Content

Content

1 Maintenance fundamentals Pilot Operated Safety Valve

2 Purpose

The purpose of this section is to describe the maintenance fundamentals of the LESER Pilot Operated Safety Valve.

You will find tables to standardize the terminology, covering the most used devices. The tables also include a description of their characteristics. Furthermore cross sectional drawings of the main valve, pilot valve (pop action and modulate action) manifold block and accessories are presented to get an overview of the location. The final section describes the operation procedure of the main valve and the pilot valve.

3 Competences

The generation, maintenance and distribution of the documentation takes place in the organisation department. The defaults will be generated by the technical department in consultation with the final assembly department and production planning department.

4 Scope

This document must be applied to the disassembling, assembling, rework and refinishing parts of a Pilot Operated Safety Valve in agencies and subsidiaries of LESER GmbH & Co. KG, customers and independent service center.

5 Disclaimer

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6 Terminology

6.1 Parts description acc. to ASME PTC 25: Main valve

Item	Component	Description per ASME PTC 25 – Parts used by LESER
Main valve		
	Main relieving valve	That part of a pilot-operated pressure relief device through which the rated flow occurs during relief.
1	Body	A pressure-retaining or containing component of a pressure relief device that supports the parts of the valve assembly and has provision(s) for connecting to the primary and/or secondary pressure source(s).

2	Pitot tube	-
5	Nozzle	A primary pressure- containing component in a safety valve that forms a part or the entire inlet flow passage.
6	Piston	The moving element in the main relieving valve of a pilot-operated piston-type pressure relief valve which contains the seat that forms the primary pressure containment zone when in contact with the nozzle.
7	Disc	A component of a direct spring valve or of a pilot in a pilot-operated valve that supports the spring. It may or may not be pressure containing.
9	Top plate	Closes the body of the main valve.
59	Dome spring	The element in a safety valve that provides the force to keep the disc on the nozzle.
	Dome	The volume on the side of the unbalanced moving member opposite the nozzle in the main relieving valve of a pilot operated pressure relief device.

Table 1: Parts description acc. to ASME PTC 25

6.2 Parts description acc. to ASME PTC 25: Pilot valve

Item	Component	Description per ASME PTC 25 – Parts used by LESER
Pilot Valve		
	Pilot	The pressure- or vacuum-sensing component of a pilot-operated pressure relief valve that controls the opening and closing of the main relieving valve.
1	Body	A pressure-retaining or containing component of a pressure relief device that supports the parts of the valve assembly and has provision(s) for connecting to the primary and/or secondary pressure source(s).
2	Guide	A component in a direct spring or pilot-operated pressure relief device used to control the lateral movement of the disc or disc

		holder.
5	Seat feeding (upper)	The pressure-sealing surfaces of the fixed and moving pressure-containing components.
7	Disc feeding (upper)	A component of a direct spring valve or of a pilot in a pilot-operated valve that supports the spring. It may or may not be pressure containing.
8	Disc feeding (lower)	
9	Bonnet	Or spring step: a load-transferring component in a safety valve that supports the spring.
10	Bonnet base part	
12/18	Adjusting screw	A screw used to adjust the set pressure or the reseat pressure of a reclosing pressure relief device.
12	Spindle	A part whose axial orientation is parallel to the travel of the disc. It may be used in one or more of the following functions: (a) assist in alignment, (b) guide disc travel, and (c) transfer of internal or external forces to the seats.
13	Seat exhaust (upper)	The pressure-sealing surfaces of the fixed and moving pressure-containing components.
14	Seat exhaust (lower)	
15	Plunger	-
17	Spring plate	Or spring step: a load-transferring component in a safety valve that supports the spring.
40	Cap	A component used to restrict access and/or protect the adjustment screw in a reclosing pressure-relief device. It may or may not be a pressure containing part.
41	Piston	The moving element in the main relieving valve of a pilot-operated piston-type pressure relief valve which contains the seat that forms the primary pressure containment zone when in contact with the nozzle.
72	Diaphragm	A flexible metallic, plastic or elastomer pressure-containing member of a reclosing pressure relief device used to sense pressure or to provide opening or closing force.

Table 2: Parts description acc. to ASME PTC 25

6.3 Parts description acc. to ASME PTC 25: POSV accessories

Item	Component	Description per ASME PTC 25 – Parts used by LESER
Main valve		
	Field test	A device for in-service or bench testing of a pilot-operated pressure relief device to measure the set pressure.
	Backflow preventer	A part or feature of a pilot-operated pressure relief valve used to prevent the valve from opening and flowing backwards when the pressure at the main valve outlet is greater than the pressure at the valve inlet.

Table 1: Parts description acc. to ASME PTC 25

7 Definition of set pressure

ASME PTC 25, 2001, 2.7 OC of PRD
LESER defines the set pressure as the value of increasing inlet static pressure at which the first audible/visible discharge (first steady flow for liquids) for gas and steam occurs. Furthermore a “popping” point of safety valve exists when the vessel pressure rises above the set pressure. At this pressure the valve opens rapidly with small or no increase in system.

8 Definition of overpressure

ISO 4126-1, 2004, 3.2.3
Overpressure is defined as the pressure increase over the set pressure at which the valve attains the lift specified by the manufacturer. Usually overpressure is expressed as a percentage of the set pressure. For steam and gas applications the maximum overpressure varies between 3% and 10% depending on applicable code and application. For liquids most codes specify a maximum overpressure of 10%.

9 Definition of blowdown

ASME PTC 25, 2001, 2.7 OC of PRD
Blowdown is considered as the difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units.

Typical values for the blowdown for POSV are 3% to 15%

Figure 1 and 2 give a graphical representation of the definitions.

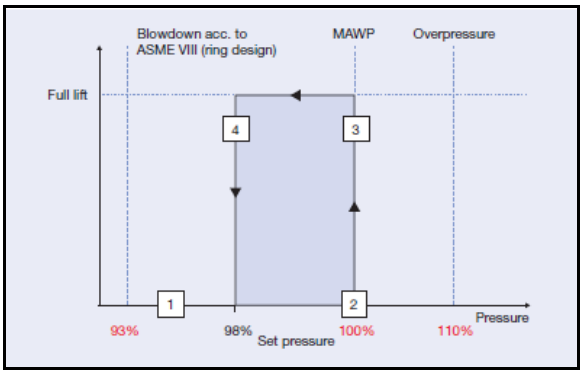


Figure 1: POSV Series 810 – Pop Action

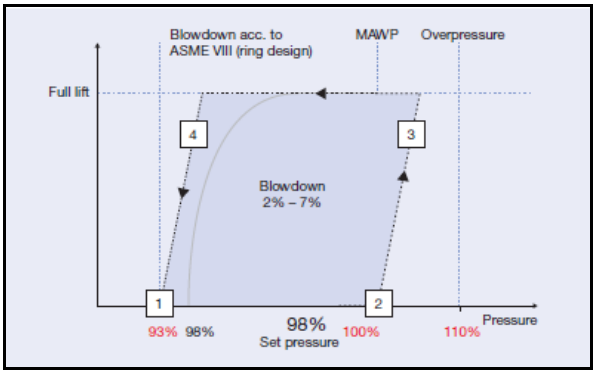


Figure 2: POSV Series 820 – Modulate Action

10 General Introduction

10.1 Main valve illustration

Below is a schematic drawing of the parts layout for the LESER POSV main valve including both the Standard and Extra Orifice designs.

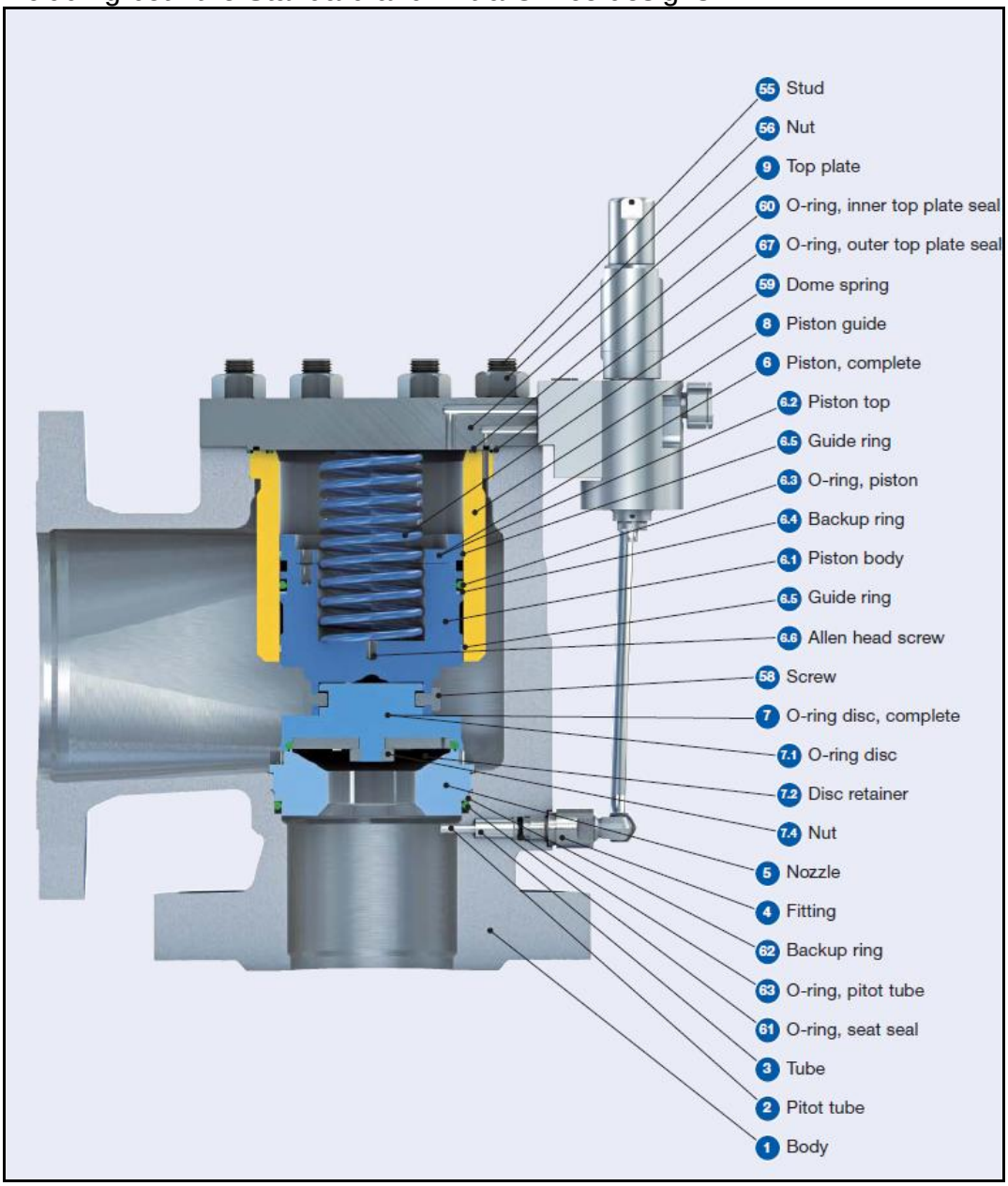


Figure 3: Illustration of the main valve

10.2 Pop action pilot valve illustration

Figure 4 shows a schematic drawing of the parts layout for the LESER Series 810 – pop action pilot valve

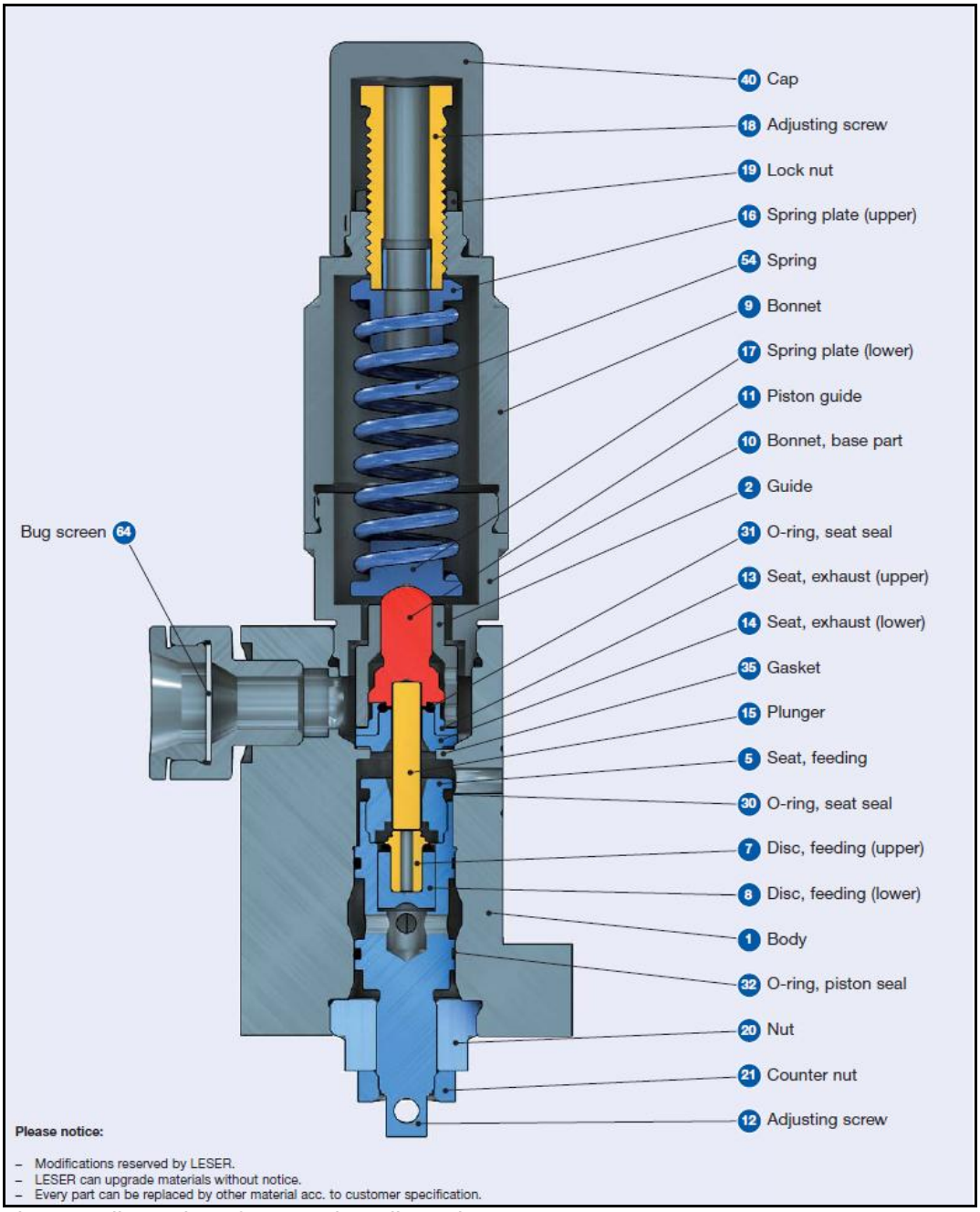


Figure 4: Illustration of Pop Action Pilot Valve

10.3 Illustration of modulate action pilot valve (diaphragm)

Figure 5 shows a schematic drawing of the parts layout for the LESER Series 820 – modulate action pilot valve.

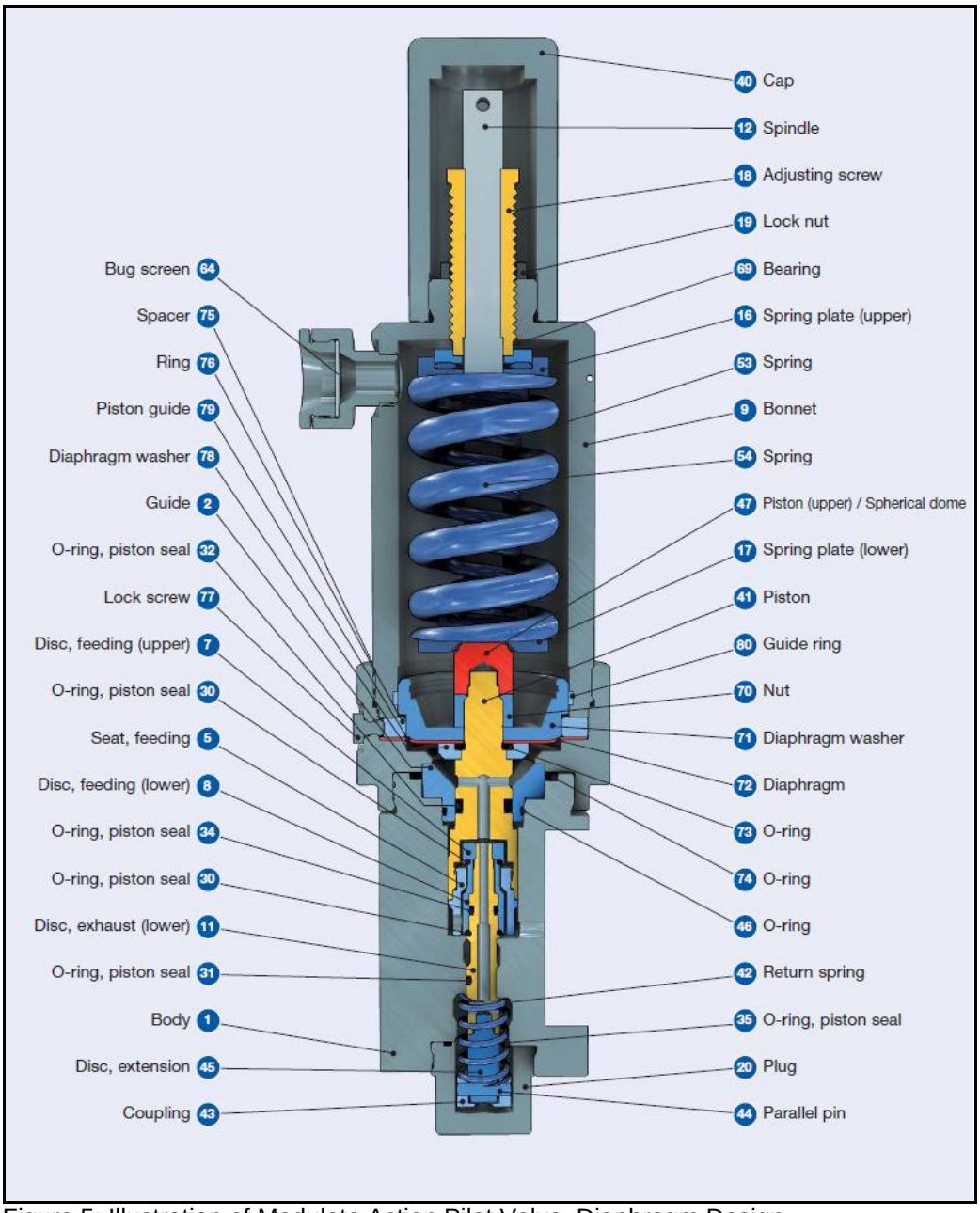


Figure 5: Illustration of Modulate Action Pilot Valve, Diaphragm Design

10.4 Illustration of modulate action pilot valve (piston)

Figure 6 shows a schematic drawing of the parts layout for the LESER Series 820 – modulate action pilot valve.

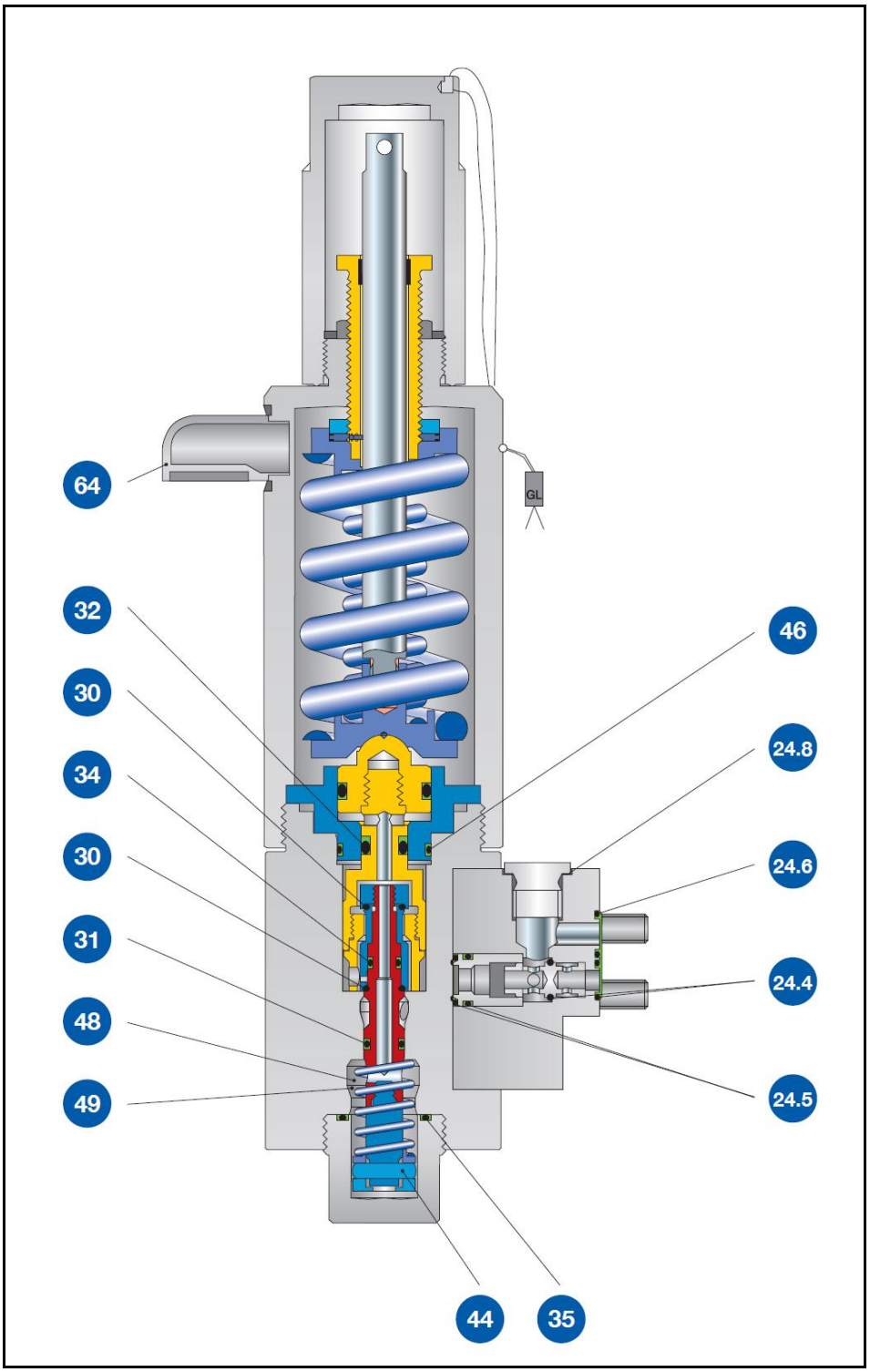


Figure 6: Illustration of modulate action pilot valve, piston design

10.5 Manifold block illustration

Below is a schematic drawing of the parts layout for the Manifold block.

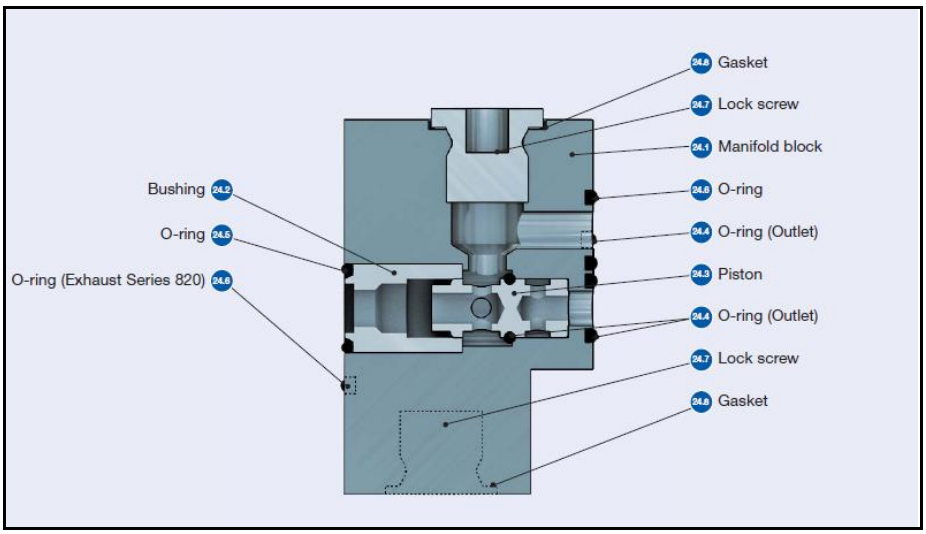


Figure 7: Illustrations of the Manifold Block

10.6 Illustration of the Accessories

The following figures show the various types of the LESER accessories for the Pilot Operated Safety Valve

Figure 8: Illustration of the field test connection

Set pressure testing with external test medium

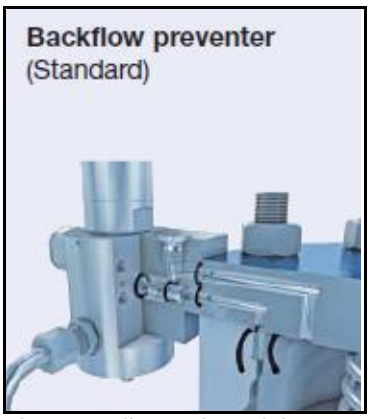


Figure 9: Illustration of the backflow preventer

Prevents return flow of the medium from the discharge into the system to be secured

Figure 10: Illustration of pilot supplyfilter

Filter to prevent plugging of the pilot

Figure 11: Illustration of the manual blowdown

Functional test of main valve piston

protected

Figure 12: Illustration of the remote sensoring

Actual operating pressure sensed to pilot.
No influence of inlet pressure losses, stable function of POSV

Further accessories for the POSV	
Drain hole	-
Pilot lifting device	Mechanical lifting of pilot for verification of POSV operation
Pilot test gag	Blocking of operation in case of required hydrostatic testing of vessel
Blowdown	Blowdown adjusted: Closing pressure difference as a fixed value between 2 – 15%. Standard adjustment between 3 – 7%

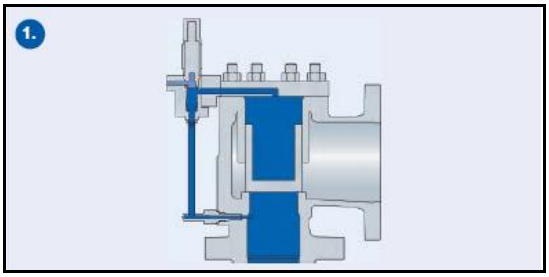
11 Operation procedure

11.1 Main valve operation cycle

LESER Pilot Operated Safety Valve (POSV) is controlled by process medium. To achieve this, the system pressure is applied to the pilot valve (= control component for the main valve) via the pressure pickup. The pilot valve then uses the dome above the main valve piston to control the opening and closing of the main valve. While there are specific differences between the Series 810 – Pop Action POSV and the Series 820 – Modulate Action POSV, the basic operation of a LESER POSV can be described as follows. During operation, the POSV goes through these basic operating states:

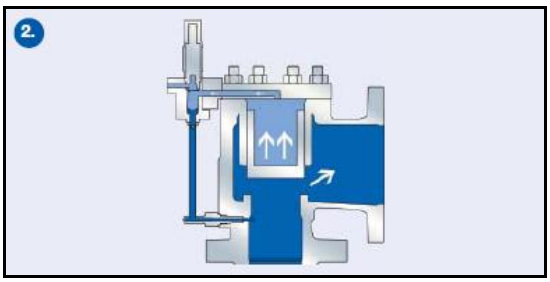
1. Below set pressure: normal operation

During normal operation, the system pressure is picked up at the main valve inlet and routed to the dome (see illustration). Since the dome area is larger than the area of the main valve seat, the closing force is greater than the opening force. This keeps the main valve tightly closed.



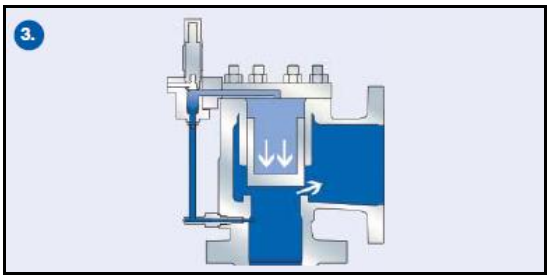
2. At set pressure: actuating state

At set pressure, the pilot valve actuates. The medium is no longer routed to the dome (see illustration). This prevents a further rise in dome pressure. Also, the dome is vented. As a result, the closing force ceases as a precondition for the system overpressure to push the main valve open.



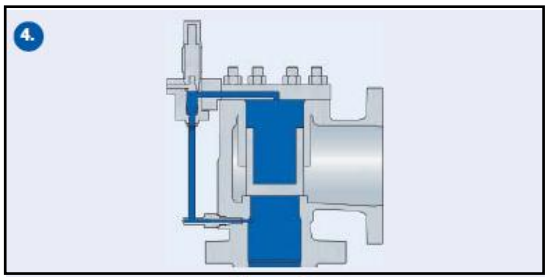
3. Main valve opening

The main valve opens. Depending on the design of the pilot valve, this opening is either rapid and complete (Pop Action) or gradual and partial following system pressure (Modulate Action).



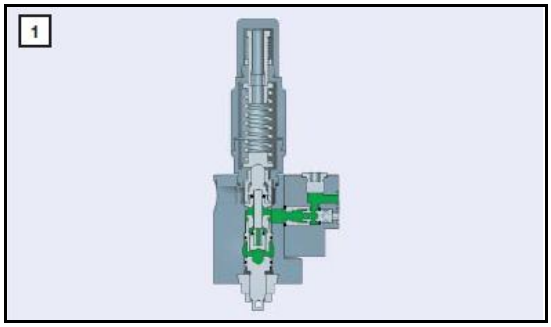
4. At closing pressure: refilling the dome

If system pressure drops to closing pressure, the pilot valve actuates and again routes the medium to the dome. The pressure in the dome builds up and the main valve recloses either rapid and complete (Pop Action) or gradual and partial following system pressure (Modulate
Action).

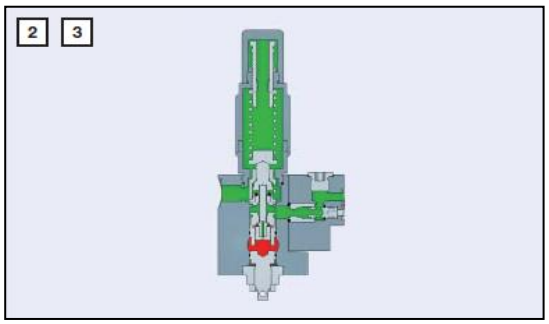


11.2 Pop action pilot valve

1. Below set pressure:
normal operation – feeding seat open, exhaust seat closed
The system pressure is routed to the top side of the main valve piston via the pressure pickup, the pilot valve and the dome of the main valve (see illustration). Since the pressure contact surface is larger on the top side than on the underside of the piston, there is always a stronger net force acting on the top side. The main valve is kept tightly closed.

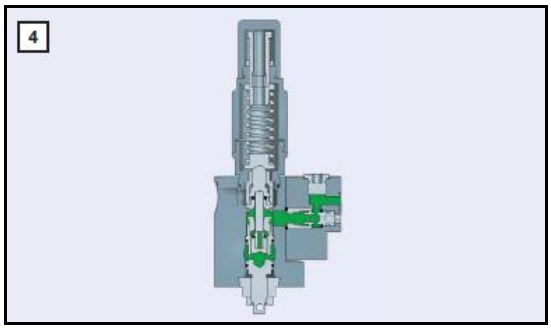


2. At set pressure:
feeding seat opening, exhaust seat closing
When set pressure is reached, the pilot valve opens the exhaust seat and closes the feeding seat. This releases the dome pressure. The release of dome pressure is a pre-condition for the opening of the main valve by system pressure.

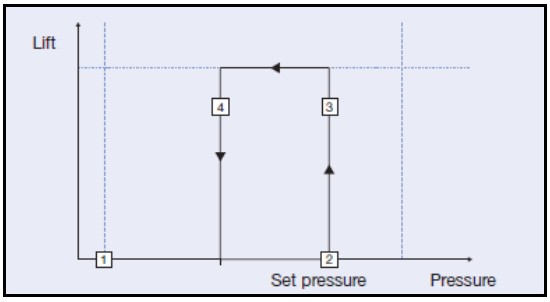


3. At and above set pressure (+ max. 1%):
pop opening
At set pressure, the main valve opens abruptly and completely feeding seat closed, exhaust seat open (Pop Action) (see bottom chart). The medium is channelled from the dome to atmosphere (see illustration on right).

4. At closing pressure:
feeding seat open, exhaust seat closed
When the system pressure drops to closing pressure, the pilot valve actuates and again channels the system pressure to the dome of the main valve. Here, the system pressure builds up, the main valve recloses. The closing stage (blowdown) can be adjusted from at least 3% (when pressure loss at the inlet is low) to max. 15% blowdown difference.



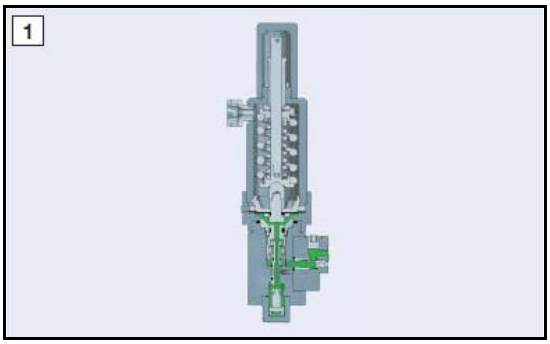
1 – Below set pressure: normal operation
2 – At set pressure
3 – Pop opening
4 – At closing pressure – blowdown



11.3 Modulate action pilot valve

The operating cycles of the Series 820 – Modulate Action and the Series 810 – Pop Action POSV differ at two points: shortly before set pressure is reached (see below, 1a) and after reaching set pressure. At this second point actual modulation takes place in the Series 820 – Modulate Action POSV. Modulation means that above set pressure the pilot valve will open the main valve in proportionto overpressure. Thus, there may only be a partial lift of the main valve. This ensures that only as much medium is discharged as is required for pressure reduction. Any unnecessary medium loss is avoided.

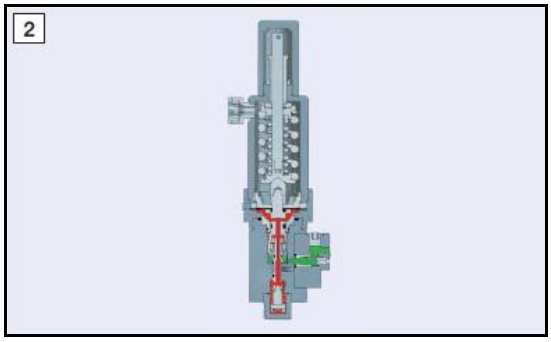
1. Below set pressure:
normal operation – feeding seat open, exhaust seat closed
The system pressure is routed to the dome, keeping the main valve tightly closed (see illustration).



1a. Near set pressure:
feeding seat closed, exhaust seat closed
(not shown)
Shortly before set pressure is reached, the pilot valve closes the dome feeding seat. This keeps the dome pressure stable. A stable dome volume is the pre-condition which allows the rising system pressure to push the main valve open at set pressure.

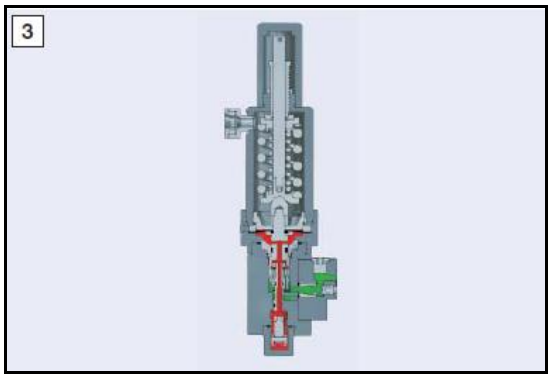
2. At set pressure (+ max. 1%): feeding seat closed, exhaust seat open

With a further slight pressure increase, set pressure is reached and the pilot valve opens the dome exhaust seat. The dome volume is discharged and the main valve opens.



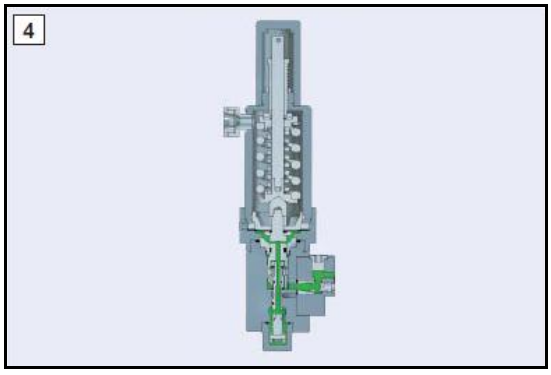
3. Modulate opening: feeding seat closed or open, exhaust seat closed or open

At this point, modulation takes place. This means that if overpressure remains within the modulating range of 93 – 110% of set pressure, the pilot valve will again close the dome exhaust seat. This stops discharge from the dome and keeps the main valve piston unchanged at the achieved lift. The achieved lift will always be enough to ensure pressure reduction, but not more than is required. During blow-off this intermediate state with a stable dome volume and main valve lift can occur repeatedly and at different pressure levels. To change the lift, there can also be partial opening movements with the exhaust seat opened, or closing movements with the feeding seat opened. Modulation ensures that only as much medium is discharged as is necessary to prevent the overpressure from exceeding the modulating range



4. At closing pressure: full closing – feeding seat open, exhaust seat closed

When system pressure drops below the modulating range to reach blowdown pressure , the pilot returns to its first state (with feeding seat open and exhaust seat closed). The main valve closes completely.



1 – Below set pressure: normal operation
2 – At set pressure
3 – Pop opening
4 – At closing pressure – blowdown