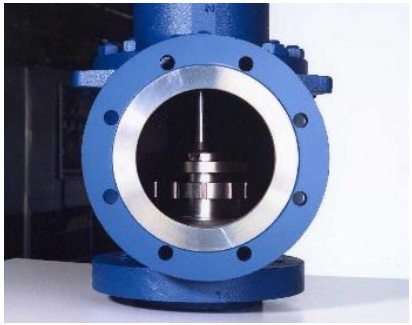


LESER Nanotightness. Technology.

Surface quality	Material handling	Measurement technology
Multi-stage lapping, honing and polishing process ensures flatness and surface roughness in the nm region	Surface protection and optimized handling processes throughout production	Optical measurement technology with nm accuracy, results are used to control process
		

LESER Nanotightness. Reduced medium loss beyond API 527.

Medium lost by an API 527-compliant safety valve per year*:



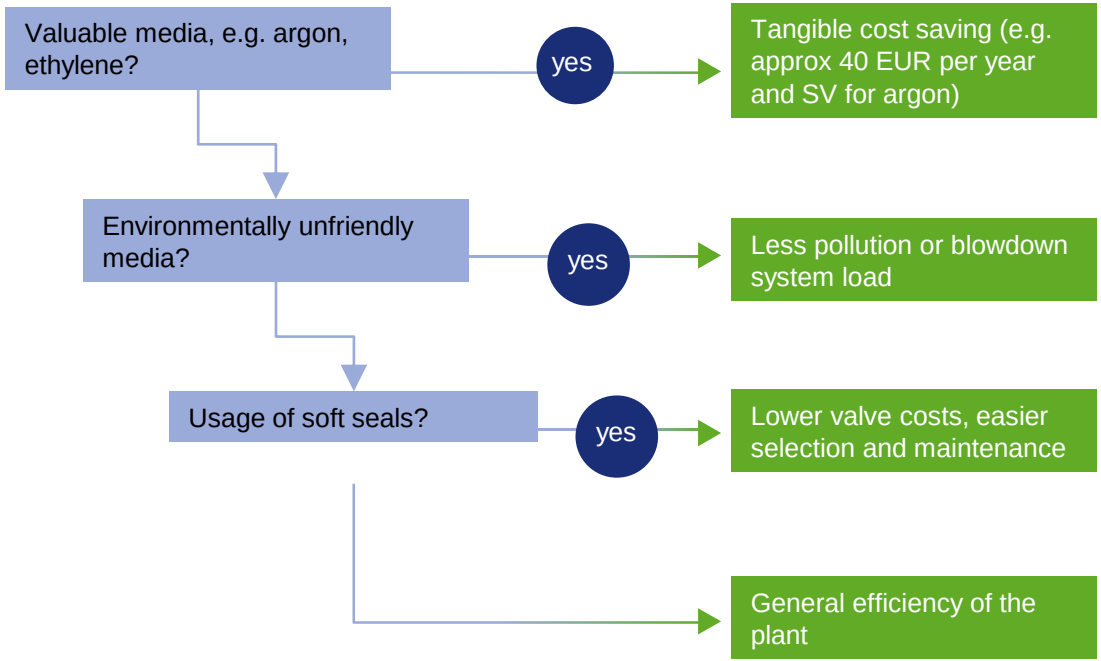
10 bar:
20 bubbles/min =
5,9 cm^3/min
= **3 m^3/year**

100 bar:
40 bubbles /min
= 11,8 cm^3/min
= **6 m^3/year**

- Pollution
- Money loss
- Efficiency
- Or need for soft seals

*Calculated for d_0 > 18 mm. For smaller d_0, medium loss would be even higher.

LESER Nanotightness.



Tightness

Thank you for your attention.