MAINTENANCE

Maintenance Handbook for LESER Product Group API

Series 526

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Introduction

About MAINTENANCE

MAINTENANCE provides a collection of documents for repairing or maintaining LESER safety valves. The following topics are covered:

- Maintenance Fundamentals of LESER safety valves (terminology, design elements relevant for valve operation)
- Repair process
- Suggested equipment for assembling, disassembling and rework of critical parts
- Disassembly, including sectional drawings
- Rework of critical parts including an overview of critical dimensions
- Assembly, including options
- Spring charts
- Testing procedures (set pressure and leak tests)
- Spare parts lists
- Guidelines for inspection, storage and transport
- Trouble shooting

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Chapter	Content	Sources
1.1 Introduction	Introdocution and table of contents	LID EN 1001-00 “Introduction”
1.2 Maintenance Fundamentals	Terminology: - Parts - Set pressure - Overpressure & blowdown Critical parts: - Nozzle & disc - Spring - Adjusting ring - Parts providing alignment - Lifting devices	LID EN 1002-00 “Maintenance Fundamentals”
1.3 Repair process	-Process of Safety Valves to Repair -Repair Traveller	LGS 4111 “Process of Safety Valves to Repair” LGS 4112 “Repair Traveller”
1.4 Suggested equipment	Equipment for disassembly and lapping - Required equipment with technical information - Order numbers of LESER equipment - LGS 4456: Most relevant sections are: Page 1-4; 7; 11-12; 14-17, 28 – 30, 34 - Equipment and materials	LGS 4460 “Specification of the API Tool Kit” LGS 4456 “Standard Tool Specification“ LGS 4116 “Operating materials and supplies for repaired valves“

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1.5 Disassembly and Cleaning	Disassembly instruction: - Step-by-step instruction for disassembly Cleaning instructions	LGS 4109 “Dismantling instructions for type 526 API“ LGS 4115 “Cleaning repaired valves”
1.6 Rework of critical parts	Critical dimensions for refinishing disc and nozzle: - Lowest allowable tolerances for refinishing - LDeS 3309.05 includes dimensions for other LESER safety valves. Relevant pages for this valve type: Page 1-2; 15-16	LDeS 3309.05 “Refinishing of seats and discs”
	Rework of the seat: - Procedure of lapping by hand, illustrated with pictures	LGS 4113 “Reworking repaired valves”
1.7 Assembly	Assembly instruction: - Step-by-step instruction for assembly	LGS 4104 “Assembly instructions for type 526 API”
	Torques: - Assembly torques for body-bonnet connection, caps, test gags, O-ring discs and bellows	LGS 3323 “Torques for screw, nuts and caps H2 / lifting devices” LGS 3325 “Torque for O-Ring-Disc and bellows connection“
	After Assembly: - Color finishing and painting - Component plate	LGS 4114 “Paint touch-up and painting repaired valves” LGS 4118 “Component plates”

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1.8 Spring charts	Spring charts: - Overview of spring ranges for set pressure adjustments and spring selection in bar and psi	LGS 3630 “Spring charts Type 526“

1.9 Testing Procedures	Testing set pressure: - Procedures and equipment for setting and testing the cold differential test pressure, including tolerances	LDeS 1001.69 “CDTP-Cold differential test pressure”
	Leak testing: - Procedures and equipment for testing functional tightness (disc-nozzle connection) - Procedures and equipment for testing shell tightness (nozzle, cap)	LGS 4434 “Performing Leak Tests”
	Tightness requirements: - Seat tightness - Shell tightness - Back seat tightness	LGS 0201 “Tightness Test”
	Last visual check up	LGS 4117 “Final visual inspection of repaired valves“
1.10 Spare parts	Spare parts list	Extract from LWN 480.00 “Type 526 spare-parts”
1.11 Installation & storage	Testing and inspection before installation: - visual inspection of the valve - hydraulic pressure test	Extract from LWN 753.00 “Installation and Plant Design”
	Inspection intervals	Extract from LWN 753.00 “Installation and Plant Design”
	Storage and transport	Extract from LWN 753.00 “Installation

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		and Plant Design”
1.12 Trouble shooting	Typical errors	Extract from LWN 765.01 “Trouble shooting”

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1 Maintenance Fundamentals

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1.1 Introduction

This chapter deals with basic information considered as necessary for assembly and disassembly of LESER's safety valves. Fundamentals include:

- Parts description
- Definition of overpressure, blowdown and set pressure at LESER
- Explanation of relevant construction elements

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1.2 Terminology

1.2.1 Parts Description acc. to ASME PTC 25

Item	Component	Description per ASME PTC 25 – Parts used by LESER
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).
5	**Nozzle**	A primary pressure- containing component in a safety valve that forms a part or the entire inlet flow passage.
5	**Seat**	The pressure-sealing surfaces of the fixed and moving pressure-containing components.
6	**Adjusting ring (blowdown ring)**	A ring assembled to the nozzle or guide of a direct spring valve, used to control the opening characteristics and/or the reseat pressure.
7	**Disc**	A moveable component of a pressure relief device that contains the primary pressure when it rests against the nozzle.
9	**Bonnet**	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	**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.
12	**Spindle (stem)**	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.
15	**Bellows**	A flexible pressure-containing component of a balanced direct spring valve used to prevent changes in set pressure when the valve is subject to superimposed back pressure, or to prevent corrosion between the disc holder and guide.
16/17	**Spring plate (spring step, -button, -washer)**	Or spring step: a load-transferring component in a safety valve that supports the spring.
18	**Adjustment screw**	A screw used to adjust the set pressure or the reseat pressure of a reclosing pressure relief device.
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.
40	**Lift lever**	A device to apply an external force to the stem of a pressure relief valve to manually operate the valve at some pressure below the set pressure
54	**Spring**	The element in a safety valve that provides the force to keep the disc on the nozzle.

Table 1: Parts description acc. to ASME PTC 25

The following parts are described in ASME PTC 25, but are not used in LESER safety valves.

Component	Description per ASME PTC 25	Not used in LESER safety valves, because
Disc holder	A moveable component in a pressure relief device that contains the disc	One piece spindle with different disc design, does not require a disc holder
Yoke	A pressure-retaining component in a pressure relief device that supports the spring in a pressure relief valve or pin in a non-reclosing device but does not enclose them from the surrounding ambient environment	Open bonnets are used for the same purpose.

Table 2: Parts description acc. to ASME PTC 25 – not contained in LESER safety valves

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1.2.2 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.

1.2.3 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%.

1.2.4 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 are 4% to 15% for steam and gas and 20% to unlimited for liquids.

Figure 1 gives a graphical representation of the definitions.

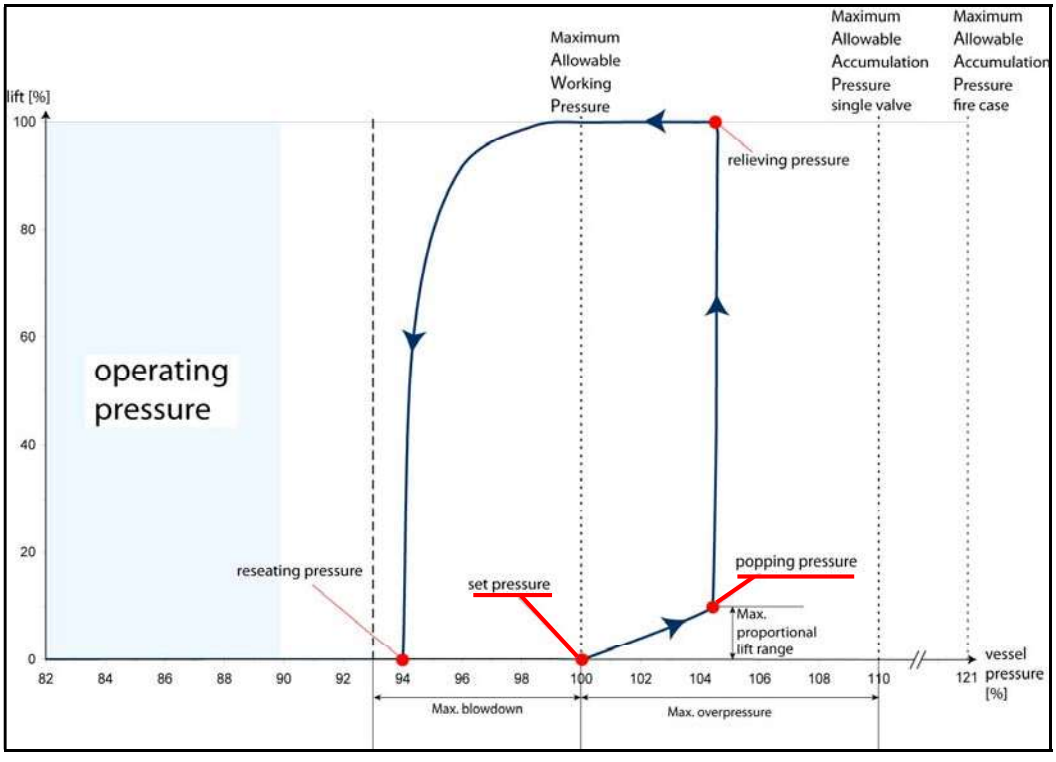

Figure 1: general characteristic of LESER safety valves for steam/gases acc. to ASME VIII

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1.3 Critical parts

This chapter contains a description of critical parts influencing the operation characteristic. Emphasized were different disc and nozzle constructions, correct spring selection, positioning and function of the adjustment ring and parts which provide alignment.

1.3.1 Nozzle and disc

The geometry of nozzle and disc is critical to the valve operation. Small changes to the dimensions of these parts can change overpressure, blowdown and general valve operation significantly. Maintenance instructions include default dimensions of these parts in chapter rework of critical dimension. These diameters must be maintained when performing repair and maintenance work. Nozzle and disc also form the seat of the valve. The surface finish of the contact surfaces is critical for the tightness of the safety valve. For a metal to metal seat the contact surfaces are lapped for a specified tightness acc. to API 527 (see chapter rework of critical parts).

Table 3 provides differences between optional disc constructions of flanged and threaded valves.

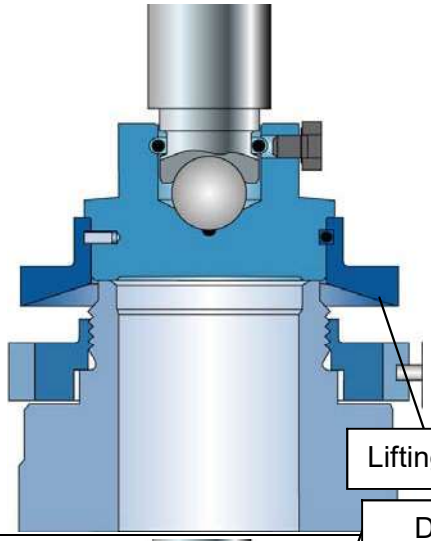
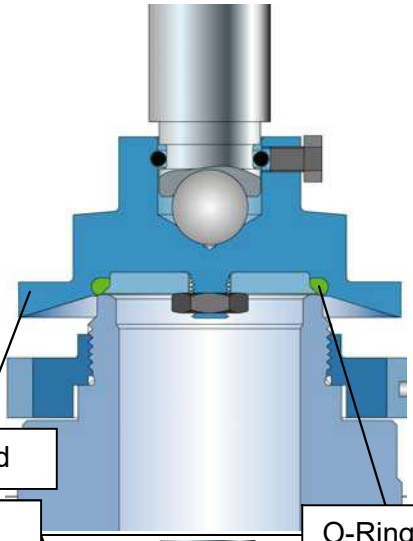
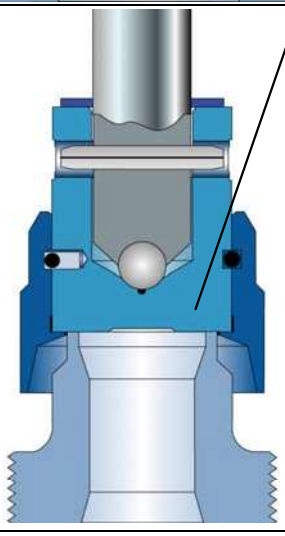
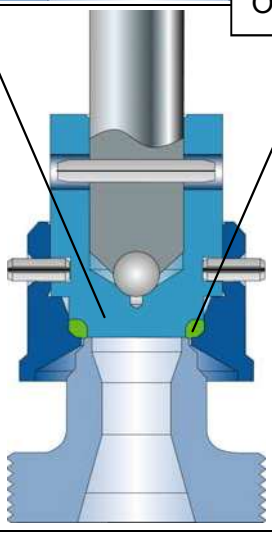
	Metal to metal seat	Soft seat – o-ring disc
Flanged valves (type 526)		
Threaded valves (type 459)		

Table 3: soft seat and metal to metal seat constructions of flanged and threaded valves

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1.3.2 Spring

The closing force on the disc is applied by the compression of the spring. When the valve opens, a further compression of the spring must be achieved by the opening forces underneath the disc. The correct spring rate is critical to overpressure and blowdown of the valve. Each spring has a defined set pressure range. The spring charts (chapter 6: spring charts) of the manufacturer must be followed when readjusting or changing the set pressure of the safety valve.
The following table lists the potential consequences of using a spring for a set pressure outside of its range.

Condition	Consequences
Set pressure above spring range	- increased blowdown - risk of excessive spring compression with coils approaching each other, resulting in restricted lift - pressure accumulation in the vessel above acceptable levels due to restricted lift
Set pressure below spring range	- increased overpressure - potential pressure accumulation in the vessel above acceptable levels

Table 4: Influence of incorrect set pressure on overpressure and blowdown

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1.3.3 Adjusting Ring

Codes and standards specify limits for the overpressure and blowdown of safety valves. In some designs adjusting rings are used to adjust the overpressure and blowdown of the safety valve in order to meet the requirements of codes and standards. In many of them a 10% accumulation pressure is used as a basis for the design strength calculation of a pressure vessel. Therefore the overpressure for safety valves is limited to 10% of the set pressure for the majority of the applications.

The position of these rings is usually factory set to meet overpressure and blowdown requirements of the applicable codes. The position of the rings can be adjusted to fine tune overpressure and blowdown of the valve.
For the most common design with one lower adjusting ring, changing the ring position has the following effects:

Lowering ring:	overpressure increases, blowdown decreases
Rising ring:	overpressure decreases, blowdown increases

The adjusting ring in LESER's type 526 should be turned to the lowest possible position on the nozzle to ensure all code requirements are met. No further ring adjustment depending on set pressure or medium is required.
The benefit for the user is the easier maintenance, because no complicated ring adjustment is necessary.

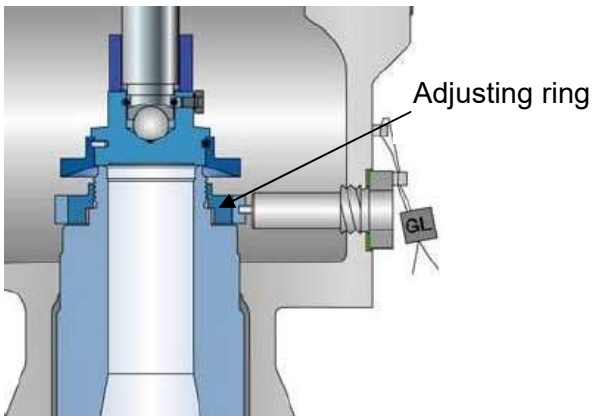

Figure 2: Blowdown ring of LESER's Type 526

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1.3.4 Parts Providing Alignment

Correct alignment of nozzle and disc are critical for proper valve operation and tightness. Disc and spindle of the valve will move up and down during valve operation.

Proper guiding of the spindle is essential for trouble free valve performance. The spindle is guided by the guide and the adjusting screw.

When installed, the user must ensure that no dust, particles in the fluid or sticky media may enter the guiding surfaces and negatively influence the valve performance. In some cases the use of a bellows is advisable to protect the guiding parts.

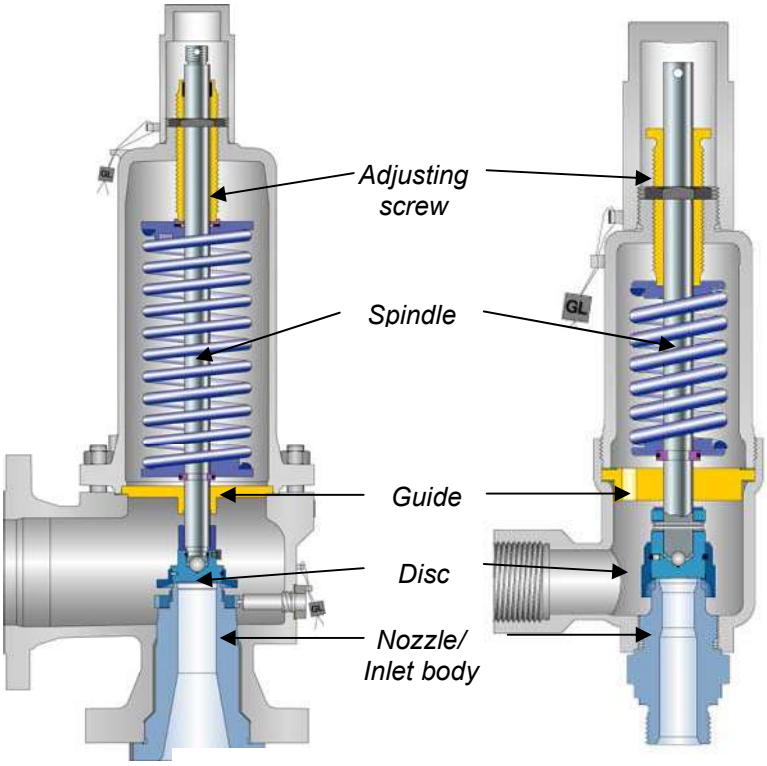

Figure 3: overview of parts providing alignment

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1.4 Lifting devices

The standard design for the valve top is a plain cap, covering and sealing the adjustment of the safety valve.
Lifting levers allow users to check if the safety valve is still operational by lifting the disc off the seat. The valve remains in place while testing is performed.
Lifting levers must allow users to lift the disc off the seat when 75% of the set pressure is present at the valve inlet.
Caps and levers are sealed to prevent any unauthorized modification of the set pressure.
Figure 4 offers different caps and lever used for different LESER safety valves.

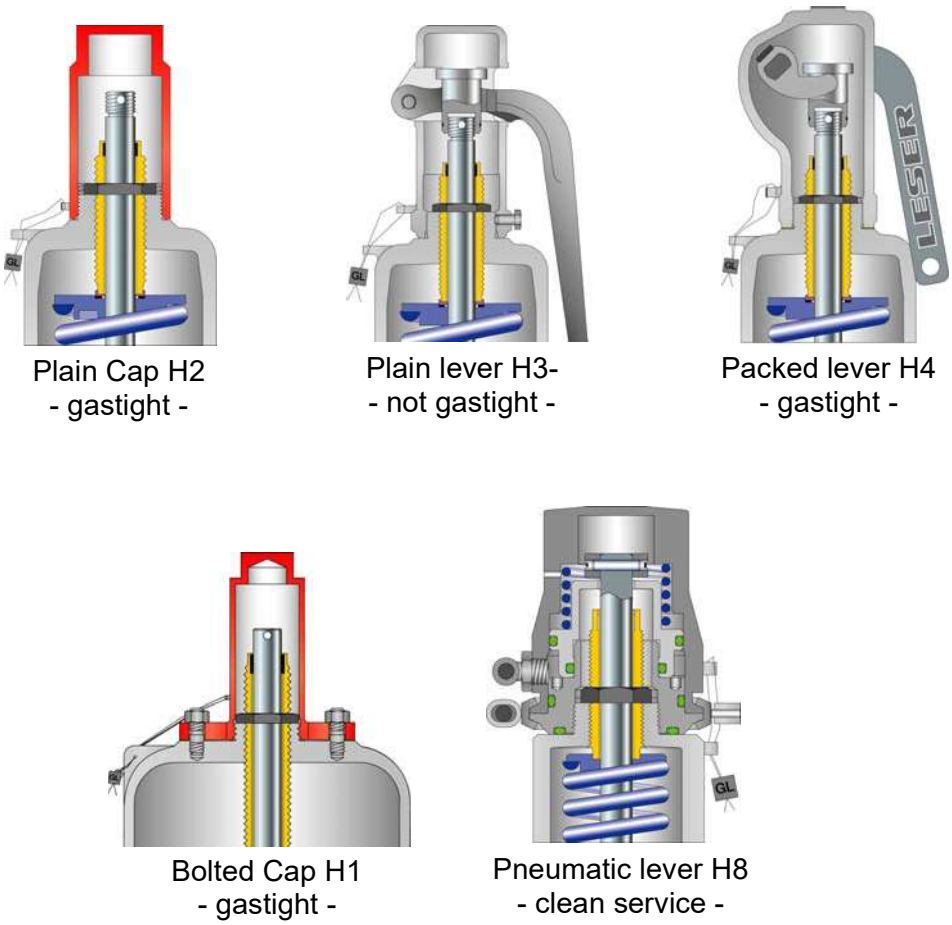

Figure 4: overview of different cap and levers

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4 Safety valve to repair 2

1 Purpose

This LESER Global Standard (LGS) shows the process for safety valves to repair.

2 Scope

This LGS applies to all members of the LESER Quality Cluster.

3 Introduction

The following flow chart shows the process steps, which are necessary for valve repair.

The right side give references to forms of inspection documentation, LESER standards, instructions and spare part lists.

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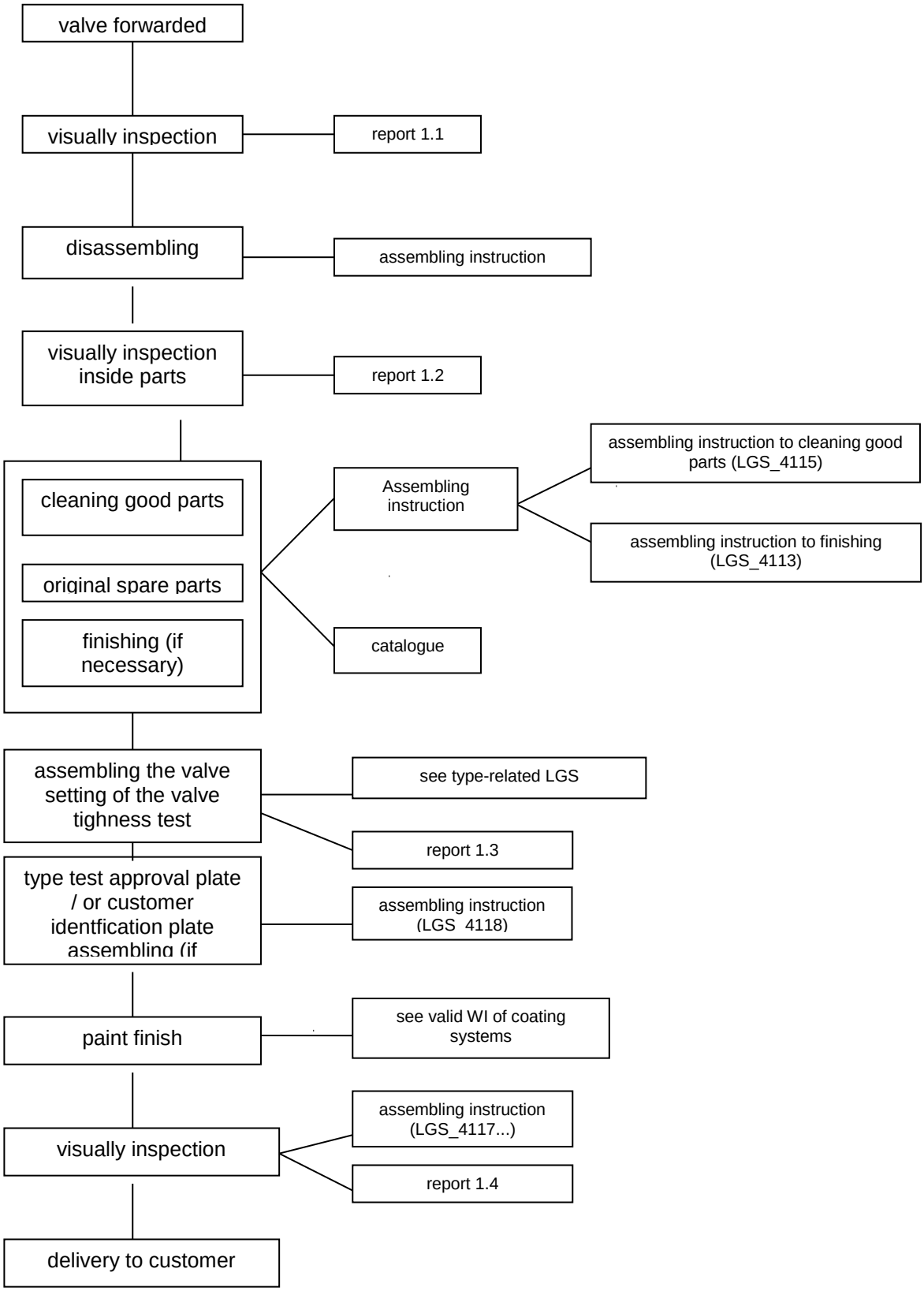
4 Safety valve to repair



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Repair Traveller

Customer			
Date		Valve type	
Serial no. / Job no.		Medium	

1.1 Forwarded Inspection

	Repair necessary	Remarks
Painting	☐	_____
Inlet / outlet surface	☐	_____
Lead seal	☐	_____
Type test approval plate	☐	_____

1.2 Disassembling

	Repair necessary	Remarks
Spring	☐	_____
Spring plate	☐	_____
Disc	☐	_____
Spindle	☐	_____
Guide	☐	_____
Spindle cap	☐	_____
Lifting device	☐	_____

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	Repair necessary	Remarks
Seat / full nozzle	☐	_____
Bellows	☐	_____

1.3 Assembling Inspection

Set pressure psig	target:	actual:
Seat tightness bubbles / min.	target:	actual:

	i.o.	n.i.o.
Backpressure / 6 psig	☐	☐

1.4 Delivery inspection

	i.o.	n.i.o.
Type test approval plate	☐	☐
Painting	☐	☐
Components	☐	☐

_____
Date/Signature

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Content

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1 Purpose

This LESER Global (LGS) describes the Took KIT requirements for equipping an agency or a warehouse for goods receiving/storage, adjusting, testing and shipping of safety valves.

2 Scope

This LGS applies to all members of the LESER quality cluster as defined in the global quality management manual.

3 Introduction

- The API Additional Tool KIT is an assembly of tools required for work on safety valves of the API 526 series shown in section 5 in addition to the Standard Tool KIT.

Order number	**0161.0004**
Internet	**www.sales@leser.com**

4 Designated use

- Assembly of safety valves
- Disassembly of safety valves
- Adjusting the set pressure of safety valves

5 Components of the API Additional Tool KIT

All tools found in this LWN are part of the Standard API Additional Tool KIT. The following pages specify the individual tools through descriptions and by giving practical examples. The technical illustrations show what the respective tools look like.

5.1 Double-ended open spanner with unequal widths across flats

The double-ended open spanner is used for tightening or unscrewing bolts and nuts.

Designated use

- tool for tightening or unscrewing bolts and nuts such as caps, levers, and inflow devices, for example
- screw connection of a variety of nuts and bolts on the safety valve (e.g. drainage screws).

Fig. 1 Unscrewing a screw connection

Fig. 2 Dealing the drain hole

Technical requirements

Requirements / Quality	Data
Width across flats in mm	36 x 41
Manufacturer	GEDORE
Material	Chrome-vanadium-steel
Design	chrome-plated, matt
Jaw position	15°
Length	360 mm
Vendor	Hahn & Kolb
External order number	52012-410
LESER order number	596.0093.0000

Technical illustration

Illustration 1: Double-ended open spanner

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Tool kit number	0161.0004
Internet	www.hahn-kolb.de

protected

5.2 Hook spanner

The hook spanner is considered to be an assembly tool specifically for nozzles.

Designated purpose of the hook spanner

- assembly of nozzles
- assembly of the safety valve on an apparatus

Fig. 3 Installing the nozzle

Fig. 4 Installing the snap ring

Technical requirements

Requirements / Quality	Data	Data
Width across flats in mm	52x55	68x75

Technical illustration

Manufacturer	GEDORE	
Material	Chrome-vanadium-steel	
Design	chrome-plated	
Length	206 mm	240 mm
Vendor	Hahn & Kolb	
External order number	52100-080	52100-100
LESER order number		
Tool kit number	0161.0004	
Internet	www.hahn-kolb.de	

protected

Requirements / Quality	Data	Data	Data	Data	Data
Width across flats in mm	80x90	95x100	120x130	135x145	155x165
Manufacturer	GEDORE				
Material	Chrome-Vanadium-Steel				
Design	chrome-plated				
Length	280 mm	280 mm	335 mm	385 mm	385 mm
Vendor	Hahn & Kolb				
External order number	52100-110	52100-120	52100-140	52100-150	52100-160
LESER order number					
Tool kit number	0161.0004				
Internet	www.hahn-kolb.de				

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Requirements / Quality	Data	Data	Data	Data
Width across flats in mm	180x195	205x220	230x245	260x270
Manufacturer	GEDORE			
Material	Chrome-Vanadium-Steel			
Design	chrome-plated			
Length	470 mm	470 mm	568 mm	568 mm
Vendor	Hahn & Kolb			
External order number	52100-170	52100-180	52100-190	52100-200
LESER order number				
Tool kit number	0161.0004			
Internet	www.hahn-kolb.de			

Content

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4 Components of the Standard Tool KIT 2

1 Purpose

This LESER Global (LGS) describes the recommended Took KIT requirements for equipping an agency or a warehouse for goods receiving/storage, adjusting, testing and shipping of safety valves.

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2 Scope

This LGS applies to all members of the LESER quality cluster as defined in the global quality management manual.

3 Introduction

- The Tool KIT is an important part of the equipment of an assembly workplace. It is required for the different work listed for most series of safety valves.

Order number	**0161.0000**
Internet	**www.sales@leser.com**

3.1 Designated use

- Assembly of safety valves
- Disassembly of safety valves
- Adjusting the set pressure of safety valves
- Lapping the valve seat
- Repair work

4 Components of the Standard Tool KIT

- All tools found in this LWN are part of the Standard Tool KIT. The following pages specify the individual tools through descriptions and by giving practical examples. The technical illustrations show how the respective tools look.

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4.1 Double-ended open spanner with unequal widths across flats

The double-ended open spanner is used for tightening or unscrewing bolts and nuts.

Designated use

- Tool for tightening or unscrewing bolts and nuts such as caps, levers, and inflow devices

Fig. 1 Unscrewing a screw connection

Fig. 2 Sealing the drain hole

Technical requirements (1)

Requirements / Quality	Data	Data	Data
DIN		3110	
Spanner width in mm	16 x 18	17 x 19	22 x 24
Length	205 mm	222 mm	250 mm
Manufacturer		GEDORE	
Material		Chrome-vanadium-steel	
Vendor		Hahn & Kolb	
External order number	52012-222	52012-230	52012-290

Technical illustration

Fig. 1: Double-ended open spanner

LESER order number	596.0058.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical requirements (2)

Requirements / Quality	Data	Data	Data
DIN		3110	
Spanner width in mm	27 x 32	41 x 46	50 x 55
Manufacturer		GEDORE	
Material		Chrome-vanadium-steel	
Length	302 mm	400 mm	460 mm
Vendor		Hahn & Kolb	
External order number	52012-370	52012-420	52008-370
LESER order number	596.0061.000	596.0062.000	596.0063.000
Tool kit number		0161.0000	
Internet		www.hahn-kolb.de	

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4.2 Single-ended open spanner

Single-ended open spanners are required for tightening or unscrewing the lever and cap.

Designated use

- lever and cap screw connections

Fig. 3 Installation of the lever and cap

Technical requirements

Requirements / Quality	Data	Data
DIN	894	
Spanner width in mm	41	60
Manufacturer	ORION	
Material	Special steel	
Length	345 mm	495 mm
Head thickness	14 mm	18 mm
Vendor	Hahn & Kolb	
External order number	52002-041	52002-060
LESER order number	596.0063.0000	596.0030.0000
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 2: Single-ended open spanner

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4.3 Flat-tip and Phillips PH screwdrivers

The screw driver is required for a variety of auxiliary work such as, for example, to remove jammed workpieces or to insert an O-ring.

Designated use

- screwing in of locking screws (H4 lever)
- insert O-rings (type 462)
- remove jammed workpieces

Fig. 3 Lifting the protective cap

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Technical requirements

Requirements / Quality	Data	Data	Data	Data
DIN		5265A		
Edge width mm	3.5	4.5	5.5	6.5
Edge thickness mm	0.6	0.8	1.0	1.2
Shaft length mm	100	125	150	150
Total length mm	204	236	261	268
Vendor		Hahn & Kolb		
External order number	52736-120	52736-135	52736-141	52736-150
LESER order number		596.0039.0000		
Tool kit number		0161.0000		
Internet		www.hahn-kolb.de		

Technical illustration

Illustration 3: Flat-head/Phillips screwdriver

4.4 Combination pliers

The combination pliers are required as an auxiliary tool for various work. For example, it can be used to cut soft and hard wire. The long cutting edges are suitable for thick cable.

Designated use

- removal of sealing wire

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Technical requirements

Requirements / Quality	Data
DIN ISO	5746
Length	180 mm
Largest Ø that can be cut	3.4 mm
Cutting edges	Induction-hardened 60 HRC
Vendor	Hahn & Kolb
External order number	52279-130
LESER order number	596.0064.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 4: Combination pliers

4.5 Pin punch

The pin punch is required for the assembly and disassembly of discs and spindles. The pins are driven in and out by means of a pin punch.

Designated use

- driving pins in and out
- fixing the spindle in place, when adjusting the set pressure

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Technical requirements

Requirements / Quality	Data
DIN	6450 C
Tips – Ø mm	3 / 4 / 5 / 6 / 7 / 8
Length x thickness mm	150 x 10/ 150 x 10/ 150 x 10/ 150 x 10/ 150 x 12/ 150 x 12
Punch head	Hardened and tempered
Delivery	In holder with base
Vendor	Hahn & Kolb
External order number	51284-500
LESER order number	596.0065.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 5: Combination pliers

4.6 Hammer

The hammer is used for marking flanges and bodies and for fastening individual parts like, for example, discs and spindles.

Designated use

- hammering in punch numbers
- fastening of discs and spindles
- hammering in pins

protected

Technical requirements

Requirements / Quality	Data	Data
DIN	1041	
Weight without handle	200	800
Manufacturer	ORION	
External order number	51180-510	51180-560
LESER order number	596.0066.0000	596.0067.0000
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 6: Hammer

4.7 Punch numbers

Punch numbers are required for a variety or marking work. At the request of the customer, the safety valve must also be marked on the edge of the flange or on the body with the set pressure or tag.

Designated use

- marking flanges and bodies

Technical requirements

Requirements / Quality	Data	Data
DIN	1451	
Type of characters	Numbers	
Character height	0.2 mm	0.6 mm
Characters	0 - 9	0 - 9
Number of punches	9	
Max workpiece strength	1200 Nm²	1200 Nm²
Hardness on end of punch	58 – 60 HRC	58 – 60 HRC
Vendor	Hahn & Kolb	
External order number	56930-020	56930-060
LESER order number	596.0068.0000	596.0069.0000
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 7: Punch numbers

protected

4.8 Punch letters

Punch letters are required for a variety or marking work. At the request of the customer, the safety valve must also be marked on the edge of the flange or on the body with the set pressure or tag or name.

Designated use

- marking flanges and bodies

Technical requirements

Requirements / Quality	Data	Data
DIN	1451	
Type of characters	Letters	
Character height	0.2 mm	0.6 mm
Characters	A - Z - &	
Number of punches	27	
Max workpiece strength	1200 Nm²	1200 Nm²
Hardness on end of punch	58 – 60 HRC	58 – 60 HRC
Vendor	Hahn & Kolb	
External order number	56932-020	56932-060
LESER order number	596.0070.0000	596.0071.0000
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 8: Punch letters

protected

4.9 Brush set

The brush set consists of brushes of different sizes.

Designated use

- repair of paint damage
- application of lubricants

Technical requirements

Requirements / Quality		Data
Flat brush	1 each	20 / 25 / 35 / 50 mm
Ring brush	1 each	Size 2 / 4 / 6
Enamel paintbrush		Size 10 / 12 / 16
Vendor		Hahn & Kolb
External order number		56932-005
LESER order number		596.0072.0000
Tool kit number		0161.0000
Internet		www.hahn-kolb.de

Technical illustration

Illustration 9: Brush set

protected

4.10 Sliding vernier calliper

Basically, the sliding vernier calliper is used to measure components, for example stroke limits. The set pressure for several identical safety valves can be roughly adjusted with the sliding vernier calliper.

Designated use

- pressure setting
- measuring stroke limits
- measuring components

protected

Technical requirements

Requirements / Quality	Data
DIN	862
Application	outside, inside, step and depth measurements
Material	INOX steel
Measuring span	150 mm
Measuring jaw length	40 mm
Length of the vernier	15.5 mm
Manufacturer	ATRON
Vendor	Hahn & Kolb
External order number	31065-110
LESER order number	596.0074.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 10: Sliding vernier calliper

4.11 Sealing pliers

Sealing pliers are required for sealing the bonnet and the body after setting the pressure of the safety valve.

Designated use

- sealing bonnets and bodies

protected

Technical requirements

Requirements / Quality	Data
Length	150 mm
Seal Ø	9 mm
Colour	Blue
Vendor	Hahn & Kolb
External order number	53205-145
LESER order number	596.0053.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 11: Sealing pliers

4.12 V-Block

When assembling the disc and spindle, there is a risk of damaging the spindle or disc by incorrect loading. To prevent this, the V-block is used as an underlay or to fix the round components in place.

Designated use

- assembly of discs and spindles
- offloading the spindle

protected

Technical requirements

Requirements / Quality	Data	Data
Name	Small V-block	Large V-block
Weight	0.93 kg	0.90 kg
Material	Steel	
Vendor	LESER	
LESER order number	445.0759.0000	445.0859.0000
Tool kit number	0161.0000	
Internet	www.sales@leser.com	

Technical illustration

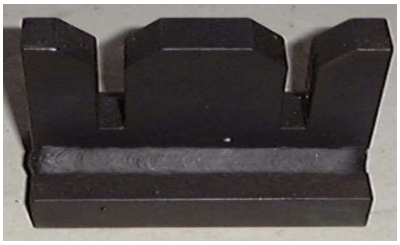


Illustration 19: V-block

4.13 Ratchet box

Besides the “ratchet”, the ratchet box contains two different extenders and a number of different sized sockets.

Designated use

- assembly and disassembly work on safety valves
- various screwing work

Technical requirements

Requirements / Quality	Data
Sockets	Hexagonal 13 sockets, 4 drive handles
Widths across flats	10, 11, 12, 13, 14, 15, 17, 19, 22, 24, 27, 30, 32
T handle	1x
Universal joint	1x
Reversible ratchet	1x
Box outside dimensions	410 x 216 x 65 mm
Vendor	Hahn & Kolb
External order number	58584-025
LESER order number	596.0076.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 20: Ratchet box

protected

4.14 Torque wrench

A defined torque must be applied for screw connections on safety valves (for example for connecting the bonnet and the body). The torque wrench is required for this.
Due to the accessibility of the connection with open-end spanners, such an attachment is recommended.

Designated use

- screw connections of bonnets and bodies
- use with bolt size 9 / 12 mm or alternatively 14 / 18 mm

protected

Technical requirements

Requirements / Quality	Data	Data
Measurement range	20 – 100 Nm	80 – 400 Nm
Scale division value	1 Nm	2 Nm
Ø of seat for heads	9 x 12 mm	14 x 18 mm
Jaw size(s)	19 / 24	19 / 24
Length	400 mm	607 mm
Margin of error	+- 2 % of set value	+- 3 % of set value
Torque application	left / right	
Vendor	Hahn & Kolb	
External order number	52264-010	52264-040
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 21: Torque wrench

4.15 Jaw attachments

Jaw attachments for the torque wrench are required, for example, for connecting the bonnet to the body.
The jaw attachments are used together with the torque wrench (see 6.14).

Designated use

- screw connections of bonnets and bodies
- bolt size 19 / 24 mm

Technical requirements

Requirements / Quality	Data	Data
Spanner width	19 mm	24 mm
Width	41 mm	51 mm
Height	9 mm	11 mm
Plug-in shaft	14 x 18 mm	14 x 18 mm
Vendor	Hahn & Kolb	
External order number	52286-119	52286-124
External order LESER	596.0078.0000	596.0079.0000
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 22: Jaw attachment

protected

4.16 Plug-in reversible ratchet

Plug-in reversible ratchets are required, for example, for connecting the bonnet to the body. The plug-in reversible ratchets are used together with the torque wrench (see 6.14).

Designated use

- screw connections of bonnets and bodies
- to hold the socket (see 6.18)

protected

Technical requirements

Requirements / Quality	Data
Cross-section of the plug-in shaft	14x18 mm
Square drive	Square 12.5 = 1/2 Inch
Vendor	Hahn & Kolb
External order number	52286-655
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 23: Plug-in reversible ratchet

4.17 Plug-in adapter

The plug-in adapter is required as a connecting piece for the torque wrench (see 6.14) and the plug-in reversible ratchet (see 6.16). It makes it possible to connect the two tools.

Designated use

- holder of the plug-in reversible ratchet (see 6.16) or the jaw attachments (see 6.14)
- screw connections of bonnets and bodies

Figure 4.1

protected

Technical requirements

Requirements / Quality	Data
Plug connection	9 x 12 mm
Drive	Square
Step-up	9 x 12 mm to 14x18
Vendor	Hahn & Kolb
External order number	52286-655
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 24: Plug-in adapter

4.18 Socket

The socket is used together with the torque wrench (see 6.14) and the plug-in reversible ratchet (see 6.16). It is used, for example, for the screw connection of the bonnet to the body.

Designated use

- screw connections of bonnets and bodies

protected

Technical requirements

Requirements / Quality	Data
DIN	3120
Width across flats	36 mm
Size	Ø 60/49.5 mm
Material	31 Cr V 3
Vendor	Hahn & Kolb
External order number	58596-360
LESER order number	596.0082.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 25:Socket

4.19 Wire brush

The wire brush made of stainless steel is used on grey cast iron and stainless steel safety valves. Any surface rust can be easily removed with the wire brush.

Designated use

- removal of surface rust
- removal of soiling

Technical requirements

Requirements / Quality	**Data**	**Data**
Wire material	Stainless steel	Steel
Total length	290 mm	290 mm
Width	35 mm	35 mm
Length of wire brushes	25 mm	25 mm
Wire Ø	0.3 mm	0.3 mm
Vendor	Hahn & Kolb	
External order number	56726-530	56725-530
LESER order number	596.0083.0000	
Tool kit number	0161.0000	
Internet	www.hahn-kolb.de	

Technical illustration

Illustration 26: Wire brush

protected

4.20 Safety glasses

The safety glasses are used to protect your eyes. They must be worn during grinding work on safety valves.

Designated use

- general safety of the eyes
- to be worn during grinding work on the safety valve

protected

Technical requirements

Requirements / Quality	Data
DIN EN	166 F
Manufacturer	ARTILUX
Design	with side guards
Vendor	Hahn & Kolb
External order number	55660-100
LESER order number	596.0085.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 27:Safety glasses

4.21 Wire twisting pliers

The wire twisting pliers are required for sealing the bonnet and body. This secures the pressure setting of the safety valve. The sealing wire is twisted and tightened by the pliers.

Designated use

- twisting the sealing wire
- sealing bonnets and bodies

protected

Technical requirements

Requirements / Quality	Data
DIN	5256
Manufacturer	STAHLWILLE
Weight	0.330 kg
Length	230 mm
Vendor	Hahn & Kolb
External order number	53137-010
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 27:Wire twisting pliers

4.22 Sealing blocks

The sealing blocks are used to seal the cap / lever and thus certify the set pressure that has been set.

Designated use

- sealing safety valves

Technical requirements

Requirements / Quality	Data
Size L x H x D	9 x 9 x 5 mm
Hole □	1.5 mm
Material	Plastic
Temp. application limit	+ 85° C
Vendor	Johan Pützfeld B.V.
LESER order number	525.0107.0000
Tool kit number	0161.0000
Internet	www.skiffy.com

Technical illustration

Illustration 29:Sealing blocks

protected

4.23 Sealing wire

After adjusting the set pressure on the safety valve, LESER must guarantee that the pressure cannot be changed without being noticed. For this measure, LESER seals the lever/cap to the bonnet. Sealing wire is used to connect these components.

Designated use

- sealing the bonnet and the lever/cap

protected

Technical requirements

Requirements / Quality	Data
Wire material	Galvanised iron wire
Delivered as	On a roll
Wire gauge	0.3 – 0.5 mm
Quantity	1 kg
For sealing	Lead 9, 12 mm
Vendor	Hahn & Kolb
External order number	53212-010
LESER order number	525.0208.0000
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration 30: Sealing wire

4.24 Pipe for large spanner

The pipe for the large spanner is an extension of the spanner. It is used to extend the lever arm when assembling the lever and makes it possible to apply high torque in order to securely connect the bonnet to the lever.

Designated use

- lever and bonnet connections

protected

Technical requirements

Requirements / Quality	Data
Code	EG Class III
Diameter	50 mm
Length	1500 mm
Rod gauge	0.3 – 0.5 mm
Quantity	1 kg
For sealing	Lead 9, 12 mm
Vendor	LESER
LESER order number	596.0097.0000
Tool kit number	0161.0000
Internet	www.sales@leser.com

Technical illustration

Illustration 24: Pipe for large spanner

4.25 Folding rule

A folding rule is required for any measuring work.

Designated use

- measuring the outside dimensions of packaging

Technical requirements

Requirements / Quality	Data
Length	2 m
Material	Wood
Width of sections	16 mm
EC class	III
Vendor	Hahn & Kolb
External order number	37332-005
LESER order number	TB D
Tool kit number	0161.0000
Internet	www.hahn-kolb.de

Technical illustration

Illustration. 32: Folding rule

protected

4.26 Glass plate

For the finishing of the seat and disc, LESER offers lapping stamps, glass plates and lapping material.
The seat and disc with the integrally attached lifting aid and with the same do are lapped with the lapping stamp or glass plate of the same size. Discs with a detachable lifting aid or generally without a lifting aid are **not** lapped with a lapping stamp, but are lapped on a glass plate after disassembling the lifting aid.

Designated use

- re-lapping discs

protected

Technical requirements

Requirements / Quality	Data
LWN	001.32
Ø	140 mm
Vendor	LESER
LESER order number	828.0000.0016
Tool kit number	0161.0000
Internet	www.sales@leser.com

Technical illustration

Illustration 17:Glass plate

4.27 Lapping stamp

For the finishing of the seat and disc, LESER offers lapping stamps, glass plates and lapping material.
The seat and disc with the integrally attached lifting aid and with the same do are lapped with the lapping stamp of the same size.

Designated use

- relapping seats and nozzles

Technical illustration

Technical requirements (1)

Requirements / Quality	Data	Data	Data
Number	3	4	5
do	18	23	29
Material	0.6025 / 1.4021	0.6025 / 1.4021	0.6025 / 1.4021
Manufacturer	LESER		
Length	205 mm	222 mm	250 mm
LESER order number	445.1359.0000	445.1459.0000	445.1559.0000
Tool kit number	0161.0000		
Internet	www.sales@leser.com		

protected

Technical requirements (2)

Requirements / Quality	**Data**	**Data**	**Data**	**Data**
Number	6	7	8	9
do	37	46	60	74
Material	0.6025 / 1.4021	0.6025 / 1.4021	0.6025 / 1.4021	0.6025 / 1.4021
Manufacturer	LESER			
Length	172 mm	205 mm	222 mm	250 mm
LESER order number	445.1659.0000	445.1759.0000	445.1859.0000	445.1959.0000
Tool kit number	0161.0000			
Internet	www.sales@leser.com			

Requirements / Quality	**Data**	**Data**	**Data**	**Data**
Number	10	12	13	14
do	92	125	165	200
Material	0.6025 / 1.4021	0.6025 / 1.4021	0.6025 / 1.4021	0.6025 / 1.4021
Manufacturer	LESER			
Length	172 mm	205 mm	222 mm	250 mm
LESER order number	445.2059.0000	445.2259.0000	445.2359.0000	445.2459.0000
Tool kit number	0161.0000			
Internet	www.sales@leser.com			

protected

4.28 Lapping pastes

As a lapping paste, LESER uses ready-to-use, water-soluble lapping pastes with different grit size depending on the damage to the sealing surface.

Designated use

- lapping discs

Technical requirements

Requirements / Quality	Data	Data	Data	Data
LWN	001.32	001.32	001.32	001.32
Name	TETRABOR			
Identifier	F 320	F 600	F 800	F 1200
Grit size in µ	49 – 17	19 – 3	14 – 2	7 – 1
Packaging	Tube			
Contents	75 ml			
Vendor	Artur Glöckler GmbH			
LESER order number	599.0301.0000	599.0401.0000	599.0101.0000	599.0201.0000
Tool kit number	0161.0000			
Internet	http://www.gloeckler.com			

Technical illustration

Illustration 15: Lapping paste

protected

4.29 Monocrystalline diamond powder

Monocrystalline diamond powder is mixed with an oil solution to the desired consistency and then applied selectively.
The workpiece is re-lapped through uniform movements on the nozzle or on a glass plate.

Designated use

- re-lapping seats and discs

protected

Technical requirements

Requirements / Quality	Data
DIN	001.32
Grit size	1.5 – 3 µ
Package size	50 g
Vendor	Peter Wolters
LESER order number	599.0102.0000
Tool kit number	0161.0000
Internet	www.peter-wolters.com

Technical illustration

Illustration 16:
Monocrystalline diamond powder

4.30 Assembly grease for threads

The assembly grease is used for greasing the adjusting screw. It makes it possible to easily screw the adjusting screw into the bonnet.

Designated use

- greasing the adjusting screw
- greasing components for improved ease of access
- protection against fretting and corrosion

protected

Technical requirements

Requirements / Quality	Data
Name	Molikote
Qualities	- non-combustible - non-corrosive
Packaging	Can
Weight	1 Kg
Internet	www.molykote.com

Technical illustration

Illustration 12: Molikote

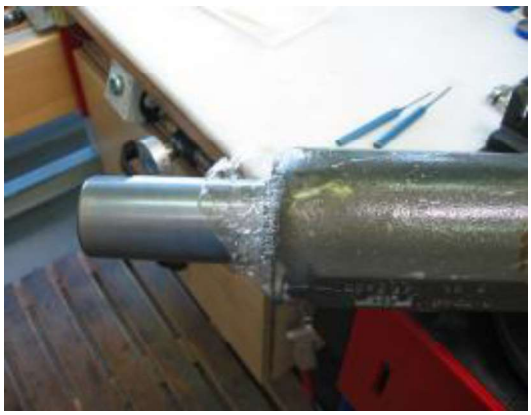
4.31 Leak detection spray

The required body seal tightness is checked by means of a leak detection spray. The leak is located based on bubble formation after applying the leak detection spray to the valve contour. In addition, it can also be used to visualise leaks in the manometer screw connections.

protected

Designated use

- external leak testing of the safety valve
- functional leak testing
- testing the seal tightness of manometer screw connections



Technical requirements

Requirements / Quality	Data
Name	Güpoflex
Application	Gas and compressed air
Qualities	- non-combustible - non-corrosive - toxicologically safe
Package size	500 ml spray can
Packaging unit	10 cans
Vendor	GÜPO
LESER order number	596.0094.0000
Tool kit number	0161.0000

Technical illustration

Illustration 13: Leak detection spray

Internet	www.guepo.de

4.32 LESER paint, blue

Damaged or scratched valve contours must be repaired by LESER blue paint.

Designated use

- repair of damaged valve contours
- repair of scratched valve contours

protected

Technical requirements

Requirements / Quality	Data
Name	LESER paint, blue
Colour	RAL 5005
Application	Valve body
Package size	500 ml can
Packaging unit	1 can
Vendor	LESER
LESER order number	596.0096.0000
Tool kit number	0161.0000
Internet	www.bfl.dk

Technical illustration

Illustration 14: LESER blue paint

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2 Scope 1
3 Disclaimer 1
4 Qualified fitting personnel 2
5 General Information 2
6 Operating materials and supplies 2

1 Purpose

This LESER Global Standard (LGS) provides a list of operating materials that are used during the assembly of LESER safety valves.

2 Scope

This document must be observed by all agencies and subsidiaries of LESER GmbH & Co. KG.

3 Disclaimer

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4 Qualified fitting personnel

The operating materials/supplies that are used during the installation of LESER safety valves must be used exclusively by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

5 General Information

Observe the safety regulations and warnings on the packaging.

6 Operating materials and supplies

Lapping paste - Tetrabor

Grit size 320
600
800
1200

Monocrystalline diamond powder - material number N145

Grit size 1.5 – 3 µm

Assembly grease

Molykotepaste – D Paste
Klübersynth UH1 14-151

Halocarbon oil

Oleic acid - PH. EUR 6.0 material number N-206

Superglue

Delo-Ca
Delo-ML 5449 anaerobic high temperature resistant

Leak detection spray

protected

Güpoflex for gas & compressed air

Quickleen – universal cleaner

Screw glue – LocTITE 222

protected

Type 526 API

protected

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protected

1 Purpose

This LESER Global Standard (LGS) describes the disassembly procedure for a LESER safety valve type 526 API.

2 Scope

This document must be applied to the dismantling an API safety valve in agencies and subsidiaries of LESER GmbH & Co. KG.

3 Disclaimer

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4 Qualified fitting personnel

LESER safety valves may only be dismantled by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

5 General Information

- Gloves must be worn during the entire dismantling process.

protected

6 General illustration

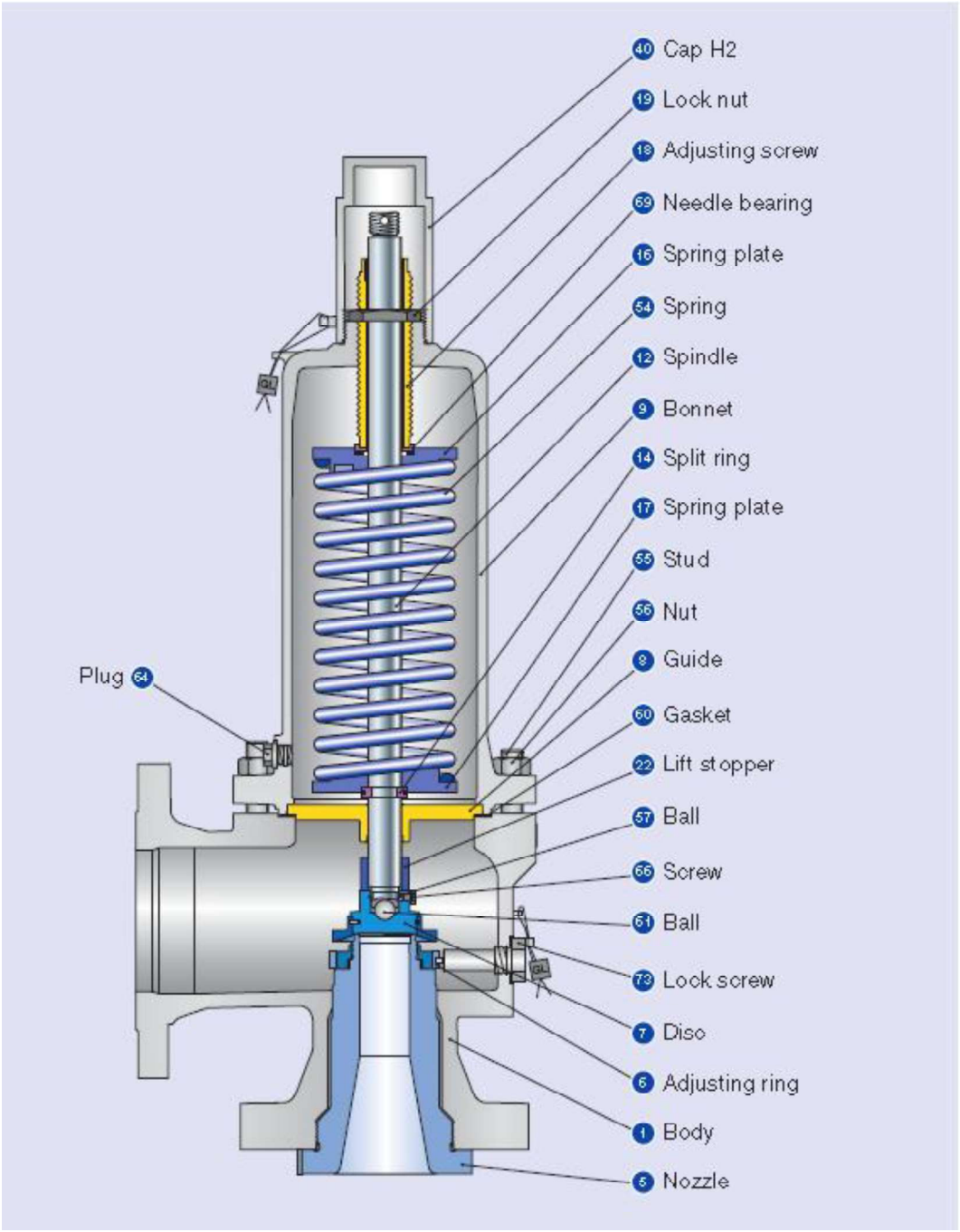


Figure 6-1: Cross-sectional view of type 526

protected

7 Dismantling type 526

7.1 Dismantling caps and lever

7.1.1 Dismantling cap H2

Illustrations	Description	Aids / Tools
Figure 7.1.1-1	Loosen cap with a spanner and screw off.	Open-end spanner

7.1.2 Dismantling lever H3

Illustrations	Description	Aids / Tools
Figure 7.1.2-1	Remove retaining washers	
Figure 7.1.2-2	Pull out the pin and lever.	

protected

Illustrations	Description	Aids / Tools
Figure 7.1.2-3	Loosen the clamping screw and screw the cap off.	Ring spanner
Figure 7.1.2-4	Completely unscrew the screw and remove the plastic ball.	
Figure 7.1.2-5	Remove retaining clip and pin. Pull spindle cap off the spindle.	

protected

7.1.3 Dismantling lever H4

Illustrations	Description	Aids / Tools
Figure 7.1.3-1	Loosen lever with open-end spanner and screw it off. Remove spacer rings.	Open-end spanner
	Remove the retaining clip and pin. Pull the spindle cap off the spindle.	

protected

Figure 7.1.3-2		

protected

7.2 Dismantling lift indicator

Illustrations	Description	Aids / Tools
Figure 7.2-1	Loosen the lock nut of the lift indicator Loosen first nut and screw out the lift indicator.	

7.3 Removing the test gag (possible for H2 and H4)

Illustrations	Description	Aids / Tools
Figure 7.3-1	Loosen and unscrew the screw. Remove sealing ring from the screw.	Open-end spanner

protected

7.4 Dismantling the O-ring damper

7.4.1 Dismantling O-ring damper H2

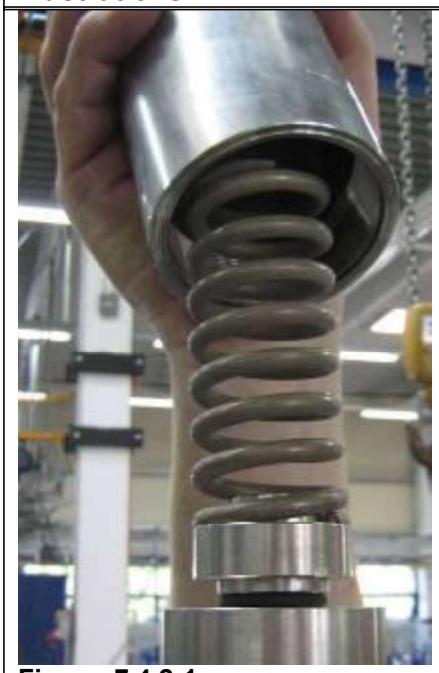
Illustrations	Description	Aids / Tools
Figure 7.4.1-1	Loosen the cap and unscrew it from the bonnet.	Open-end spanner
Figure 7.4.1-2	Remove the retaining spring from the opposite ring.	
Figure 7.4.1-3	Remove the opposite ring from the support sleeve (1)	

protected

Illustrations	Description	Aids / Tools
Figure 7.4.1-4	Pull O-ring off the spindle over the support sleeve (2).	
Figure 7.4.1-5	Remove the support sleeve from the spindle (3).	

protected

7.4.2 Dismantling O-ring damper H4

Illustrations	Description	Aids / Tools
 Figure 7.4.2-1	Loosen cap and screw it off.	
Figure 7.4.2-2	Remove spring, first O-ring, support sleeve, opposite ring and second O-ring from the spindle.	

protected

Illustrations	Description	Aids / Tools
Figure 7.4.2-3	Remove the retaining clip and pin. Pull the spindle cap off the spindle.	
Figure 7.4.2-4	Individual parts of the O-ring damper	

protected

7.5 Pressure spring and adjusting screw disassembly

Illustrations	Description	Aids / Tools
Figure 7.5-1	Remove lock nut from adjusting screw.	Open-end spanner
Figure 7.5-2	Secure the spindle from turning with a pin punch. Apply the open-end spanner in a clockwise direction until no more pressure can be felt from the spring.	Pin punch Open-end spanner
Figure 7.5-3	Screw adjusting screw out of the bonnet	

protected

Illustrations	Description	Aids / Tools
Figure 7.5-4	Unscrew the lock nut.	
Figure 7.5-5	Remove plastic bushing	

protected

7.6 Dismantling the bonnet

Illustrations	Description	Aids / Tools
Figure 7.6-1	Loosen the nuts and unscrew them from the studs. Lift the bonnet off the bolts.	Open-end spanner

7.7 Dismantling spindle/disc assembly

7.7.1 Removing the assembly (with stainless steel bellows)

Illustrations	Description	Aids / Tools
Figure 7.7.1-1	Pull the top spring plate and axial needle-bearing (if applicable) off the spindle. Remove the spring and bottom spring plate one after the other.	

protected

Illustrations	Description	Aids / Tools
Figure 7.7.1-2	Lift the spindle/disc/cooling zone/guide washer out of the body.	
Figure 7.7.1-3	Remove the retaining clip and half-washers from the spindle.	
Figure 7.7.1-4	Unscrew the clamping screw.	Ring spanner

protected

Illustrations	Description	Aids / Tools
Figure 7.7.1-5	Take the small balls out of the disc.	
Figure 7.7.1-6	Pull the cooling zone off the spindle. The spindle and bellows cannot be disassembled because they are glued together.	⚠

protected

7.7.2 Dismantling spindle/disc assembly (without bellows)

Illustrations	Description	Aids / Tools
Figure 7.7.2-1	Remove the top spring plate, spring and bottom spring plate from the spindle one after the other. Lift the spindle with the guide washer out of body.	
Figure 7.7.2-2	Remove the retaining clip and half-washers from the spindle. Pull the guide washer off the spindle.	
Figure 7.7.2-3	Remove the lift stopper from the spindle, if applicable.	

protected

Illustrations	Description	Aids / Tools
Figure 7.7.2-4	Loosen and unscrew the clamping screw. Shake out the small ball.	Ring spanner
Figure 7.7.2-5	Take the ball out of the disc.	

protected

7.8 Dismantling the disc assembly

7.8.1 Metallic seal

Illustrations	Description	Aids / Tools
Figure 7.8.1-1	Unscrew the retaining ring with the C-spanner.	Hook spanner
Figure 7.8.1-2	Remove lifting aid from disc body	

protected

7.8.2 O-ring seal

Illustrations	Description	Aids / Tools
Figure 7.8.2-1	Loosen nut and screw it off.	Open-end spanner
Figure 7.8.2-2	Disc with washer and O-ring	
Figure 7.8.2-3	Remove retainer and O-ring	
Figure 7.8.2-4	Individual parts of the disc assembly with O-ring	

protected

7.8.3 Disc disassembly with sealing plate

Illustrations	Description	Aids / Tools
Figure 7.8.3-1	Loosen nut and screw it off.	Open-end spanner
Figure 7.8.3-2	Remove the retainer from the sealing plate.	
Figure 7.8.3-3	Take the sealing plate out of the disc.	
Figure 7.8.3-4	Individual parts of the disc assembly with sealing plate	

protected

7.9 Unscrewing the locking screw and screw plug

Illustrations	Description	Aids / Tools
Figure 7.9-1	Loosen and remove the screw plug from the side of the body.	Open-end spanner
Figure 7.9-2	Loosen and remove the locking screw from the back part of the body.	Open-end spanner
Figure 7.9-3	Remove the spacer from each of the two screws.	

protected

7.10 Removing the studs from the body

Illustrations	Description	Aids / Tools
Figure 7.10-1	Remove studs with impact wrench. **Tip:** Place the guide washer on the opening of the body so that no studs can fall on the seat.	Impact wrench

protected

7.11 Dismantling the nozzle and blow down ring

Illustrations	Description	Aids / Tools
Figure 7.11-1	Completely unscrew the blow down ring from the nozzle.	
Figure 7.11-2	Remove nozzle with C-spanner (put a small protective slab between the nozzle and C-spanner).	Hook spanner
Figure 7.11-3	Unscrew nozzle from the body.	

protected

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1 Purpose

This LESER Global Standard (LGS) provides instructions on cleaning LESER safety valves. The required work steps and materials are described.

2 Scope

This document must be applied when cleaning safety valves in agencies and subsidiaries of LESER GmbH & Co. KG.

3 Disclaimer

LESER puts in a great deal of effort into making up-to-date and correct documentation available. Nevertheless, LESER GmbH & Co. KG gives no guarantee that the recommended actions presented here are entirely correct and error. This document is to be applied exclusively to the specified type. LESER GmbH & Co. KG declines any liability or responsibility for the correctness and completeness of the content.

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4 Qualified fitting personnel

LESER safety valves may only be cleaned by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

5 General Information

- Gloves must be worn during the entire cleaning process (except for stainless steel and painted valves).
- Wear safety glasses.

6 Cleaning repaired valves

6.1 Blast cleaning

Stainless steel valves - glass bead blast cleaning

Cast steel - sand or bead blast cleaning

The body and bonnet must be blasted from the **inside and outside** for as long as it takes to remove all residual paint, rust or other soiling.

Caution: Protect the seat sealing surface and working surfaces, otherwise they will be damaged.

Figure 6.1-1: Flange covering, plastic

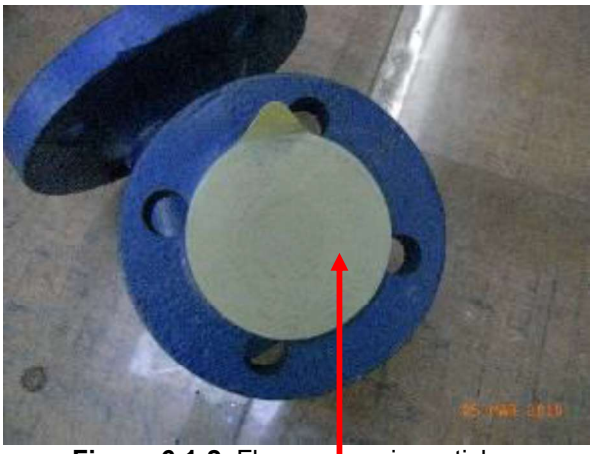

Figure 6.1-2: Flange covering, sticker

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6.2 Brushing

The inside parts and inside of the body and bonnet are to be cleaned with a wire-cup brush and drill / pneumatic grinder until they are clean - until all soiling is removed.

Caution: Protect the seat sealing surface and working surfaces, otherwise they will be damaged.

6.3 Washing

When washing, make sure that **all parts** that belong to **one repaired safety valve** are washed together. When filling the washing machine, make sure that the washing medium can flow out of the bodies, bonnets and caps / levers without any residue.

Figure 6.3-1

The bodies must **always** be placed on the lid section.

Figure 6.3-2

WRONG

Figure 6.3-3

RIGHT

protected

Note: Any waste that occurs when cleaning must be disposed of according to the applicable rules and regulations of the respective country.

7 Handling the components

Generally, the wearing of gloves when handling cleaned and unpainted components is compulsory.

Such components must never be touched at any time without protection.
This applies both to employees from the operating as well as administrative areas.

Figure 7-1

Wet gloves must be replaced with dry ones.

Damaged gloves that cannot exclude contact between the metal surface and skin must not be used.

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In particular
In particular, valves, especially the sealing surfaces on the flanges and also the interior areas, must not be touched **without** gloves, because these areas will not be protected even in later process steps by paint. Nor may spare parts be touched **without** gloves when unpainted and unpackaged.

7.1 Exceptions:

The requirement for gloves is removed in the following cases:

- assembly of Compact Performance valves (for process-related reasons)
- assembly of stainless steel valves (no danger of corrosion)

It is also mandatory to wear gloves in the initially mentioned cases when performing the order picking for spare parts.

7.2 Process overview

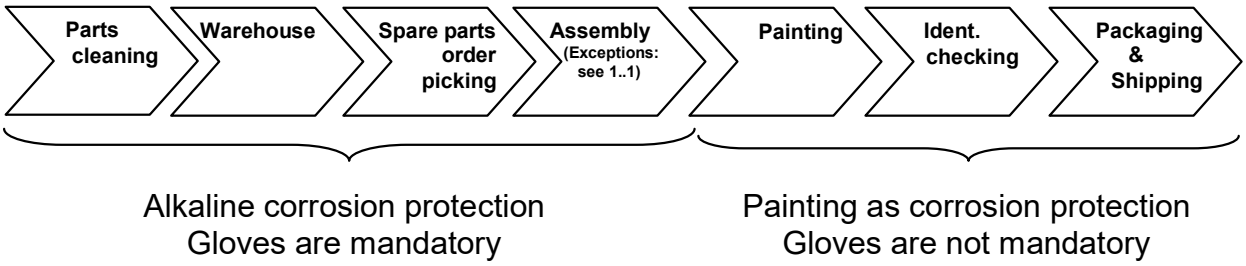

Figure 7.1-1

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1 Purpose

This LDeS gives information about the dimensions and the surface quality which have to be observed during the refinishing work, it also provides the work instructions. This LDeS replaces dimensional drawing no. 395 19 09.

2 Scope

This LDeS applies to the LESER sites Hamburg and Hohenwestedt. This LDeS is valid for:

- semi nozzles
- discs without lifting gear
- discs with removable lifting gear for screwed nozzles

3 References

None

4 Conditional Agreement

The further mentioned rules for the refinishing of seats and discs have been issued and explained in all conscience and describe the particular final design of the components.

LESER reserves the right to make necessary modifications at the components without determining these changes in this standard directly. So, if there are any doubts on user side when applying these rules, LESER has to be contacted before performance of rework to clarify the actual situation.

When applying these rules and regulations it has to be considered generally that they describe the refinishing at components which have an effect on the function and capacity of the safety valves. Even marginal deviations to this guidelines can effect a malfunction or constricted capacity of the safety valve and therewith an inadmissible pressure increase can arise during application/operation. This could possibly have serious consequences for humans and environment. Therefore it has to be proceed carefully when applying these rules.

LESER assumes no liability for safety devices which have been repaired or reworked in accordance with this LDeS. The repair shop is solely responsible for the function and capacity of the re-introduced safety device.

The user of this LDeS should be clear on the fact that the repair of a safety device against inadmissible overpressure is subjected to European and international laws. The violation of valid rules will be traced and avenged acc. to relevant legislations.

In case of any doubts during application of this LDeS, LESER has to be consulted before starting repair or rework of LESER safety devices.

protected

5 Introduction

If the sealing surfaces of seat and disc have been damaged by frequent setting, for example, or by impurities in the medium, the original sealing quality can be restored by refinishing of the sealing surfaces.

6 Execution

The refinishing by smooth turning and grinding with final lapping should be done on the seat and if necessary also on the disc with the least possible swarf. Please see the limiting values in the following tables.

6.1 Measures and facing profile

Tables 5.1, 6.1, 8.1, 9.1, 10.1, 11.1, 12.1, 13.1, 14.1, 15.1, 16.1 and 17.1, together with the corresponding illustrations, contain the linear and square dimensions which have to be observed. After processing of the seat surface it is also important that the seat profile is restored moderately using inner and outer chamfers. If necessary the contact surface

between the spindle guide and the body has to be refinished coplanar and concentric to the seat.

6.2 Surface quality

A surface quality to a mean roughness depth of Rz1 (Mirror Finish) must be achieved on both sealing surfaces through lapping.

6.3 Test

In a final test on the mounted valve, it has to be guaranteed that:

- The semi rings on the spindle must be off the guide when the valve is closed.
- The lower spring plate may not touch the guide when the spring is assembled.
- In lift restricted valves, the lift restriction must be checked and if necessary the lift restriction bushing extended.

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7 Refinishing of seat and disc for types 441 and 421, metal sealing

Work is to be done according to illustrations 5.1, 5.2 and 5.3 and according to table 5.1

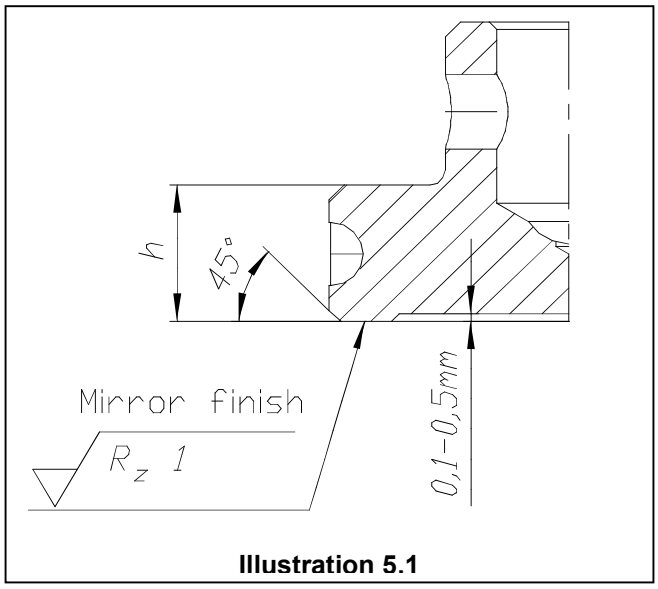

Illustration 5.1

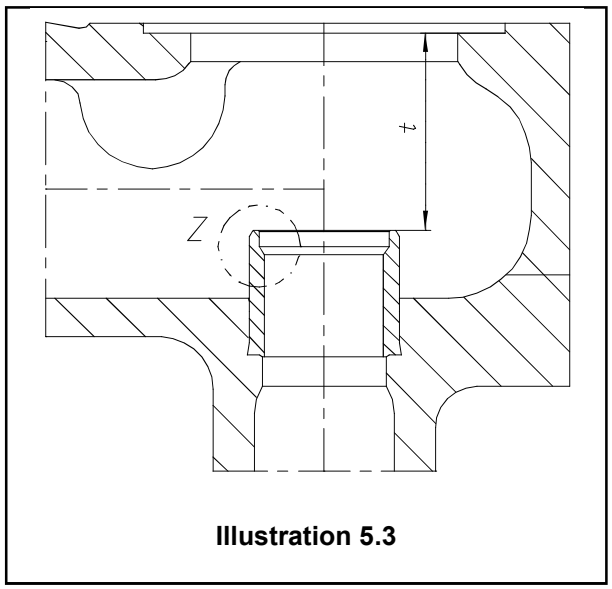

Illustration 5.3

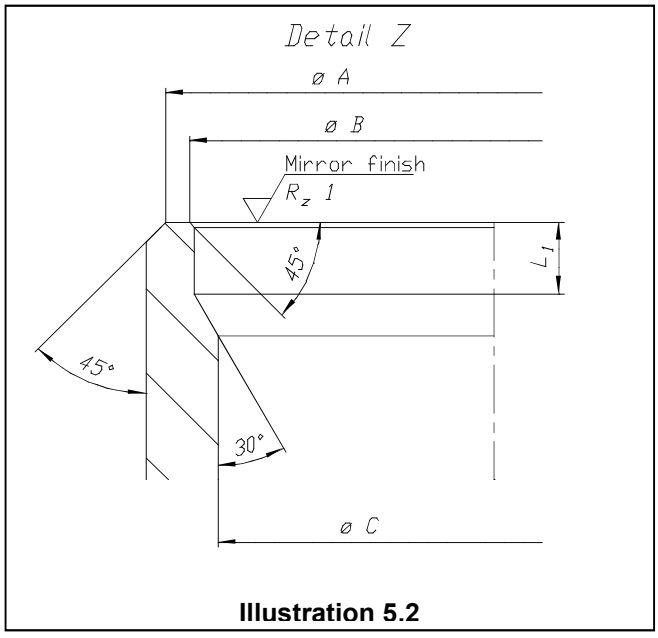

Illustration 5.2

Changes in dimension may only be so large that the highest admissible dimension for t is not exceeded and the smallest admissible dimension for h is not fallen below. The dimensions A and B on the seat must be restored with inner and outer chamfering.

protected

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. The maximum allowable reduction in "L_1" is 0,5 mm.

Table 5.1: seats and discs of type 441 and 421

C [mm]	441 DN [mm]	421 DN [mm]	Refinishing of seat				Refinishing of disc	
			Seat depth T [mm]	Tolerance for t [mm]	B ∅ [mm]	A ∅ [mm]	Boundary height h [mm]	Tolerance for h [mm]
18	20	-	24,5	+0,5	$18,4_{-0,2}$	$20,4^{+0,2}$	7,0	-0,2
23	25	25	38,0	+0,5	$25,4_{-0,2}$	$27,4^{+0,2}$	9,1	-0,2
29	32	32	47,0	+0,5	$32,4_{-0,2}$	$34,4^{+0,2}$	9,1	-0,2
37	40	40	53,0	+0,5	$40,4_{-0,2}$	$42,4^{+0,2}$	9,1	-0,25
46	50	50	53,5	+0,5	$50,4_{-0,3}$	$53,4^{+0,3}$	10,1	-0,25
60	65	65	63,5	+0,5	$67,0_{-0,3}$	$71,0^{+0,3}$	11,0	-0,25
74	80	80	91,0	+0,8	$82,0_{-0,3}$	$86,0^{+0,3}$	10,0	-0,3
92	100	100	114,0	+0,8	$103,0_{-0,3}$	$108,0^{+0,3}$	11,5	-0,3
98	125	125	114,0	+0,8	$103,0_{-0,3}$	$108,0^{+0,3}$	11,5	-0,3
125	150	150	154,5	+1	$130,0_{-0,3}$	$135,0^{+0,3}$	14,5	-0,4
165	200	-	257,1	+1	$180,0_{-0,4}$	$186,0^{+0,4}$	15,5	-0,4
200	250	-	273,0	+1,5	$220,0_{-0,4}$	$226,0^{+0,4}$	17,5	-0,5
235	300	-	318,0	+1,5	$259,0_{-0,5}$	$265,0^{+0,5}$	28,0	-0,5
295	400	-	391,5	+1,5	$326,0_{-0,5}$	$332,0^{+0,5}$	32,0	-0,5

protected

8 Refinishing of seat and disc for types 431 and 411, metal sealing

Work is to be done according to illustrations 6.1, 6.2 and 6.3 and according to table 6.1.

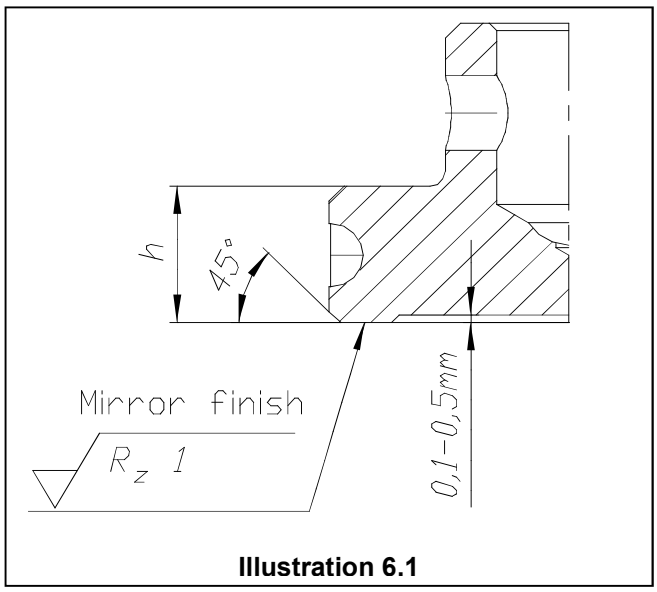

Illustration 6.1

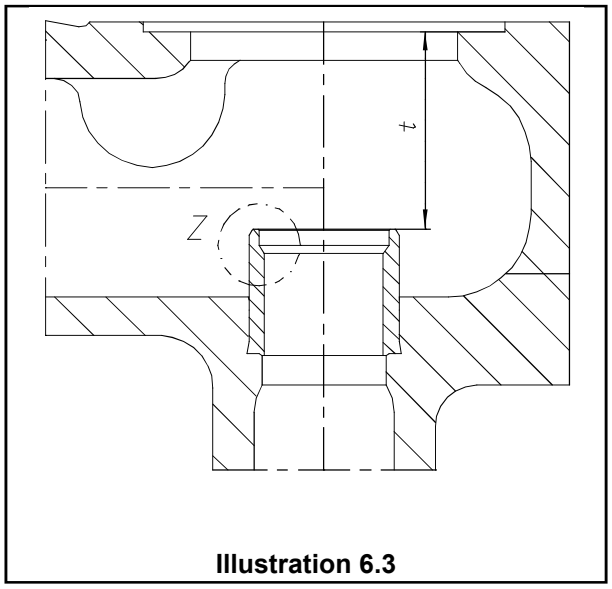

Illustration 6.3

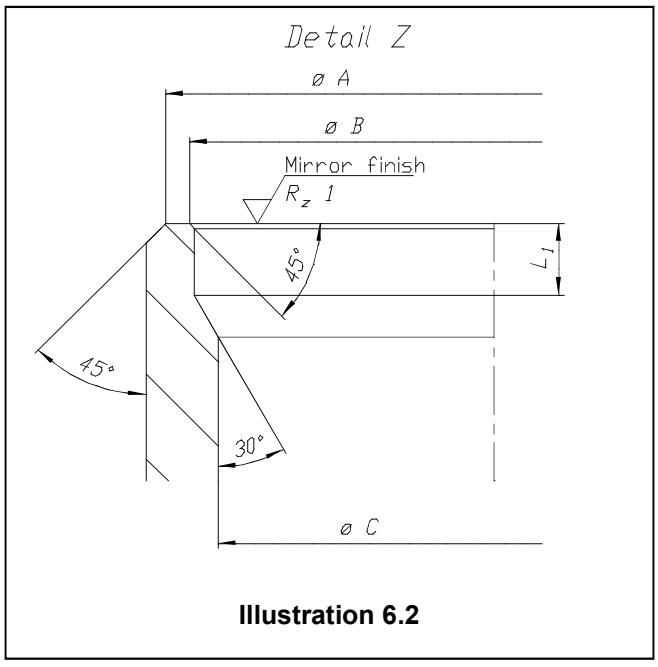

Illustration 6.2

Changes in dimension may only be so large that the highest admissible dimension for t is not exceeded and the smallest admissible dimension for h is not fallen below. The dimensions A and B on the seat must be restored with inner and outer chamfering.

protected

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. The maximum allowable reduction in "L_1" is 0,5 mm.

Table 6.1: seats and discs of type 431 and 411

C [mm]	431 DN [mm]	411 DN [mm]	Refinishing of seat				Refinishing of disc	
			Seat depth t [mm]	Tolerance for t [mm]	B ∅ [mm]	A ∅ [mm]	Boundary height h [mm]	Tolerance for h [mm]
12	15	-	22,0	+0,3	$13,7_{-0,2}$	$15,3^{+0,2}$	20	-0,2
18	20-32	20-32	22,5	+0,5	$18,4_{-0,2}$	$20,4^{+0,2}$	7,0	-0,2
23	40	40	25,0	+0,5	$25,4_{-0,2}$	$27,4^{+0,2}$	9,1	-0,2
29	50	50	28,0	+0,5	$32,4_{-0,2}$	$34,4^{+0,2}$	9,1	-0,2
37	65	65	35,0	+0,5	$40,0_{-0,2}$	$42,4^{+0,2}$	9,1	-0,25
46	80	80	39,0	+0,5	$50,4_{-0,3}$	$53,4^{+0,3}$	10,1	-0,25
60	100	100	55,0	+0,5	$67,0_{-0,3}$	$71,0^{+0,3}$	11,0	-0,25
74	125	125	62,0	+0,8	$82,0_{-0,3}$	$86,0^{+0,3}$	10,0	-0,3
92	150	150	72,0	+0,8	$103,0_{-0,3}$	$108,0^{+0,3}$	11,5	-0,3

protected

9 Refinishing of seat and disc types 441 and 431, O-ring seals

Work is to be done according to illustration 7.1

The outer chamfer of these seats is responsible for the sealing (see illustration 7.1), therefore the diameter of the seat must not be changed. In case of edge damage, the seat surface may be turned or ground by between 0,2 and 0,4 mm until the damage is removed. After that the edge should be carefully treated with smooth emery paper to restore an angle of 45°. Please make sure that the edge is free for burrs.

The O-ring in the disc must be renewed.

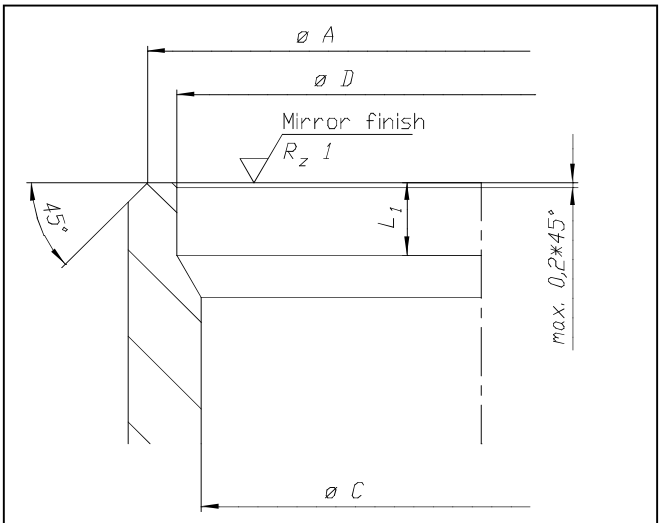

Illustration 7.1

10 Refinishing of seat and disc for type 455 and 456, metal sealing

Work is to be carried out according to the illustrations 8.1, 8.2 and 8.3 and according to table 8.1.

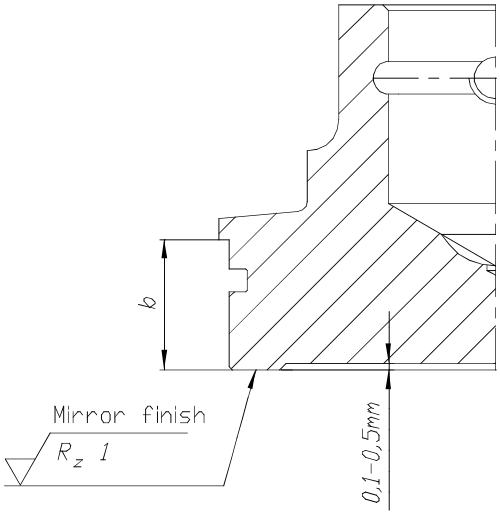

Illustration 8.1

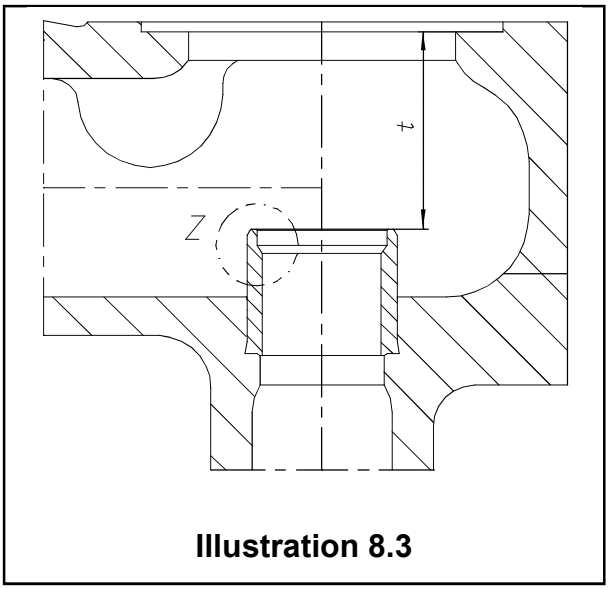

Illustration 8.3

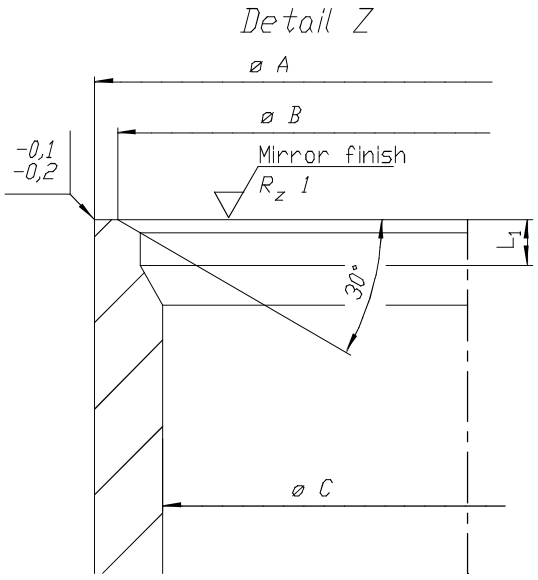

Illustration 8.2

Changes in dimension may only be so large that the highest admissible dimension for t is not exceeded and the smallest admissible dimension for b is not fallen below. The dimensions A and B on the seat must be restored with inner and outer chamfering.

protected

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. The maximum allowable reduction in "L_1" is 0,5 mm.

Table 8.1: seats and discs of type 455

C [mm]	DN [mm]	Refinishing of seat				Refinishing of disc	
		Seat depth t [mm]	Tolerance for t [mm]	B ∅ [mm]	A ∅ [mm]	Boundary height b [mm]	Tolerance for b [mm]
20	25	50,0	+0,5	$22{,}5_{-0{,}2}$	$24{,}5^{+0{,}2}$	10,5	-0,2
40	50	66,0	+0,5	$46{,}5_{-0{,}2}$	$49{,}0^{+0{,}2}$	12,5	-0,3
60	80	85,0	+0,5	$66{,}5_{-0{,}3}$	$71{,}5^{+0{,}3}$	16,0	-0,3
74	100	117,0	+0,8	$82{,}0_{-0{,}3}$	$86{,}0^{+0{,}3}$	17,0	-0,4

11 Refinishing of seat and disc types 455 and 456, O-Ring seals

Work is to be carried out according to the illustrations 9.1 and 9.3 and according to table 9.1.
In these valves the seal is made at the inner chamfer, this is therefore the important feature. The inner chamber is formed with a 30° angle (see Illustration 9.1).

When refinishing according to Table 9.1, the diameter B has to be restored and the chamfer area with surface quality Rz 10 has to be finished / ground free of burrs.

The O-Ring in the disc has to be renewed.

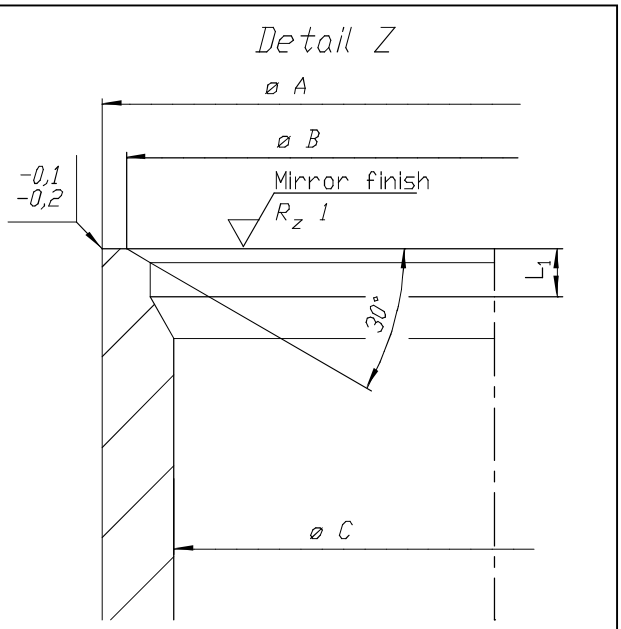

Illustration 9.1

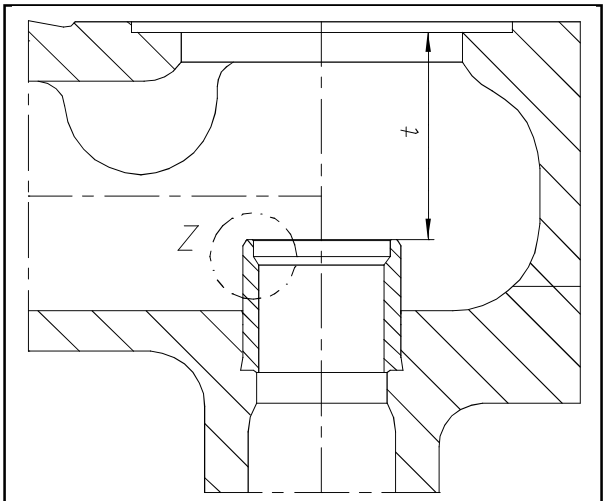

Illustration 9.2

protected

Table 9.1: seats and discs of type 455 and 456

C [mm]	DN [mm]	Refinishing of seat			
		Seat depth t [mm]	Tolerance for t [mm]	B ∅ [mm]	A ∅ [mm]
20	25	50,0	+0,5	$22,5_{-0,2}$	$24,5^{+0,2}$
40	50	66,0	+0,5	$46,5_{-0,2}$	$49,0^{+0,2}$
60	80	85,0	+0,5	$66,5_{-0,3}$	$71,5^{+0,3}$
74	100	117,0	+0,8	$82,0_{-0,3}$	$86,0^{+0,3}$

12 Refinishing of seat and disc for full nozzle types 457 and 458, metal sealing

Work is to be carried out according to the illustrations 10.1, 10.2 and according to table 10.1.

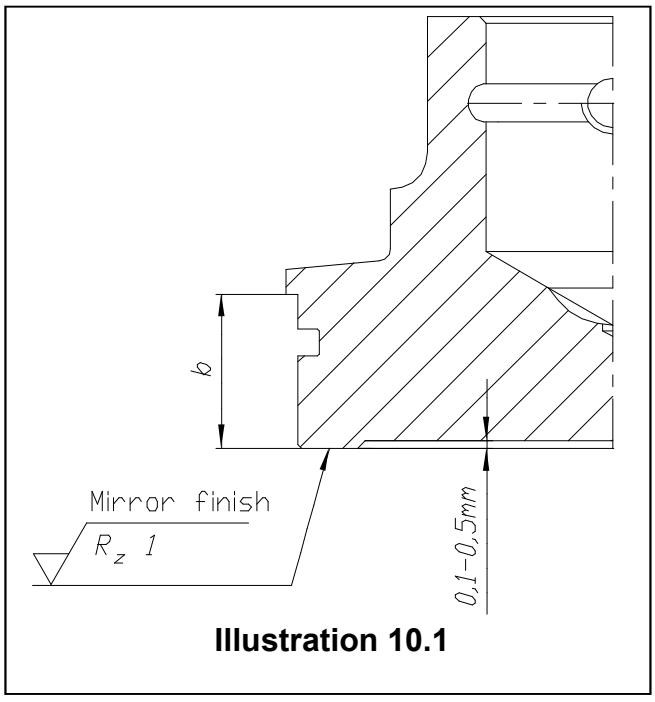

Illustration 10.1

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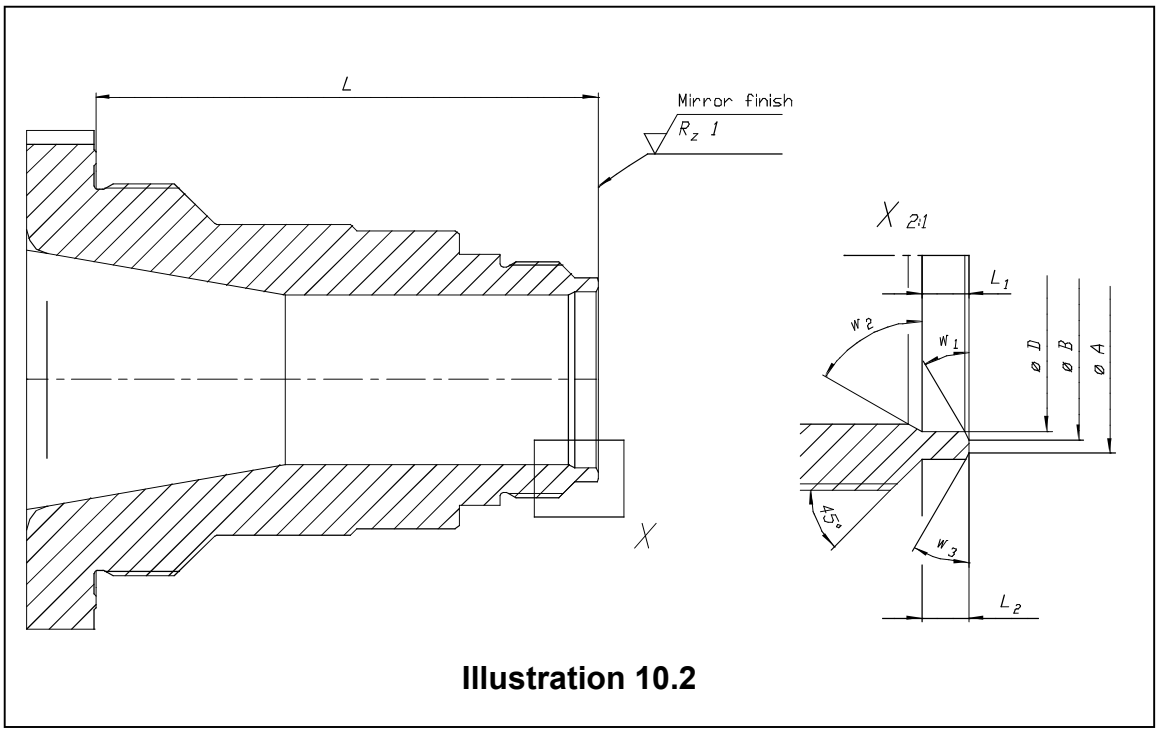

Illustration 10.2

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 10.1). The dimensions A and B on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. "L_1" can be minimized by about a maximum of … (see table 10.1).

Table 10.1: seats and discs full nozzle type 457/458

Valve DN	Seat											Disc	
	Diameter				Length				Angle				
	do Ø [mm]	D Ø [mm]	B Ø [mm]	A Ø [mm]	L [mm]	L_1 [mm]	L_2 [mm]	Tolerance L; L_1; L_2 [mm]	W_1 [°]	W 2 [°]	W 3 [°]	b [mm]	Tolerance b [mm]
25	15	16	17	19	130	3	-	- 0,2	30	30	30	10,5	-0,1
	20	21	22,5	24,5		3	-	- 0,2		60	30		
50	30	32	36	39	162	3,5	12,5	- 0,3	30	60	45	12,5	-0,2
	40	43	46	49		3	-	- 0,3			-		
80	50	52	55,4	59,4	180	3	4	- 0,3	30	60	45	17,0	-0,2
	60	62	66,5	71,5		4	-	- 0,3		60			
100	50	52	55,4	59,4	215	3	4	- 0,3	30	60	45	17,0	-0,2
	60	64	67,5	71,5		5	-	- 0,3	30	60	45	17,0	-0,2
	74	79	82	86		5	6	- 0,3	30	60	-	17,0	-0,2
	88	93	99	103		6	-	- 0,3	30	60	-	17,0	-0,2
150	110	116	120	124	277,5	5	-	- 0,3	30	90	-	17,0	-0,3

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13 Seat geometry for flat sealing O-ring disc design (for valves delivered before 2002)

Work is to be carried out according to the illustration 11.1and according to table 11.1.

The flat sealing O-ring-disc has not been supplied since the redesign of the O-ring dics in 2002. To refinish “old design” discs see the following details.

The flat sealing O-ring disc design is identified internally within Leser by “F-Text” codes L40-43. Where a customer has an O-ring disc valve supplied before 2002, the customer should contact Leser to confirm whether these dimensions are to be used before commencing work on the valve.

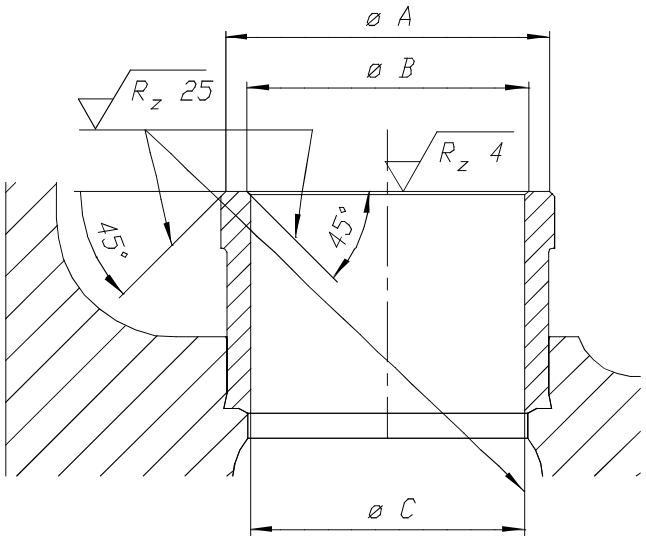

Illustration 11.1

Table 11.1: flat sealing O-ring disc

C	B	A
closest flow area do [mm]	**inner seat chamfer ∅ [mm]**	**outer seat chamfer*1 ∅ [mm]**
18	$18{,}4_{-0{,}2}$	$22{,}8^{+0{,}2}$
23	$23{,}4_{-0{,}2}$	$29{,}8^{+0{,}2}$
29	$29{,}4_{-0{,}2}$	$37{,}1^{+0{,}2}$
37	$37{,}4_{-0{,}2}$	$46{,}0^{+0{,}2}$
46	$46{,}4_{-0{,}2}$	$54{,}4^{+0{,}3}$
60	$60{,}4_{-0{,}3}$	$71{,}0^{+0{,}3}$
74	$74{,}4_{-0{,}3}$	$89{,}0^{+0{,}3}$
92	$92{,}4_{-0{,}3}$	$111{,}0^{+0{,}3}$
98	$98{,}4_{-0{,}3}$	$111{,}0^{+0{,}3}$
125	$125{,}4_{-0{,}3}$	$138{,}0^{+0{,}3}$

*1) outer seat champfer formed with a 45° angle / free of burrs

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14 Refinishing of seat and disc type 526, metal sealing

Work is to be carried out according to the illustrations 12.1, 12.2 and according to table 12.1.

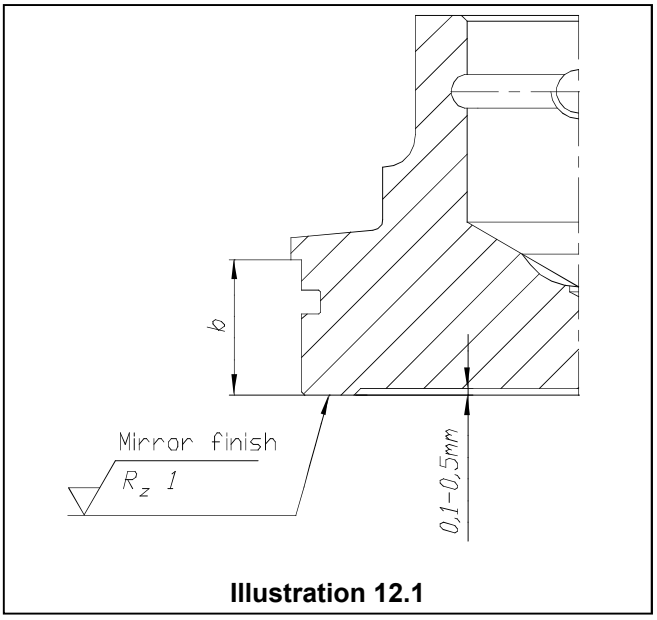

Illustration 12.1

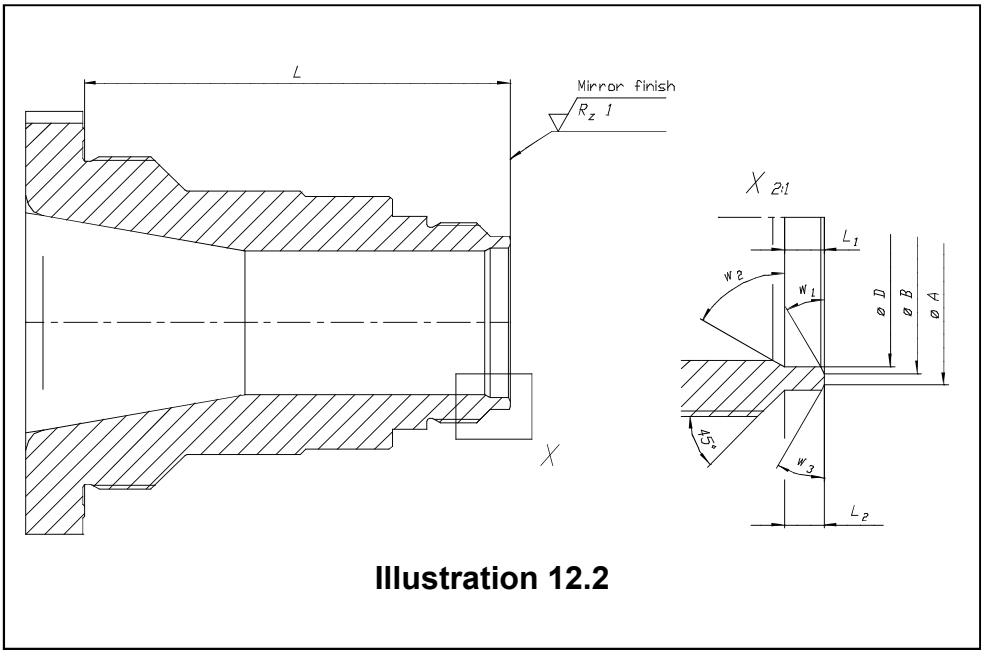

Illustration 12.2

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 12.1). The dimensions A and B on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. "L_1" can be minimized by about a maximum of … (see table 12.1).

protected

Table 12.1: seats and discs type 526

Orifice	Size	Pressure range Inlet / Outlet [lbs]	Seat										Disc	
			Diameter			Length				Angle				
			A Ø [mm]	B Ø [mm]	D Ø [mm]	L [mm]	L_1 [mm]	L_2 [mm]	Tolerance L; L_1; L_2 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	b [mm]	Tolerance [mm]
E	1"x2"	300 x 150	$19,6^{+0,2}$	$18,0_{-0,2}$	17,4	87,3	10,0	-	- 0,2	45,0	60,0	45,0	10,5	-0,1
	1 ½"x2"	1500 x 300	$18,7^{+0,2}$	$16,6_{-0,2}$	16,1	87,3	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,1
	1 ½"x3"	2500 x 300	$18,6^{+0,2}$	$16,6_{-0,2}$	16,1	122,2	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,1
F	1 ½"x2"	900 x 300	$22,5^{+0,2}$	$20,5_{-0,2}$	19,5	106,3	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,2
	1 ½"x3"	2500 x 300	$20,5^{+0,2}$	$19,1_{-0,2}$	19,5	122,6	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,2
G	1½"x3"	900 x 300	$27,5^{+0,2}$	$25,0_{-0,2}$	23,5	106,3	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,2
	2"x3"	1500 x 300	$27,5^{+0,2}$	$25,0_{-0,2}$	23,5	128,1	5,0	3,0	- 0,2	45,0	60,0	60,0	10,5	-0,2
H	1½"x3"	150 x 150	$36,0^{+0,2}$	$33,0_{-0,2}$	30,5	106,3	5,0	3,0	- 0,2	45,0	60,0	45,0	10,5	-0,2
	2"x3"	600 x 150	$35,2^{+0,2}$	$33,0_{-0,2}$	29,4	102,2	5,0	3,0	- 0,2	30,0	60,0	30,0	10,5	-0,2
	2"x3"	1500 x 300	$35,2^{+0,2}$	$33,0_{-0,2}$	29,4	126,5	5,0	3,0	- 0,2	30,0	60,0	30,0	10,5	-0,2
J	2"x3"	150 x 150	$43,5^{+0,2}$	$41,0_{-0,2}$	39,0	102,2	6,0	6,0	- 0,2	30,0	60,0	30,0	12,5	-0,2
	3"x4"	900 x 300	$43,5^{+0,2}$	$41,0_{-0,2}$	37,0	156,5	6,0	6,0	- 0,3	30,0	60,0	30,0	12,5	-0,2
K	3"x4"	150 x 150	$50,5^{+0,3}$	$47,0_{-0,2}$	45,0	127,9	6,0	6,0	- 0,2	30,0	60,0	30,0	12,5	-0,2
	3"x6"	600 x 150	$50,5^{+0,3}$	$47,0_{-0,2}$	45,0	156,5	6,0	6,0	- 0,3	30,0	60,0	30,0	12,5	-0,2
	3"x6"	1500 x 300	$50,5^{+0,3}$	$47,0_{-0,2}$	45,0	169	6,0	7,0	- 0,3	30,0	60,0	45,0	12,5	-0,2
L	3"x4"	150 x 150	$61,5^{+0,3}$	$58,0_{-0,2}$	56,0	127,9	6,0	6,0	- 0,2	30,0	60,0	30,0	15,0	-0,2
	4"x6"	600 x 150	$61,5^{+0,3}$	$58,0_{-0,2}$	56,0	149,9	6,0	6,0	- 0,2	30,0	60,0	30,0	15,0	-0,2
	4"x6"	600 x 150	$61,5^{+0,3}$	$58,0_{-0,3}$	56,0	149,9	6,0	6,0	- 0,2	30,0	60,0	30,0	15,0	-0,2
	4"x6"	1500 x 150	$61,5^{+0,3}$	$58,0_{-0,3}$	56,0	169	6,0	6,0	- 0,3	30,0	60,0	30,0	15,0	-0,2
M	4"x6"	600 x 150	$68,0^{+0,3}$	$64,5_{-0,3}$	61,5	149,9	5,0	6,0	- 0,3	30,0	60,0	30,0	15,0	-0,2
	4"x6“	900 x 150	$69,0^{+0,3}$	$64,5_{-0,3}$	61,5	169	5,0	6,5	- 0,3	30,0	60,0	30,0	15,0	-0,2
N	4"x6“	900 x 150	$74,0^{+0,3}$	$70,0_{-0,3}$	67,0	169	4,0	6,0	- 0,3	30,0	60,0	30,0	15,0	-0,2
P	4"x6"	150 x 150	$89,0^{+0,3}$	$85,0_{-0,3}$	82,0	153,1	5,0	6,0	- 0,3	30,0	45,0	45,0	15,0	-0,2
	4"x6"	900 x 150	$89,0^{+0,3}$	$85,0_{-0,3}$	82,0	197,5	5,0	6,0	- 0,3	30,0	45,0	45,0	15,0	-0,2
Q	6"x8"	300 x 150	$114,5^{+0,3}$	$111,0_{-0,3}$	108,5	209,5	6,0	6,0	- 0,3	45,0	45,0	45,0	17,0	-0,2
R	6"x8"	300 x 150	$137,5^{+0,3}$	$133,0_{-0,3}$	131,0	209,5	25,0	6,0	- 0,3	45,0	60,0	45,0	17,0	-0,2
	6"x10"	600 x 150	$137,5^{+0,3}$	$133,0_{-0,3}$	131,0	189,3	25,0	6,0	- 0,3	45,0	60,0	45,0	17,0	-0,2
T	8"x10"	300 x 150	$171,5^{+0,4}$	$167,0_{-0,4}$	164,0	225,7	6,0	6,0	- 0,3	30,0	60,0	45,0	17,0	-0,3

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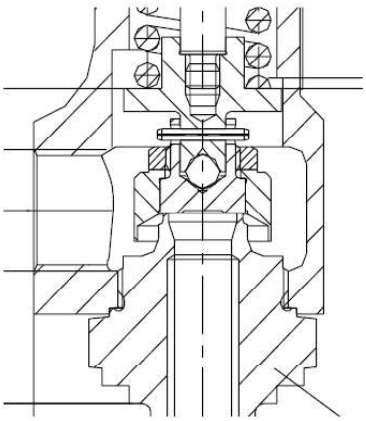
15 Refinishing of seat and disc type 437, metal sealing or sealing plate

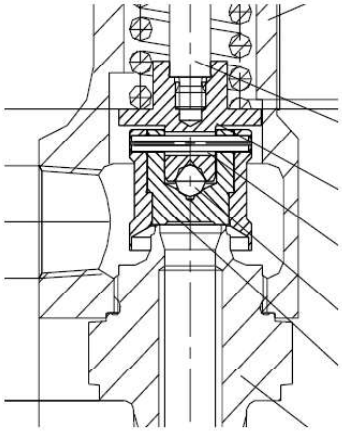
Since 2007 the types 437 do6 + 10 have been converted to the new metal-to-metal disc design. The “old” disc design is not available as spare part at LESER. Instead LESER will offer conversion kits to change over to the new design. For detailed information please ask LESER sales.

Feature-Benefits Type 437 do = 6 and do = 10 (Stainless steel disc): Old vs. New Disc Design

Old:



New:



Feature	Benefit
Easy assembly	No torque wrench needed
Removable lifting aid	Simple repair of sealing surface
Zero-potential assembly of disc	Optimal functional tightness without refinish
Conversion kit available	Refitting of every customer valve possible

Rework shall be done according to illustration 13.1, 13.2 and table 13.1.

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 13.1). The dimensions A and C on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked.

Remark: Small changes at the seat geometry can have big influence to the function of the safety valve. LESER recommends using the new inlet body and disc.

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Table 13.1: Seat and disc type 437

do	Seat										Disc		
	Diameter			Length				Angle					
	A ∅ [mm]	B ∅ [mm]	C ∅ [mm]	L [mm]	L_1 [mm]	L_2 [mm]	max. Tolerance L; L_1; L_2 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	b [mm]	max. Tolerance b [mm]	L_2 [mm]
6	$10,5^{-0,05}$	$7,5^{+0,05}$	$8,5^{+0,1}$	16,5	-	1,5	- 0,1	45	18	45	6,0	+/- 0,25	0,5
10	$14,0^{-0,05}$	$12,0^{+0,05}$	-	16,5	-	2,0	- 0,1	-	18	-	6,0	+/- 0,25	0,5

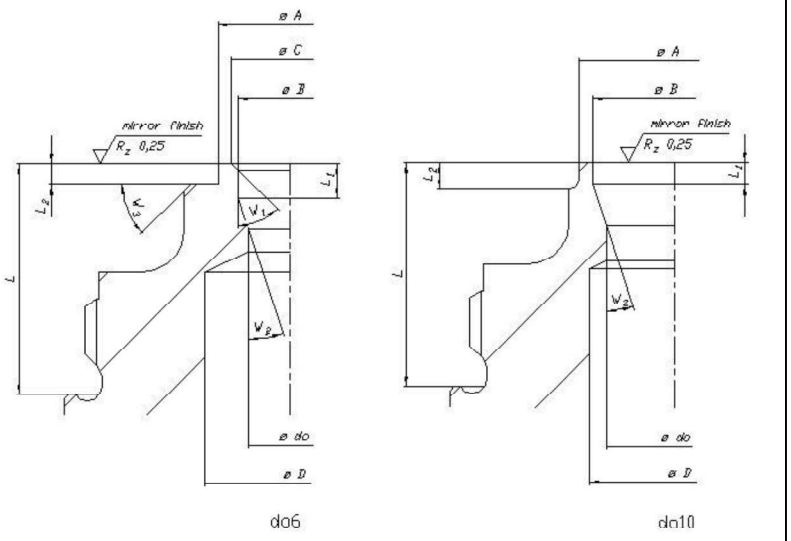

Illustration 13.1

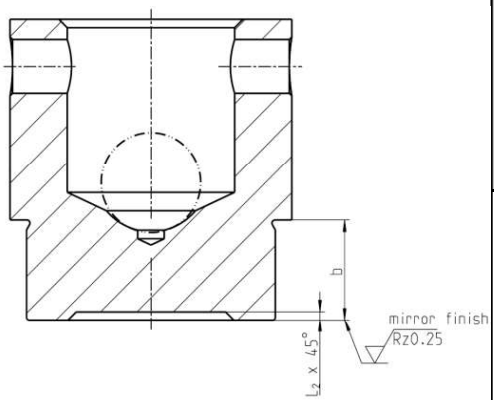

Illustration 13.2

Since April 2014 the inlet body of type 437 do10 have been supplied with new seat geometry. The former inlet body is not available as spare part at LESER. The seat geometry of type 437 do6 has been still the same.

The rework of type 437 do10 with new seat geometry shall be done according to illustration 13.1, 13.2 and table 13.2.

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 13.2). The dimensions A and B on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked.

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Remark: Small changes at the seat geometry can have big influence to the function of the safety valve. LESER recommends using the new inlet body and disc.

Within ECO 200071 (valid for serial production since 09/2014) the seat contour of Type 437 do 10 has been optimized (for further informations see LDeS 3001.18 Chapter 5.2). The following table contains the measures of the optimized seat contour for Type 437 do10.

Table 13.2: Seat and disc type 437 with new seat geometry since 2014

do	Sitz											Teller		
	A ∅ [mm]	B ∅ [mm]	C ∅ [mm]	L [mm]	L_1 [mm]	L_2 [mm]	max. Toleranz L; L_1; L_2 [mm]	R_1 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	b [mm]	max. Toleranz b [mm]	L_2 [mm]
10	$14,0^{-0,05}$	$12,5^{+0,05}$	-	16,5	1,6	-	- 0,1	0,2	-	18	-	6,0	+/- 0,25	0,5

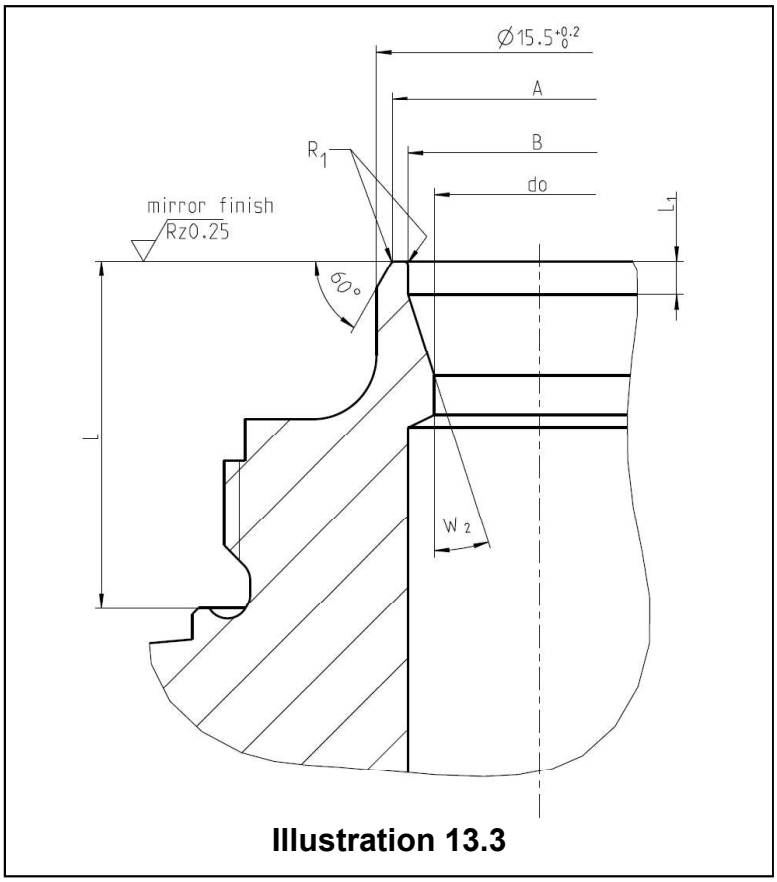

Illustration 13.3

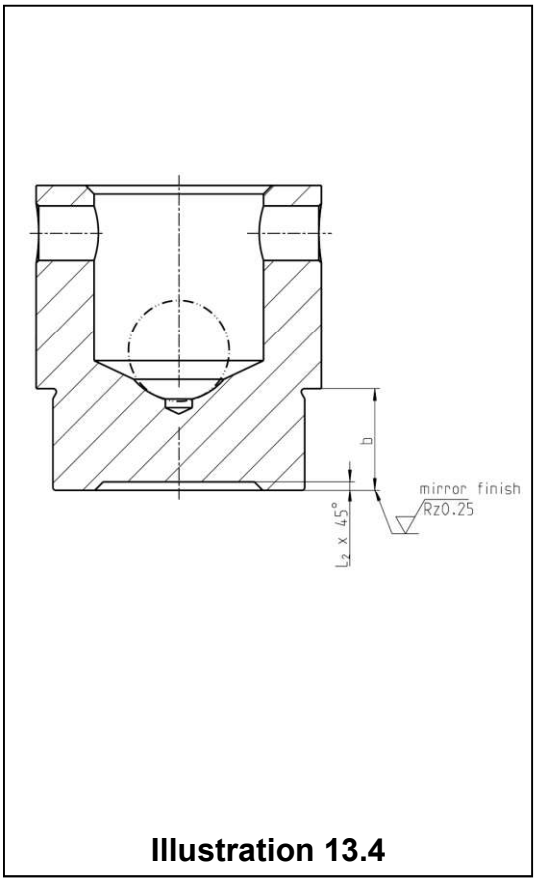

Illustration 13.4

protected

16 Refinishing of seat and disc type 438, O-Ring seals

Rework shall be done according to illustration 14.1 and table 14.1

The outer chamfer of these seats is responsible for the sealing (see illustration 14.1), therefore the diameter of the seat must not be changed. In case of edge damage, the seat surface may be reworked by turning and grinding to remove the damages. After that the edge has to be deburred with abrasive paper (grit 400-800).

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 14.1). The dimensions A and B on the seat must be restored with inner and outer chamfering. The recess dimensions "L_1" do not have to be reworked.

The disc may be reworked within the measurement and tolerances according to tabe 14.1. The O-ring in the disc must be renewed.

protected

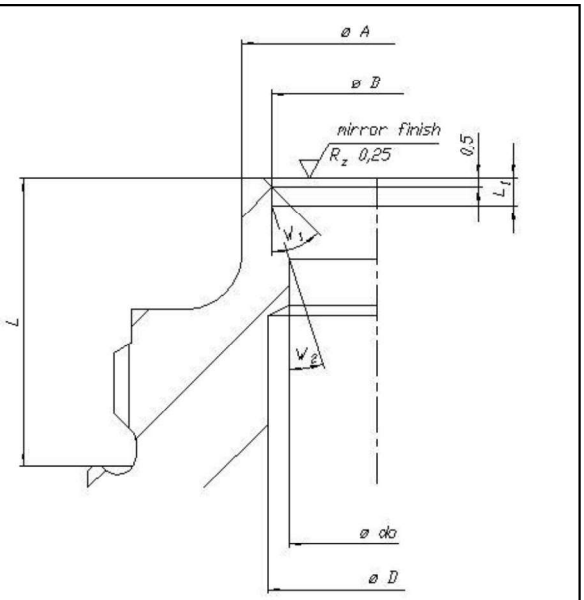

Illustration 14.1

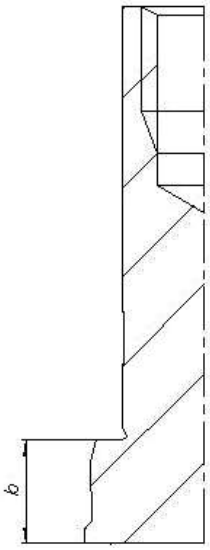

Illustration 14.2

Table 14.1: seats and discs type 438

do	Seat									Disc	
	Diameter			Length			Angle				
	A ∅ [mm]	B ∅ [mm]	D ∅ [mm]	L [mm]	L_1 [mm]	Tolerance L; L_1 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	b [mm]	Tolerance b [mm]
10	$15{,}5_{-0{,}1}$	$12^{+0{,}05}$	-	16,5	1,6	- 0,1	-	18	-	4,9	+ 0,1/-0,2

17 Refinishing of seat and disc type 439, Vulcanized soft seat

The rework shall be done according to illustration 15.1 and table 15.1.

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 15.1). The dimensions A and B on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked

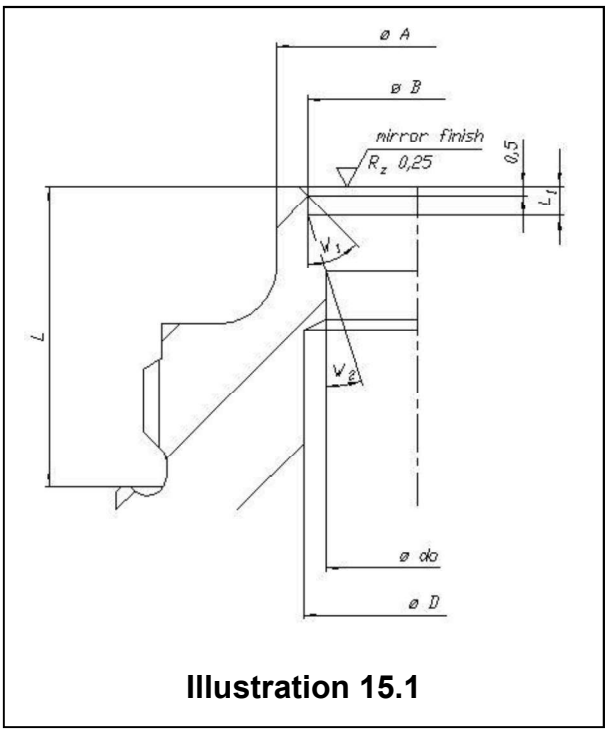

Illustration 15.1

Table 15.1: seats and discs type 439

do	Seat								
	Diameter			Length			Angle		
	A ∅ [mm]	B ∅ [mm]	D ∅ [mm]	L [mm]	L_1 [mm]	Tolerance L; L_1 [mm]	W_1 [°]	W_2 [°]	W_3 [°]
10	$15{,}5_{-0{,}1}$	$12^{+0{,}05}$	-	16,5	1,6	- 0,1	-	18	-

protected

18 Refinishing of seat and disc type 459, metal sealing, sealing plate

Work is to be done according illustration 16.1, 16.2.

Changes in dimension may only be such as not to reduce dimensions b and/or L below the lowest allowable tolerance (see table 16.1). The dimensions A and B on the seat must be restored with inner and outer chamfering.

The recess dimensions "L_1" do not have to be reworked by a lathe, but must be preserved at their original order of magnitude. "L_1" can be minimized by about a maximum of … (see table 16.1).

protected

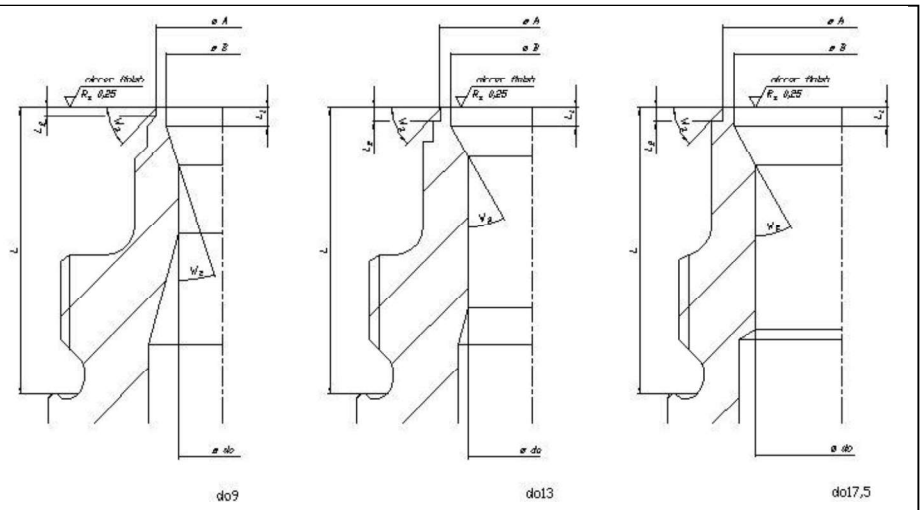

Illustration 16.1

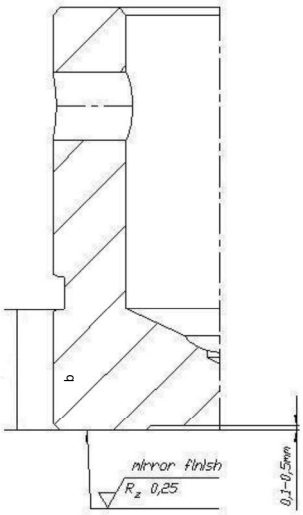

Illustration 16.2

Table 16.1: seats and discs type 459

do	Seat									Disc	
	Diameter		Length				Angle			b	Tolerance b
	A ∅ [mm]	B ∅ [mm]	L [mm]	L_1 [mm]	L_2 [mm]	Tolerance L; L_1; L_2 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	[mm]	[mm]
6	$10,5^{-0,05}$	$8,5^{+0,1}$	29,0	2,5	0,9	- 0,1	-	18	45	8,0	+ 0,1
9	$12,9^{+0,1}$	$11,5^{+0,05}$	29,0	2,0	1,1	- 0,1	-	18	45	8,0	+ 0,1
13	$18,1^{+0,1}$	$16,5^{+0,05}$	29,0	2,0	1,5	- 0,1	-	30	45	8,0	+ 0,1
17,5	$23,8^{+0,1}$	$22,0^{+0,05}$	29,0	2,0	1,5	- 0,1	-	30	45	7,9	+ 0,1

19 Refinishing of seat and disc type 462, O-Ring disc

Work is to be done according to illustration 17.1, 17.2.

The outer chamfer of these seats is responsible for the sealing (see illustration 17.1), therefore the diameter of the seat must not be changed. In case of edge damage, the seat surface may be turned or ground by between 0,2 and 0,4 mm until the damage is removed. Please make sure that the edge is free for burrs.

The O-ring in the disc must be renewed.

protected

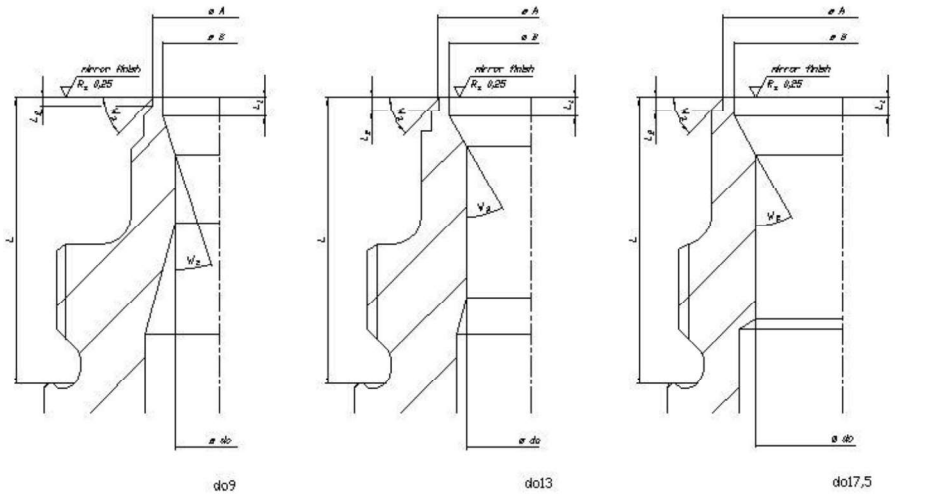

Illustration 17.1

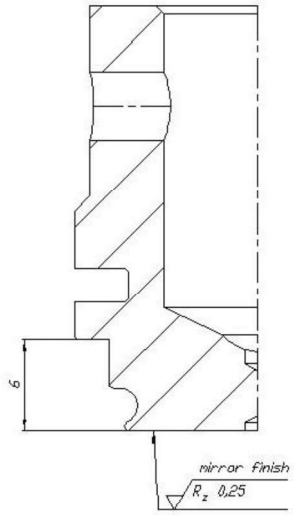

Illustration 17.2

Table 17.1: seats and discs type 462

do	Seat									Disc	
	Diameter		Length				Angle				
	A ∅ [mm]	B ∅ [mm]	L [mm]	L_1 [mm]	L_2 [mm]	Tolerance L; L_1; L_2 [mm]	W_1 [°]	W_2 [°]	W_3 [°]	b [mm]	Tolerance b [mm]
9	12,9	11,5	29,0	2,0	1,1	+0,1	-	18	45	5,3	+0,05
13	18,1	16,5	29,0	2,0	1,5	+0,1	-	30	45	6,0	+0,05
17,5	23,8	22,0	29,0	2,0	1,5	+0,1	-	30	45	6,0	-0,1

20 Refinishing of seat and disc of POSV type 811/821

Rework shall be done in accordance to illustration 18.1, 18.2 and table 18.

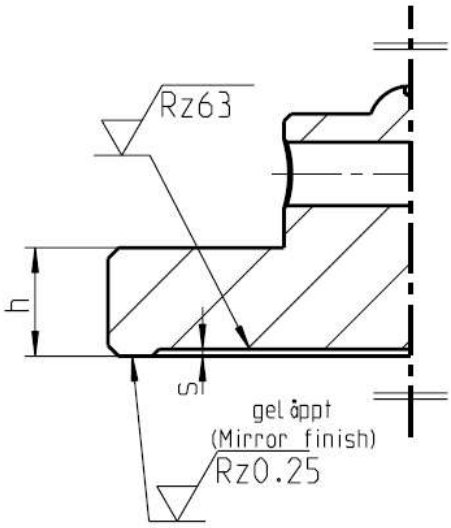

Illustration 18.1: Steel disc

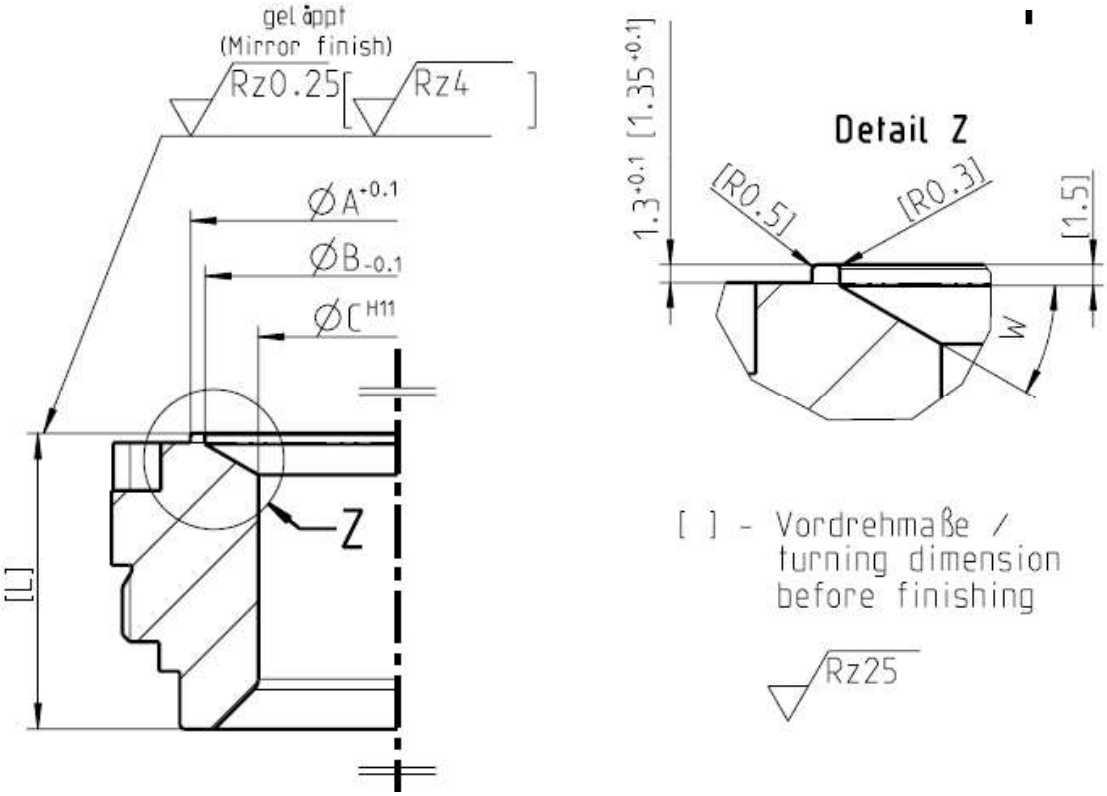

Illustration 18.2: Seat (semi-nozzle)

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Rework shall be limited to the lowest allowable dimensions [L_{min}] and h_{min}. The radii [R 0.5] and [R 0.3] and the shoulder [$1.35^{+0.1}$] at the seat shall be reworked exactly to assure the tightness of the o-ring disc. The rework of the shoulder [1.5] and the angle W of the seat and the shoulder s of the steel disc is recommended.

NPS xNPS	DN x DN	Orifice	Seat (semi-nozzle)						Steel disc		
			$A^{+0,1}$ ∅ [mm]	$B_{-0,1}$ ∅ [mm]	C^{H11} ∅ [mm]	[L] [mm]	[L_{min}] [mm]	W [°]	h [mm]	h_{min} [mm]	s [mm]
1x2	25x50	D	29,5	26,5	11	33,4	32,4	45	8,5	7,5	1
		E	29,5	26,5	14,7	33,4	32,4	45	8,5	7,5	1
		F	29,5	26,5	18,4	33,4	32,4	45	8,5	7,5	1
		G	29,5	26,5	23	33,4	32,4	45	8,5	7,5	1
1,5x2	40x50	D	37,5	34,5	11	33,4	32,4	45	10,5	9,5	1
		E	37,5	34,5	14,7	33,4	32,4	45	10,5	9,5	1
		F	37,5	34,5	18,4	33,4	32,4	45	10,5	9,5	1
		H	37,5	34,5	29	33,4	32,4	45	10,5	9,5	1
1,5x3	40x80	G	37,5	34,5	23,6	39,4	38,4	45	10,5	9,5	1
		H	37,5	34,5	29,4	39,4	38,4	45	10,5	9,5	1
		J	38	35,7	35,7	33,4	32,4	-	10,5	9,5	1
2x3	50x80	G	56,5	52,5	23,6	40,4	39,4	30	13,5	12,5	1
		H	56,5	52,5	29,4	40,4	39,4	30	13,5	12,5	1
		J	56,5	52,5	38	40,4	39,4	30	13,5	12,5	1
		K+	56,5	52,5	48	35,4	34,4	30	13,5	12,5	1
3x4	80x100	J	80,5	76	38	61,7	60,7	30	15,4	14,4	1
		K	80,5	76	45	61,7	60,7	30	15,4	14,4	1
		L	80,5	76	56	61,7	60,7	30	15,4	14,4	1
		N+	80,5	76	75	41,7	40,7	30	15,4	14,4	1
4x6	100x150	L	102,5	98	56	64,7	63,7	30	20	19	2
		M	102,5	98	63	64,7	63,7	30	20	19	2
		N	102,5	98	69	64,7	63,7	30	20	19	2
		P	102,5	98	83	50,7	49,7	30	20	19	2
		P+	102,5	98	95	41,7	40,7	30	20	19	2
6x8	150x200	Q	150	145	110	56,7	55,7	30	30	29	2
		R	150	145	133	56,7	55,7	30	30	29	2
		R+	150	145	142	46,7	45,7	30	30	29	2
8x10	200x250	T	188	182	168	68,2	67,2	30	30	29	2
		T+	188	182	180	58,2	57,2	30	30	29	2

Table 18: Seat and steel disc of type 811/821

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1 Purpose 1
2 Scope 1
3 References 1
4 Disclaimer 1
5 Qualified fitting personnel 2
6 General Information 2
7 Reworking the of the working surfaces 2
8 Re-lapping 2
8.1 Re-lapping seat and disc sealing surfaces 2

1 Purpose

This LESER Global Standard (LGS) provides instruction on reworking LESER safety valves. The required work steps and materials are described.

2 Scope

This document must be applied when reworking safety valves in agencies and subsidiaries of LESER GmbH & Co. KG.

3 References

LWN 313.32 to 313.40

4 Disclaimer

LESER puts in a great deal of effort into making up-to-date and correct documentation available. Nevertheless, LESER GmbH & Co. KG gives no guarantee that the recommended actions presented here are entirely correct and error free. This document is to be applied exclusively to the specified type. LESER GmbH & Co. KG declines any liability or responsibility for the correctness and completeness of the content.

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5 Qualified fitting personnel

The reworking of LESER safety valves may only be performed by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

6 General Information

- During all work on the working surfaces,
- Wear safety glasses.

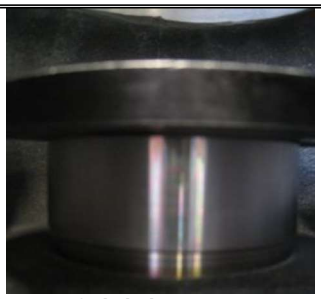
7 Reworking the of the working surfaces

When re-turning damaged working surfaces, comply with the specifications of LWN 313.32 to 313.40.

8 Re-lapping

8.1 Re-lapping seat and disc sealing surfaces

8.1.1 Lapping with the lapping stamp.

Illustrations	Description	Aids / Tools
 **Figure 8.1.1-1**	The lapping stamp is to be used for reworking damage on the seat sealing surface. Lapping paste and oleic acid must be applied to the lapping stamp. Select the lapping paste depending on the degree of damage. The more severe the damage is, the coarser the lapping paste that is to be used at the beginning	
Monocrystalline diamond powder Oleic acid **Figure 8.1.1-2**	Wet the disc with the monocrystalline diamond powder and the oleic acid. Four small points on the sealing surface of the disc must be used. Monocrystalline diamond powder is applied to 2 points and oleic acid to the other 2 points.	

protected

Figure 8.1.1-3 Error! No sequence specified.	The seat and disc are re-lapped together. The seat and disc are lapped together so that better surface evenness of the disc is achieved. Lapping is performed by slight circular hand movements.	

8.1.2 Re-lapping with a glass plate

Illustrations	Description	Aids / Tools
Glass plate **Figure 8.1.2-1**	Re-lapping the seat with a glass plate results in greater surface evenness.	

8.1.3 Re-lapping the nozzle and the disc

Illustrations	Description	Aids / Tools
Nozzle **Figure 8.1.3-1**	Re-lapping of the nozzle and the disc is performed separately on a glass plate. Mix the monocrystalline diamond powder together with the oleic acid on the glass plate and then lap the nozzle and the disc. Lapping is performed by slight circular hand movements.	

Alternate methods that ensure the same effect may be used.

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4 Introduction 1
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5.1 Type 48x Clamp rings and Split-rings 3
6 Caps and lifting devices 4
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8 Screwed plugs, locking screws (metal sealing) 6
9 Nozzles, inlet bodies and screwed bonnets (T459/462) 6
10 Torques for sealing plate disks (valve types 441/433/526) 9

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1 Purpose

This LESER Global Standard (LGS) describes torques ranges for screws and bolts.

2 Range of application

This LGS is valid for all members of LESER Quality union.

3 References

None

4 Introduction

The above torque ranges are valid for material marked full shaft screws or full shaft bolts and nuts used for the connection between body and bonnet according to AD-B7 and similar applications.

The torque ranges are valid for lubricated threads with a friction factor or 0,1 and rectangular facings of the nuts in relation to the bore. With the above torques about 70 – 90 % of the yield strength of the material is reached.

For higher friction factors (0,12 – 0,15) the higher valves for the torque are required. The maximum limits must not be exceeded.

Data base: The 70 % valves (low torque valve) for friction factor 0,1 are taken from the catalogue of „Fa. Gebr. Grohmann, 1991, Wissenswertes über Edelstahlschrauben".

5 Body and bonnet connection

Material	Material equivalent	Min. – max. Torque [Nm]					
DIN	ASME	Thread					
		M10	M 12	M 16	M 20	M 24	M 27
Ck 35/ C 35 (1.1181)	Steel	18 - 22	28 - 36	68 - 87	130 - 166	255 - 288	
A4 Klasse 70 (1.4401)	A193 B8M Cl.2	25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	310 - 345
	A193 B8M Cl.1	25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	
5.6	-	19 - 22	30 - 39	73 - 93	--	--	--
8.8	-	40 - 45	65 - 84	155 - 198	--	--	--
	A320 Gr. B8M	25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	310 - 345
1.7225	A 193 Gr. B7		60 - 70	135 - 170	220 - 250	280 – 320	450-480
	A 320 Gr. L7		60 - 70	135 - 170	220 - 250	280 – 320	450-480
	A 320 Gr. L7M		60 – 70	135 - 170	220 - 250	280 – 320	450-480
1.4301	A 193 Gr. B8 CL. 2		60 - 70	135 - 170	250 - 260	250 – 300	
	A 193 Gr. B8T CL. 2			135 - 170	250 - 260		
	A320 Gr. B8 CL. 2	35 - 40	60 - 70	135 - 170	250 - 260	250 - 300	
1.4462	SA-479	25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	310 - 345
1.4501	SA-479	25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	
	A 193 Gr. B7M		60 - 70	135 - 170	220 - 250	280 – 320	
	A453 Gr.660 Class D		70-85	160-190	280-300	340-360	
A5 Klasse 70 (1.4571)		25 - 30	45 - 58	108 - 138	204 - 261	202 – 258	310 - 345
2.4819	N10276	19 - 22	30 - 39	73 - 93	170-185	280-300	
	B8MLCuN-Cl.1B	18 - 22	28 - 36	68 - 87	130 - 166	255 - 288	
Torque to yield bolts:							
17709	A 193 Gr. B16	-	31 - 37	98 - 118	190 - 228	280 - 320	
	A 193 Gr. B7	-	31 - 37	98 - 118	190 - 228	280 - 320	

Table 1.1 for screws and nuts DIN 931, 933, 938 and EN 24032

Note: In case of Gylon gasket application, the nuts resp. screws have to be tightened again after 15 min.

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Material DIN	Material-equivalent ASME	Min. – max. Torque [Nm] * Thread M 12	M 16		
Ck 35/ C 35 (1.1181)	Steel	39 – 41	59 - 61		
5.6	-	39 – 41	59 - 61		

Table 2 for screws and nuts for safety valves Type 447/547

*) The above mentioned torqueses are based on field tests. They allow a tight connection without destroying the PTFE-material.

5.1 Type 48x Clamp rings and Split-rings

Table .1 + Table .2 list torques for screws and nuts for connection of body and bonnet for clean service valves - Type 48X.

Table 2.1: Torques for nuts for **Clamp rings** for clean service - Type 48X

Material DIN	Material-equivalent ASME	Torque [Nm] Thread M 6	M 8
KLAPPRING (1.4404)	(SS316)	6	14

Table 2.2: Torques for screws and nuts for clean service **Split-rings** - Type 48X

Material DIN	Material-equivalent ASME	Torque [Nm] Thread M 6	M 8	M 10
A4 Klasse 70 (1.4401)	(B8M)	11	26	51

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6 Caps and lifting devices

Size	Thread	Torque [Nm]**		Wrench size
		Standard	HALAR-coated gasket	
0	M 24 x 1,5	60 – 75	60 - 75	SW 27
I	M 33 x 1,5	80 – 100	60 - 75	SW 46
II	M 42 x 1,5	100 – 125	100 - 125	SW 55
III	M 60 x 1,5	140 – 175	240 - 270	SW 75
IV+V	M 75 x 1,5	175 – 220	n.a.	SW 95

Table 3: Caps and lifting devices (sealing torque)

**) To achieve manually with 200 mm extended wrench.
Sufficient for clean and lubricated threads and not damaged sealing surfaces.

n.a. Gasket not available for this size

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7 Test Gag

7.1 Short locking screws

For tightening of the short locking screws (pos. 2, e.g. drawing 190.0309-XX-B01) the torque ranges of table 4 are recommended.

Cap size Size lifting device	Thread size	Torque [Nm]***
0	M12	28 - 32
I	M12	
II	M12	
III	M12	
IV	M16	72 -76
V	M16	

Table 4: Test Gag: Recommended starting torque ranges for short screws

***) The used sealing rings out of vulcanised fibre may not be deformed further because they are soft sealings.

7.2 Long locking screws

For tightening of the long locking screws (pos. 1, e.g. drawing 190.0309-XX-B01) the torque ranges of table 5 are recommended.

Cap size Size lifting device	Thread size	Torque [Nm]*
0	M12	15
I	M12	
II	M12	20
III	M12	
IV	M16	35
V	M16	

Table 5: Test Gag: Recommended starting torque ranges for long screws

*) The torques ranges are not valid for O-ring discs and sealing plates designs. In case of need they have to be required at TB/DD.

7.3 Long locking screw as transport locking device

For tightening the long locking screw as transport locking device (e.g. drawing 190.0809-XX-B01) the torques are adjusted acc. to table 6.

Cap size Size lifting device	Thread size	Torque (All types) [Nm]
0	M12	4
I	M12	
II	M12	
III	M12	
IV	M16	
V	M16	

Table 6 Torque specification of long locking screw as transport locking device.

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8 Screwed plugs, locking screws (metal sealing)

Material DIN	Material equivalent ASME	Min. – max. torques [Nm] * Gewinde			
		G 1/8	G1/4	G1/2	
A4 Klasse 70 (1.4401)	(B8M)	15 - 20	35-40	65-90	

Table 7: Recommended locking torques for screwed plugs (e. g. Type 526)

*) Lower values are valid for sealing with sealing ring acc. to DIN 7603.

9 Nozzles, inlet bodies and screwed bonnets (T459/462)

Benennung/Name	Orifice/DN do or Size	Druckstufe/ Pressure Class	Gewindegröße Thread size	Anzugs-drehmoment Torque [Nm]
SITZBUCHSE/Nozzle 526 1E2	1 D+E2	150-600	M38x1,5	95
SITZBUCHSE/Nozzle 526 1.5E2	1,5 D+E2	900 -1500	M38x1,5	95
SITZBUCHSE/Nozzle 526 1.5F2	1,5 F2	150-1500	M48x1,5	95
SITZBUCHSE/Nozzle 526 1.5G3	1,5 G3	150-900	M48x1,5	95
SITZBUCHSE/Nozzle 526 1.5H3	1,5 H3	150-300	M48x1,5	95
SITZBUCHSE/Nozzle 526 1.5EF3	1,5 E+F3	2500	M48x1,5	95
SITZBUCHSE/Nozzle 526 2H3	2 H3	150-1500	M64x1,5	115
SITZBUCHSE/Nozzle 526 2J3	2 J3	150-300L	M64x1,5	115
SITZBUCHSE/Nozzle 526 2G+H3	2 G+H3	2500	M64x1,5	115
SITZBUCHSE/Nozzle 526 3K4	3 K4	150-600	M100x2	300
SITZBUCHSE/Nozzle 526 3L4	3 L4	150-300L	M100x2	300
SITZBUCHSE/Nozzle 526 3J4	3 J4	300-1500	M100x2	300

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SITZBUCHSE/Nozzle 526 3K4/6	3 K4/6	900-1500	M100x2	300
SITZBUCHSE/Nozzle 526 4L 6	4 L6	300-600	M120x2	430
SITZBUCHSE/Nozzle 526 4L6	4L6	900-1500	M120x2	430
SITZBUCHSE/Nozzle 526 4M6	4 M6	150-900	M120x2	430
SITZBUCHSE/Nozzle 526 4N6	4N6	150-900	M120x2	430
SITZBUCHSE/Nozzle 526 4P6	4 P6	150-900	M120x2	430
SITZBUCHSE/Nozzle 526 6Q8	6 Q8	150-600	M165x2	610
SITZBUCHSE/Nozzle 526 6R8	6 R8/10	150-600	M165x2	610
SITZBUCHSE/Nozzle 526 8T10	8 T10	150-300	M220x2	700
Type 457/458				
SITZBUCHSE Nozzle 458 DN 25/ 15	d015	Alle/all	M36x1,5	
SITZBUCHSE Nozzle 458 DN 25/ 20	do20	Alle/all	M36x1,5	**95**
SITZBUCHSE Nozzle 458 DN 50/ 30	do30	Alle/all	M64x1,5	
SITZBUCHSE Nozzle 458 DN 50/ 40	do40	Alle/all	M64x1,5	**115**
SITZBUCHSE Nozzle 458 DN 80/ 50	do50	Alle/all	M100x2	**300**
SITZBUCHSE Nozzle 458 DN 80/ 60	do60	Alle/all	M100x2	
SITZBUCHSE Nozzle 458 DN100 do50	do50	Alle/all	M120x2	
SITZBUCHSE Nozzle 458 DN100 do60	do60	Alle/all	M120x2	
SITZBUCHSE Nozzle 458 DN100 do74	do74	Alle/all	M120x2	
SITZBUCHSE Nozzle 458 DN100 do88	do88	Alle/all	M120x2	**450**
SITZBUCHSE Nozzle 458 DN150/110	do110	Alle/all	M165x2	**650**
Type 441/442 Sitzbuchse/Full nozzle				
DN25	do23	Alle/all	M36x1,5	**95**
DN40	do29+37	Alle/all	M48x1,5 M52x1,5	**95**
DN50	do46	Alle/all	M64x1,5	**115**
3"	do60	Alle/all	M85x1,5	**115**
DN80	do60	Alle/all	M100x2	**300**
DN100	do92	Alle/all	M120x2	**450**
Type 437/438/439 Eintrittskörper/Inlet body				
do6+10		Alle/all	M30x1,5	**90**

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Type 459/462 Eintrittskörper/Inlet body				
do6+9,13 und 17,5	Alle/all	Alle/all	M33x1,5	**100**
Type 459/462 Gehäuse/Federhaube Outlet body/Bonnet/ Spacer			M64x1,5	**250**
do6+9,13 und 17,5	Alle/all	Alle/all	M33x1,5	**100**
Type 431/433 PN160				
Klemmring/Sitzbuchse Clamps/nozzles	do12	Alle/all	M33x1,5	**100**

Table 8 Recommended torques of valve nozzles for type 441/442; 457/458 and 526, inlet bodies of type 437/438/438/459 and 462 and screwed bonnets (type 459/462)

protected

10 Torques for sealing plate disks (valve types 441/433/526)

Sealing plate disks of valve types 441/433/526 had been modified in project Vendi 95 (ECO 200295) and therefore the torques in table 9 for the fixing nuts are valid.

Thread Size Fixing Nut	Torque [Nm]
M5	**4**
M8	**15**
M12	**43**
M16	**70**

Table 9: Torques for sealing plate disks 441/433/526

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2 Gültigkeitsbereich / Range of application.....1
3 Referenzen / References 1
4 Geltungsbereich.....1
***5* O-Ring-Teller Befestigung, Teller aus 1.4404 / *o-ring-disc, material 1.4404* 2**
***6* Faltenbalg-Anschlussteil aus 1.4404 / *bellows connection, material 1.4404* 2**
7 Berechnungsformeln (LESER-intern) / *Calculation formulas (LESER internal)* .3

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1 Zweck / Purpose

Dieser LESER Global Standard (LGS) beschreibt Anzugsdrehmomente für O-Ring-Teller.
This LESER Global Standard (LGS) describes torques ranges for o-ring-disc.

2 Gültigkeitsbereich / Range of application

Dieser LGS gilt für die alle Mitglieder des LESER Qualitätsverbunds.
This LGS is valid for all members of LESER Quality union.

3 Referenzen / References

LGS 3325

4 Geltungsbereich

Die in den Tabellen angegebenen Montage-Anzugsmomente M_A sollen dazu dienen, dass eine Überbeanspruchung (Verdrehung) der Gewindeverbindung beim Festziehen verhindert wird. In Tabelle 2 werden außerdem empfohlene Drehmomente zur Erzielung von Dichtheit genannt.

Bemerkung:
Die Angaben über die Montage-Anzugsdrehmomente sind als annähernde Richtwerte zu betrachten, da das Anzugsdrehmoment durch unterschiedliche Oberflächen- und Schmierverhältnisse, aber auch durch mehrmaliges Anziehen und Lösen der Verbindung beeinflusst wird. Deshalb ist auch eine genaue Berechnung des Anzugsdrehmoments kaum möglich.
Seite 2 dieser LGS ist nur für den LESER internen Gebrauch bestimmt.

4 Range of application

The below mentioned torques MA are maximum valves to avoid damages to the threaded connections. In table 2 alson recommended torques for achieving tightness are mentioned.

Remark:
The torque values shall be taken as a recommendation. Different lubrification, frequent assembly and disassembly can influence the values substantially.
Page 2 of this LGS is limited for LESER internal use.

5 O-Ring-Teller Befestigung, Teller aus 1.4404 / *o-ring-disc, material 1.4404*

Gewindegröße *Thread size*	M 5	M 8	M 10	M 12	M 16	M 30
Max. M_A [Nm]	2	21	40	70	100	570
M_A empfohlen [Nm] *M_A recommended*	2-3	12-15	20-25	45-50	65-70	85-90

Tabelle 1 / *table 1*

6 Faltenbalg-Anschlussteil aus 1.4404 / *bellows connection, material 1.4404*

Gewindegröße *Thread size*	M 24 x 1,5	M 27 x 1,5	M 30 x 1,5	M 36 x 1,5	M 40 x 1,5	M 48 x 1,5	M 60 x 1,5
Max. M_A [Nm]	232	336	500	828	1220	2015	4000
M_A empfohlen *M_A recommended*	60-75	70-85	75 - 90	90-110	100 - 120	110-135	140-175

Tabelle 2 / *table 2*

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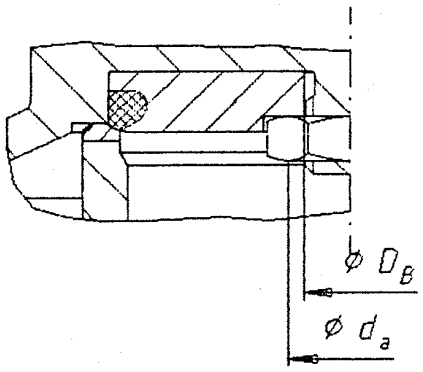

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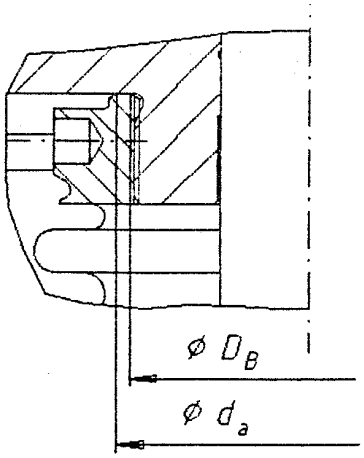

Bild 2

7 Berechnungsformeln (LESER-intern) / *Calculation formulas (LESER internal)*

Annähernde Berechnungsformel für das Anzugsdrehmoment der Schraubenverbindungen bei O-Ring-Teller und oberem Faltenbalg-Anschlussteil.

Montage-Anzugsdrehmoment: M_A
Die in LGS 3325 Blatt 1 angegebenen Tabellen beinhalten die Montage-Anzugsdrehmomente, die nach folgender annähernder Berechnungsformel errechnet sind:

$$M_A = 0{,}9 \times M_{A\,0{,}9} \qquad (1)$$

$$M_{A\,0{,}9} = 0{,}45 * A_s * o_{0,2} * d_2 * \left(\mu_{ges} * \left(1 + \frac{d_a + D_B}{2 * d_2} \right) + \frac{P}{\pi * d_2} \right) \qquad (2)$$

Formel (2) in (1):

$$M_A = 0{,}4 * A_s * o_{0,2} * d_2 * \left(\mu_{ges} * \left(1 + \frac{d_a + D_B}{2 * d_2} \right) + \frac{P}{\pi * d_2} \right) \qquad (3)$$

$M_{A\,0,9}$: Das maximale Anzugsdrehmoment, bei dem 90% der Streckgrenze ausgenutzt wird, in Nmm.

A_S: Spannungsquerschnitt des Gewindes in mm² (siehe Gewindetabellen).

$o_{0,2}$: Streckgrenze der Raumtemperatur in N/mm².

d_2: Flankendurchmesser des Gewindes in mm.

P: Steigung des Gewindes.

d_a, D_B: Siehe Bilder 1 und 2.

$\mu_{ges.}$: Gesamtreibungszahl
$\mu_{ges.} \approx 0{,}14$ im Normalfall, trocken.
$\mu_{ges.} \approx 0{,}1$ bei Gewinden mit MOS_2 - Paste geschmiert.

protected

Type 526 API

protected

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9.17 Sealing the valve 45

protected

1 Purpose

This LESER Global Standard (LGS) describes the assembly procedure for a LESER safety valve type 526 API.

2 Scope

This document must be applied to the assembly of an API safety valve in agencies and subsidiaries of LESER GmbH & Co. KG.

3 References

LGS 3325 (LWN 322-04)
WI 3308-08 (LWN 308-08)
LGS 3323 (LWN 322-03)
WI 3324-01 (LWN 324.01)

4 Disclaimer

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5 Qualified fitting personnel

The assembly of LESER safety valves may only be performed by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

6 General Information

- Gloves must be worn during the entire assembly.

7 General illustration

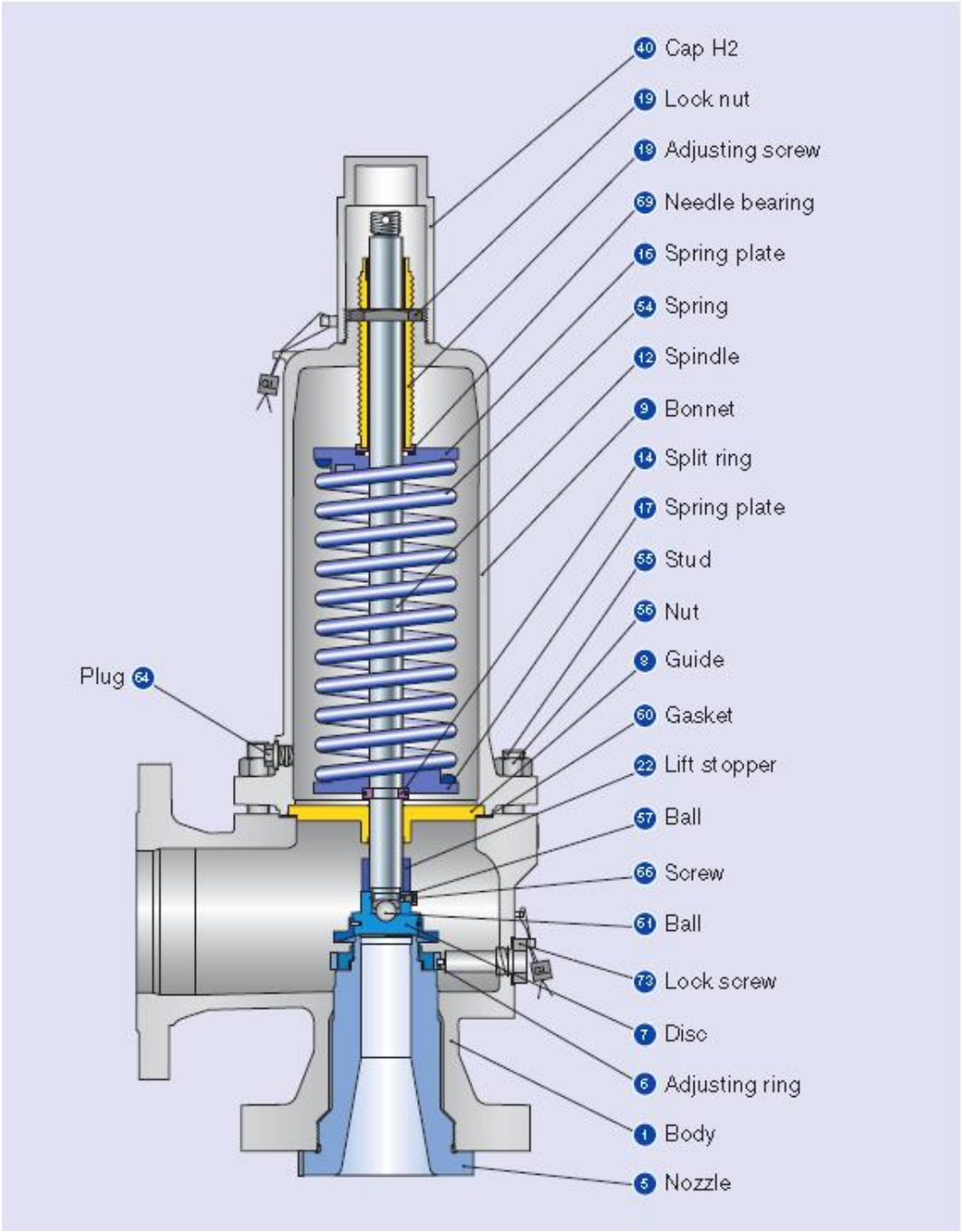


Figure 7-1: Cross-sectional view of API 526

protected

8 Preparation for valve assembly

8.1 Emboss the punch numbers (if requested in the order).

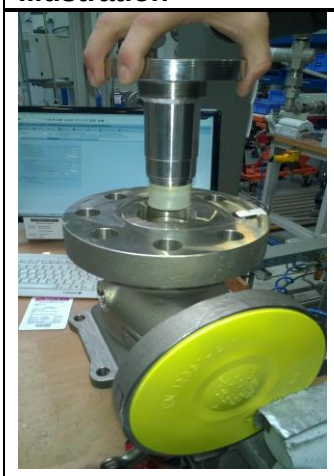
Illustration	Description	Aids / Tools
Figure 8.1-1	Emboss the code into the edge of the outlet flange (position of the code as per the work plan).	Hammer Punch numbers

9 Assembly of type 526

9.1 Assembly of the nozzle and blow down ring

Illustration	Description	Aids / Tools
Figure 9.1-1	Grease sealing surface	Brush Assembly grease (Molykote Paste)

protected

Illustration	Description	Aids / Tools
	While screwing the nozzle into the body, the protection of the nozzle should stay in place to secure the sealing surface against damage.	
Figure 9.1-2	Screw nozzle into the body.	
Figure 9.1-3	Tighten nozzle with C-spanner (put a small protective slab between the nozzle and C-spanner).	C-spanner with a nose

protected

Figure 9.1-4	Screw the blow down ring completely down to the nozzle.	

9.2 Screw the studs into the body.

Illustration	Description	Aids / Tools
Figure 9.2-1	Screw in the studs with an impact wrench. **Tip:** Place the guide washer on the opening of the body so that no studs can fall on the seat.	Impact wrench

protected

9.3 Installation of the locking screw and screw plug

Illustration	Description	Aids / Tools
Figure 9.3-1	Grease the locking screw and screw plug.	Brush Halocarbon (OI-56 S / 60H)

Figure 9.3-2	Grease a spacer ring for each of the screws and put on as a seal.	

Illustration	Description	Aids / Tools
Figure 9.3-3	Screw the locking screw into the back section of the body and tighten.	Open-end spanner
Figure 9.3-4	Screw the screw plug into the side of the body and tighten.	Open-end and ring spanner

protected

9.4 Assembly of disc assembly

9.4.1 Metal seat

Illustration	Description	Aids / Tools
Figure 9.4.1-1	Put disc body and lifting aid together and clamp in place.	Clamping block
Figure 9.4.1-2	Insert retaining ring and tighten with C-spanner.	C-spanner with a nose

protected

9.4.2 O-ring seal

Illustration	Description	Aids / Tools
Figure 9.4.2-1	Individual parts of the disc assembly with O-ring seal	

Illustration	Description	Aids / Tools
Figure 9.4.2-2	Wet O-ring with water and avoid any twisting when introducing it.	
Figure 9.4.2-3	Insert retainer.	
Figure 9.4.2-4	Screw nut onto neck and tighten. (Set torque as per LGS 3325).	Torque wrench with socket attachment Clamping block

protected

Illustration	Description	Aids / Tools
Figure 9.4.2-5	Secure the nut by hitting it with a centre punch	Centre punch Hammer
Figure 9.4.2-6	Emboss the marking for the O-ring material according to WI 3308-08 .	Punch numbers Hammer

protected

9.4.3 Disc with sealing plate

Illustration	Description	Aids / Tools
Figure 9.4.3-1	Individual parts of the disc assembly with sealing plate	
Figure 9.4.3-2	Put the sealing plate in the disc.	
Figure 9.4.3-3	Put the retainer on the sealing plate.	
Figure 9.4.3-4	Screw nuts onto studs and tighten (torque as per LGS 3325). Secure the nut by hitting it with a centre punch Emboss the marking for the sealing plate material according to WI 3308-08 .	Torque wrench with socket attachment Centre punch Hammer Punch numbers

protected

9.5 Assembly of spindle/disc assembly

9.5.1 Assembly of spindle/disc assembly (without bellows)

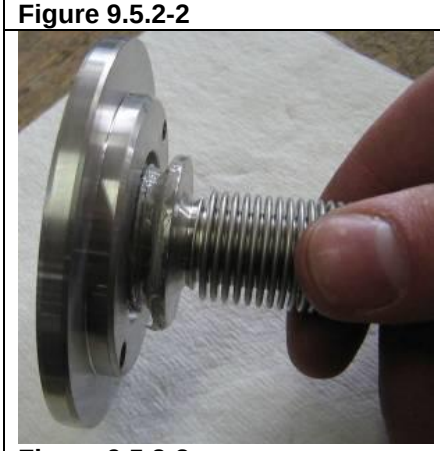
Illustration	Description	Aids / Tools
Figure 9.5.1-1	Insert the ball into the disc.	
Figure 9.5.1-2	Push on spindle and insert small balls into the screw opening of the disc.	Possibly tweezers
Figure 9.5.1-3	Screw in and tighten the clamping screw.	Ring spanner

protected

Illustration	Description	Aids / Tools
Figure 9.5.1-4	Put on lift stopper, if requested. (variable lift stopper; possibly determine in advance; see Chap. 10)	
Figure 9.5.1-5	Push on guide washer. Put half-washers in the recess of the spindle and secure with a retaining clip.	
Figure 9.5.1-6	Push the lower spring plate, the spring and the upper spring plate onto the spindle.	

protected

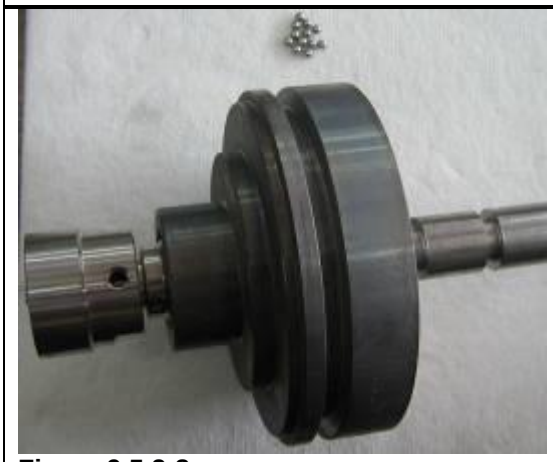
9.5.2 Assembly of spindle/disc assembly (with stainless steel bellows)

Illustration	Description	Aids / Tools
Figure 9.5.2-1	Stainless steel bellows and guide washer	
Figure 9.5.2-2	Grease the sealing surface and thread of the bellows.	Brush Assembly grease (Molykote Paste)
 **Figure 9.5.2-3**	Twist the guide washer onto the bellows. In some cases, larger bellows have an inside thread and are screwed on the corresponding outside thread of the guide washer.	
	Fix the guide washer in the vice and tighten it. (Torque as per LGS_3323)	

protected

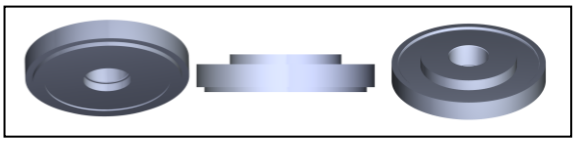
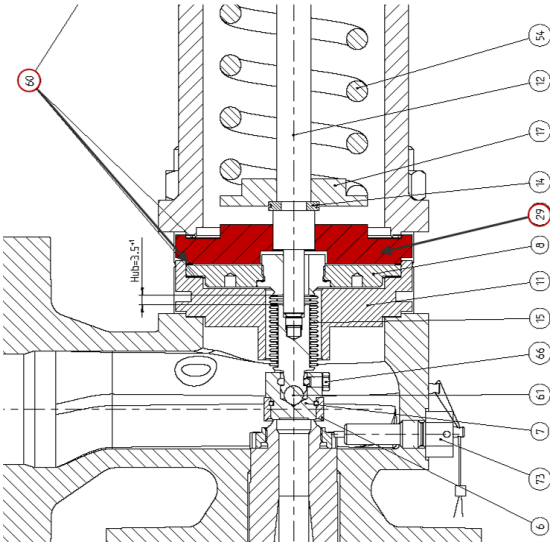
Illustration	Description	Aids / Tools
Figure 9.5.2-4	Stainless steel bellows and guide washer	
Figure 9.5.2-5	Sparingly apply one drop to the thread of the spindle.	Glue DELO ML 5327
Figure 9.5.2-6	Quickly screw the spindle together with the bellows hand tight.	
Figure 9.5.2-7	Put the cooling zone onto the spindle.	

protected

Illustration	Description	Aids / Tools
 **Figure 9.5.2-8**	Put the disc on the spindle. Put the balls into the opening of the disc, or alternatively secure the disc with a pin (depending on the disc version).	
Figure 9.5.2-9	Screw the clamping screw into the disc hole.	Ring spanner
Figure 9.5.2-10	Put half-washer into the recess and secure with a retaining clip.	

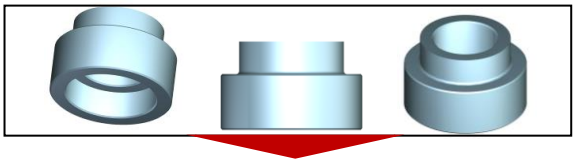
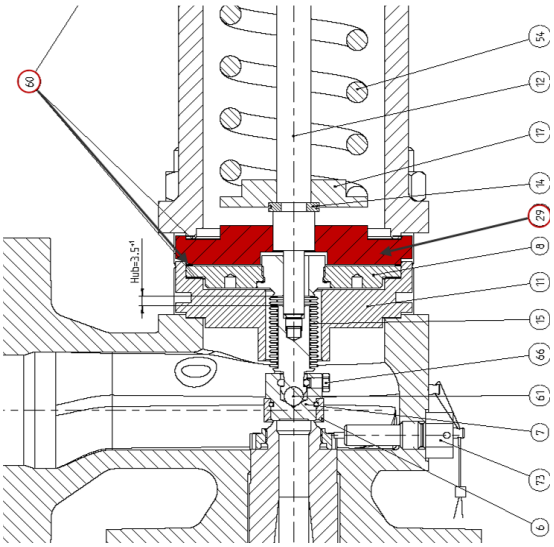
protected

9.5.3 Assembly spindle/disc-construction group (with stainless steel bellow and without balanced piston)

Balanced Piston 	Operate the assembly of the stainless steel bellow like in chapter: 9.5.2. up to incl. Figure 0-8. Then assembly balanced piston as follows.	
	(a) Put the sealing ring (pos.60) on the guide washer. (b) Afterwards push the balanced piston above the spindle. (pos.29)	
	Put half-washer into the recess and secure with a retaining clip.	

protected

9.5.4 Assembly spindle/disc-construction group (with stainless steel bellow and balanced piston)

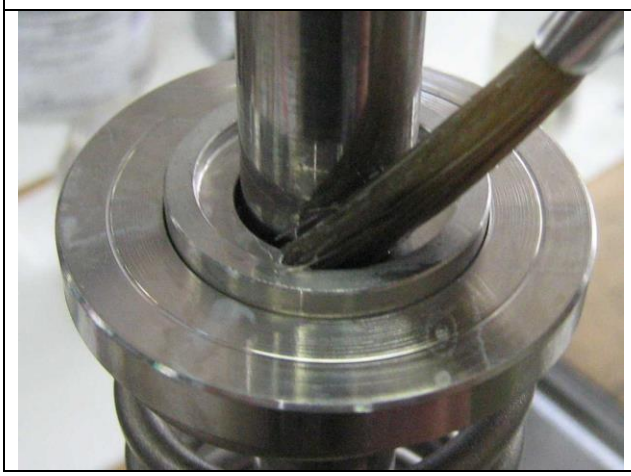
Balanced piston 	Operate the assembly of the stainless steel bellow like in chapter: 9.5.2. up to incl. Figure 0-8. Then assembly balanced piston as follows.	
	(a) Put the sealing ring (pos.60) on the guide washer. (b) Afterwards push the balanced piston above the spindle. (pos.29)	
	Put half-washer into the recess and secure with a retaining clip.	

protected

9.5.5 Insert construction group (without bellow)

	Insert disc-/spindle construction group carefully into the body. While doing so press the guide washer down and lift the spindle slightly up, so that the disc does not land. Put the disc with the spindle carefully on the seat.	Fixture according to fixture catalogue
	Put the spring and the upper spring disk on the lower spring disk.	

protected

	If applicable, grease the axial needle roller on the top spring plate.	Brush Halocarbon (OI-56 S / 60H)
	Put the bearing washer on the axial needle roller and grease.	Brush Halocarbon (OI-56 S / 60H)

protected

9.5.6 Inserting the spindle/disc assembly (with stainless steel bellows)

Illustration	Description	Aids / Tools
	Put the sealing into the body.	
	Insert the spindle/disc/cooling zone into the body. In the process, push the guide washer down and lift the spindle somewhat so that the disc does not touch down. Carefully put the disc with the spindle down on the seat.	

Figure 9.5.3-1

protected

Figure 9.5.3-2	Put the bottom spring plate, the spring and the top spring plate on one after the other.	

protected

Illustration	Description	Aids / Tools
Figure 9.5.3-3	If applicable, grease the axial needle roller on the top spring plate.	Brush Halocarbon (OI-56 S / 60H)
Figure 9.5.3-4	Put the bearing washer on the axial needle roller and grease.	Brush Halocarbon (OI-56 S / 60H)

protected

9.6 Assembly of the bonnet

Illustration	Description	Aids / Tools
Figure 9.6-1	Put the bonnet on the studs. Screw nuts onto the studs and tighten. (Set torque as per LGS 3323).	Torque wrench

9.7 Determination and installation of the lift stopper

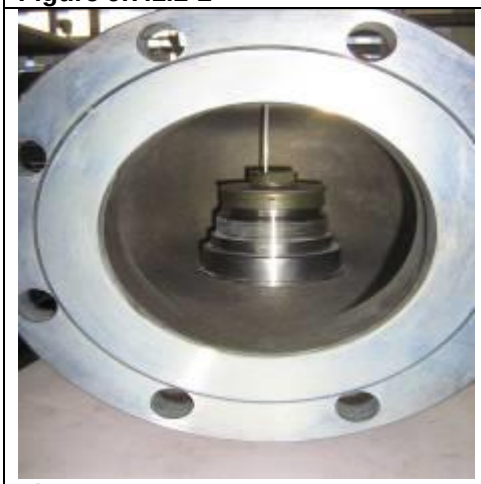
9.7.1 Lift stopper with ring/sleeve

9.7.1.1 Procedure for small valves without bellows (up to approx. DN 65 / 2 1/2").

Illustration	Description	Aids / Tools
Figure 9.7.1.1-1	Take the extent to which the stroke has to be limited from the work order. Insert the spindle/disc assembly without the spring and spring plate. Put on the bonnet and tighten the nuts. Make the adjusting screw and spindle flush.	
Figure 9.7.1.1-2	Clamp the body on the outlet in the vice. Lift the disc with a screwdriver through the inlet as far as it will go.	Screwdriver Clamping block
Figure 9.7.1.1-3	Measure the spindle overlap in an opened state. Deduct the requested stroke from this measurement and have a lift stopper made.	Sliding Vernier calliper

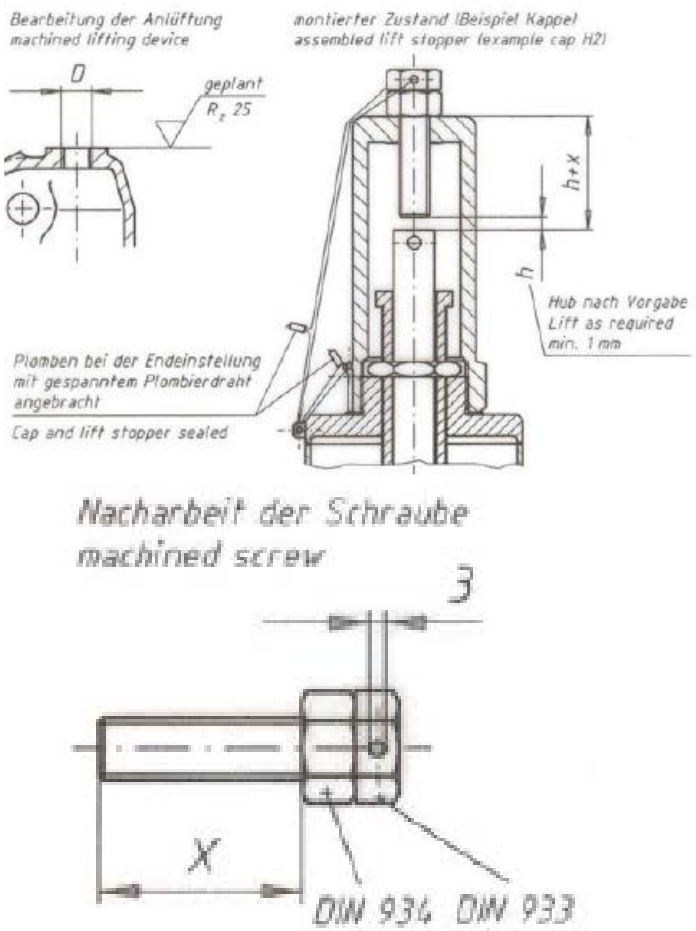
protected

9.7.1.2 Procedure for large valves without bellows (as of approx. DN 80 / 3").

Illustration	Description	Aids / Tools
Figure 9.7.1.2-1	Carefully put the disc on the nozzle and put the sealing ring in the body. Take the extent to which the stroke has to be limited from the job order.	
Figure 9.7.1.2-2	Put the guide washer on the body.	
 **Figure 9.7.1.2-3**	Use the depth gauge to measure the path from the top edge of the guide washer to the top edge of the disc. Deduct the measurement of the guide washer as well as the desired stroke from the order and have the lift stopper made.	

protected

9.7.2 Lift stopper with set screw (taken from WI 3324-01)

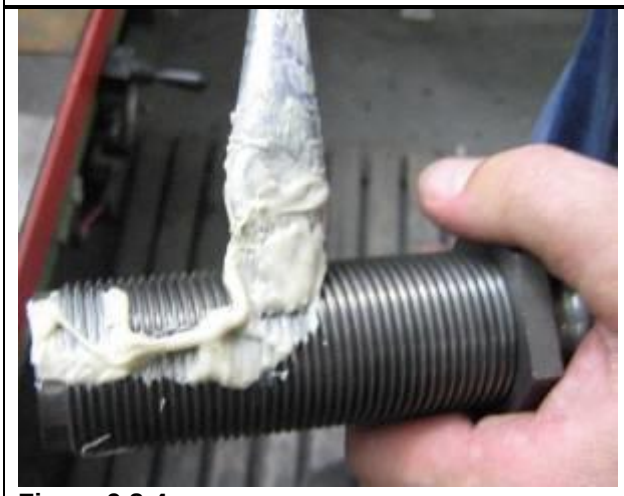
Illustration	Description	Aids / Tools
 **Figure 9.7.1.2-1**	Take the extent to which the stroke has to be limited from the job order. Use a completely assembled valve to measure the distance from the top edge of the cap/lever to the end of the spindle. Deduct the measurement of the guide washer as well as the desired stroke from the order and have the lift stopper made. Seal the screws with PTFE tape, screw them in and tighten. (Set torque as per LGS 3323).	PTFE tape Sliding Vernier calliper

protected

9.8 Assembly of the adjusting screw

Illustration	Description	Aids / Tools
Figure 9.8-1	Individual parts of the adjusting screw	
Figure 9.8-2	Put the bushing in the adjusting screw.	
Figure 9.8-3	Screw the lock nut on approximately three-quarters of the way down the adjusting screw.	

protected

Illustration	Description	Aids / Tools
 **Figure 9.8-4**	Grease adjusting screw	Brush Assembly grease (Molykote Paste)
Figure 9.8-5	Screw the adjusting screw into the bonnet until resistance from the spring is felt.	

protected

9.9 Adjusting the set pressure

Illustration	Description	Aids / Tools
Figure 9.9-1	Secure the spindle from turning with a pin punch.	Pin punch Open-end spanner
Figure 9.9-2	Slowly pressurise the valve on the test bench to find out whether the valve opens at the set pressure. The set pressure of the valve has been reached when you can hear air escaping. Full opening must be achieved. If the valve opens outside the stipulated set pressure tolerance, then the adjusting screw must be adjusted again. Turning in a clockwise direction causes the valve to open at higher pressure. Turning in a counter-clockwise direction causes the valve to open at lower pressure. Release the pressure when readjusting the adjusting screw. Readjust the adjusting screw and then pressurise the valve again.	Open-end spanner
Figure 9.9-2	If the pressure setting has been completed, secure the adjusting screw with a lock nut. Afterwards, check the set pressure once again.	Open-end spanner

protected

9.10 Testing the seat tightness P12

This test is performed for every valve after setting the pressure.

The exact execution of the test is described in a separate work instruction ***AA-EF-013***.

9.11 Assembly of the cap / lever

9.11.1 Assembly of cap H2

Illustration	Description	Aids / Tools
Figure 9.11.1-1	Grease the thread and sealing face of the cap.	Brush Halocarbon (OI-56 S / 60H)
Figure 9.11.1-2	Screw on the cap and tighten with a spanner. (Set torque as per LGS 3323).	Open-end spanner

protected

9.11.2 Assembly of lever H3

Illustration	Description	Aids / Tools
Figure 9.11.2-1	Put the spindle cap onto the spindle and secure with a pin and retaining clip.	
Figure 9.11.2-2	Put clamping screw into H3 cap at designated place.	Ring spanner
Figure 9.11.2-3	Put the small plastic balls in the hole of the adjusting screw.	
Figure 9.11.2-4	Grease the thread of the lever and screw it onto the bonnet (lever must be opposite from outlet).	Brush Halocarbon (OI-56 S / 60H)

protected

Illustration	Description	Aids / Tools
Figure 9.11.2-5	Insert the venting lever into the spindle cap.	
Figure 9.11.2-6	Use a pin and retaining washers to secure the venting lever.	
Figure 9.11.2-7	Make sure that the lever has enough play to vent.	
Figure 9.11.2-8	Tighten the clamping screw on the lever.	Ring spanner

protected

9.11.3 Special assembly of the Cap H3

There are different variations to assemble the H3 Cap.

The variation A describes the standard variation.

The variation B is pulled by the option code M08 and as well shown in the work plan.

The variations B and C are dealt with exclusively in the EOM.

.

Variante	Beschreibung	Steuerung	H3 Anlüftung
A	Position: **Standard**	-/-	
B	Position: **90° versetzt zum Standard** (Richtung Austritt)	**Sonder**	
C	Position: **180° versetzt zum Standard** (Richtung Austritt)	**M08**	
D	Position: **270° versetzt zum Standard** (Richtung Austritt)	**Sonder**	

protected

Cap H4

9.11.4 Test of the lifting fork position

right

wrong

***Lüftegabel** assembled wrong (position)*

1. working steps

- Before the assembly of the already assembled H4 cap the position of the lifting fork within the cap has to be checked to guarantee that the cap is working properly.
    - With it take a look from the thread side into the cap and check the position of the lifting fork.

2. aid

- k.A.

3. tool

- k.A.

4. device

- k.A.

protected

9.11.5 Assembly of lever H4

Illustration	Description	Aids / Tools
Figure 9.11.5-1	Put the spindle cap onto the spindle and secure with a pin and retaining clip.	
Figure 9.11.5-2	Align the lever with sealing rings so that the lever arm is parallel to the outlet.	
Figure 9.11.5-3	Grease the lever and sealing rings. Put them on and tighten with an open-end spanner (torque as per LGS 3323).	Open-end spanner Torque wrench

protected

9.11.6 Special assembly of the cap H4

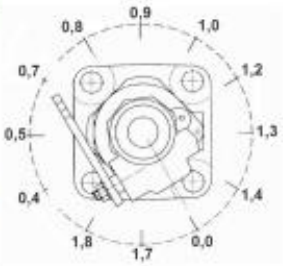
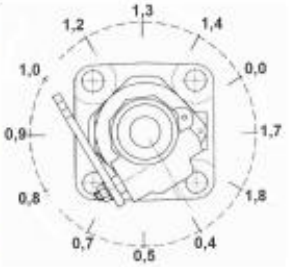
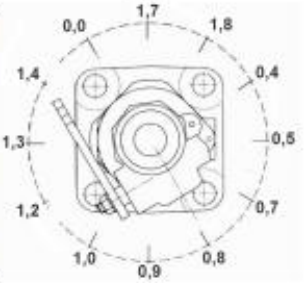
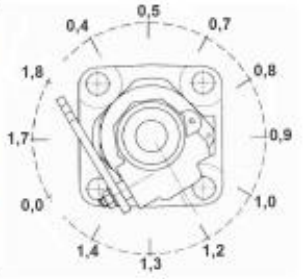
There are different variations to assemble the H4 cap.

The variation A describes the standard variation.

The variation B is pulled by the option code M08 and as well shown in the work plan.

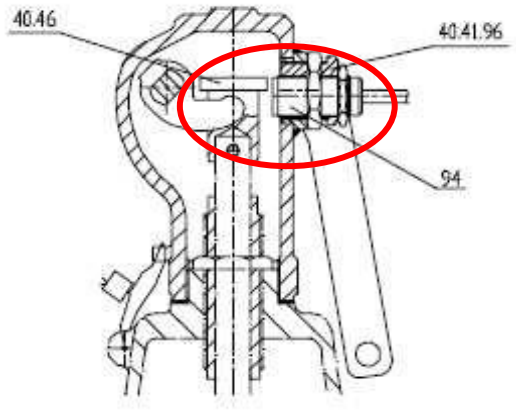
The variations B and C are dealt with exclusively in the EOM.

.

Variante	Beschreibung	Steuerung	H4 Anlüftung	
A	Position: **Standard**	-/-		
B	Position: **90° versetzt zum Standard** (Richtung Austritt)	Sonder		
C	Position: **180° versetzt zum Standard** (Richtung Austritt)	M08		
D	Position: **270° versetzt zum Standard** (Richtung Austritt)	Sonder		

protected

9.12 Assembly of the lift indicator

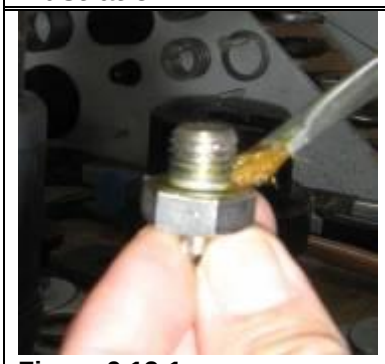
Illustration	Description	Aids / Tools
Figure 9.12-1	Individual parts of the lift indicator	
Figure 9.12-2	Put the cap into position as described in 13.3 and secure.	Open-end spanner
 **Figure 9.12-3**	Put the eccentric hole of the holder into such a position that the collar of the spindle cap would seal on top with the edge of the lift indicator (see illustration).	

protected

Illustration	Description	Aids / Tools
Figure 9.12-4	Secure the position with a lock nut.	
Figure 9.12-5	Screw the lift indicator into the collar of the spindle cap as far as it will go. Then unscrew it one complete turn. Secure the position of the lift indicator by tightening the first nut hand tight. Then lock with a second nut.	

protected

9.13 Installation of the test gag (possible for H2 and H4)

Illustration	Description	Aids / Tools
 **Figure 9.13-1**	Grease the sealing surface of the short bolt.	Brush Halocarbon (OI-56 S / 60H)
Figure 9.13-2	Put on the sealing ring and grease it as well.	Brush Halocarbon (OI-56 S / 60H)
Figure 9.13-3	Screw the test gag into the cap or lever and tighten (torque as per LGS 3323).	

protected

9.14 Installation of the different O-ring dampers

9.14.1 O-ring damper H2

Illustration	Description	Aids / Tools
Figure 9.14.1-1	Individual parts of the O-ring damper H2	
Figure 9.14.1-2	Put the support sleeve onto the adjusting screw.	
Figure 9.14.1-3	Put O-ring onto the spindle over the support sleeve. The O-ring must not sit on the cross hole or a thread, if one is present. ⚠	

protected

Illustration	Description	Aids / Tools
Figure 9.14.1-4	Put the counter ring onto the O-ring or support sleeve.	
Figure 9.14.1-5	Put retaining spring onto the counter ring.	
Figure 9.14.1-6	Grease the cap on the thread. Screw it onto the bonnet and tighten (torque as per LGS 3323).	Open-end spanner

protected

9.14.2 O-ring damper H4

Illustration	Description	Aids / Tools
Figure 9.14.2-1	Individual parts of the O-ring damper H4	
Figure 9.14.2-2	Fasten the O-ring damper on the spindle with a steel pin and retaining clip. Then assemble the H4 lever cover as described in 12.43.	
Figure 9.14.2-3		

protected

Illustration	Description	Aids / Tools
Figure 9.14.2-4	Put the first O-ring - counter ring - second O-ring - support sleeve - spring - cap onto the lever one after the other.	
Figure 9.14.2-5		
Figure 9.14.2-6	Grease, screw on and tighten the thread and sealing lip of the cap (torque as per LGS 3323).	Halocarbon (OI-56 S / 60H) Open-end spanner

protected

9.15 Adjusting the set pressure

Pressurise the valve as per the workplace description.

Check whether the valve opens at the set pressure. The set pressure of the valve has been reached when the pressure display remains constant when the line pressure increases. It must fully open.

The valve must open within the tolerance range 3 times in succession.

Document the set pressure.

9.16 Testing the seal tightness of the back seal P21 (seal tightness to the outside)

This test is performed for every gas-tight valve after its assembly.

9.17 Sealing the valve

Illustration	Description	Aids / Tools
Figure 9.17-1	If structurally possible (sealing hole/lug on cap/lever and bonnet exist), then seal the valve. Otherwise sealing lugs must be welded on. Closely connect the sealing hole or lug from the cap/lever and bonnet in a clockwise direction, and connect the locking screw and sealing lug with sealing wire and seal the ends of the wire with a lead seal. If classification approvals (TÜV etc.) are required, then seal afterwards.	Sealing pliers Wire twisting pliers Sealing block Wire

protected

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4 Qualified fitting personnel 1
5 General Information 2
6 Paint touch-up and painting repaired valves 2

1 Purpose

This LESER Global Standard (LGS) provides instructions on painting LESER safety valves. The required work steps and materials are described.

2 Scope

This document must be applied when painting safety valves in agencies and subsidiaries of LESER GmbH & Co. KG.

protected

3 Disclaimer

LESER puts in a great deal of effort into making up-to-date and correct documentation available. Nevertheless, LESER GmbH & Co. KG gives no guarantee that the recommended actions presented here are entirely correct and error free. This document is to be applied exclusively to the specified type. LESER GmbH & Co. KG declines any liability or responsibility for the correctness and completeness of the content.

LESER GmbH & Co. KG reserves the right to change the information contained in this document, which is for the products of LESER GmbH & Co. KG and is intended for LESER subsidiaries, at any time and without prior announcement.

LESER GmbH & Co. KG is available to the users of this document to provide additional information.

4 Qualified fitting personnel

The assembly of LESER safety valves may only be performed by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

5 General Information

- Wear safety glasses
- Wear respirator/dust mask

6 Paint touch-up and painting repaired valves

For valves that have to be repainted, the facing and the welded-on component/customer ID plates must be masked off correctly. Any additional plates will only be attached after painting, if welding is not required. Open bonnets must be sealed with protective caps. The same applies to any existing threaded holes. Outside threads must be protected with a suitable protective cap / existing painting socket or with masking tape.

Figure 6-1: Protective cap for open bonnet

Figure 6-2: Flange sticker

protected

disclosure cat.:	II	proofread:	OR	published date:	9/14/11	effect. date:	18.11.201
author:	Nieh	released by:	KUW	replaces:	initial	status:	published
resp. depart.:	PP	date of release:	11/8/11	revision No.:	0		
doc. type:	LGS	change rep. No.:	651A	retention period:	10		

Figure 6-3: Component plate sticker

Figure 6-4: Protective cap

Figure 6-5: Component plate sticker

Figure 6-6: Protective cap

protected

Figure 6-7: Masking tape

Figure 6-8: Protective cap

Figure 6-9

The layer thickness of the coat of paint should be ~ 40µm for one coat of paint.

protected

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2 Scope 1
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6 Attaching component/customer identification plates 2
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6.2 World plate (NGA) 4
6.3 Fastening to bonnets with welding spots 8

1 Purpose

This LESER Global Standard (LGS) provides instructions on attaching the name plates of LESER safety valves. The required work steps and materials are described.

2 Scope

This LGS must be applied when attaching the name plates of safety valves in agencies and subsidiaries of LESER GmbH & Co. KG.

3 Disclaimer

LESER puts in a great deal of effort into making up-to-date and correct documentation available. Nevertheless, LESER GmbH & Co. KG gives no guarantee that the recommended actions presented here are entirely correct and error free. This document is to be applied exclusively to the specified type. LESER GmbH & Co. KG declines any liability or responsibility for the correctness and completeness of the content.

LESER GmbH & Co. KG reserves the right to change the information contained in this document, which is for the products of LESER GmbH & Co. KG and is intended for LESER subsidiaries, at any time and without prior announcement.

LESER GmbH & Co. KG is available to the users of this document to provide additional information.

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4 Qualified fitting personnel

The name plates of LESER safety valves must attached exclusively by trained or qualified fitters. The relevant qualifications must be obtained through appropriate training measures.

5 General Information

- Gloves must be worn for all fitting work (except for stainless steel and painted valves).
- Wear safety glasses.

6 Attaching component/customer identification plates

If grooved pins with round heads are not required, the plate is to be welded to the designated place with the spot welding device.

The world plate (NGA) is fastened to the bonnet. In exceptional cases, it may also be fastened with grooved pins with round heads, in which case it may also be fastened to the body.

The standard plate is welded to the flat surface designated for that purpose.

Types 437, 438, 439 - outlet body

Types 459, 462, - bonnet

No fastening with grooved pins with round heads

Flanged valves - on the **right** side as seen from the outlet side. **Exception**: Types 457 / 458 / 526 - on the back side using the set screw

protected

6.1 Standard plate

Figure 6.2.1-1

The standard plate comes in two versions.

For valves that are designed according to ASME (feature N68/N70), the version is created with the UV and NB symbols.

For valves that are designed according to TÜV, the UV and NB symbols are not included.

Attachment locations for standard component plates

Figure 6.2.1-2: Type 459

Figure 6.2.1-3: Type 462

protected

Figure 6.2.1-4: Type 437

Figure 6.2.1-5: Type 462

Figure 6.2.1-6: Standard plate on a flanged valve

Figure **6.2.1-7**: Types 457 / 458 / 526

protected

6.2 World plate (NGA)

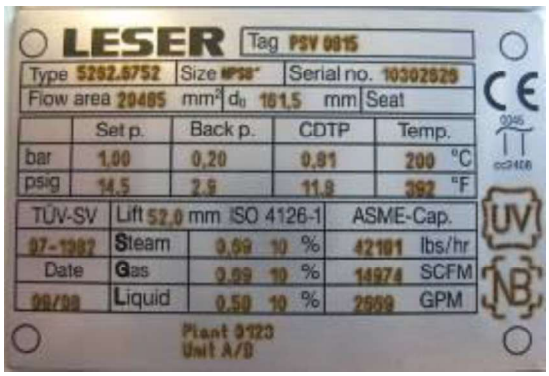


Figure 6.2.1-1

The world plate (NGA) comes in two versions.

For valves that are designed according to ASME (feature N68/N70), the version is created with the UV and NB symbols.

For valves that are designed according to TÜV, the UV and NB symbols are not lasered on.

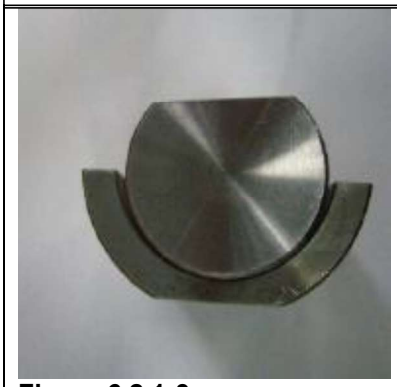
6.2.1 Pre-curving of the NGA

For bonnets with a curved cross-section, the plate must be pre-curved with a radius. To do this, place the labelled plates in the apparatus with the lettering facing down.

Illustrations	Description	Aids / Tools
Figure 6.2.1-1	Pre-curving the plate	Apparatus
	Pre-curving the plate for open bonnets (V20-V25)	Apparatus

protected

Figure 6.2.1-2		

Illustrations	Description	Aids / Tools
 Figure 6.2.1-3	Adjustment of plate for closed bonnets (V20 - V32)	

When opening bonnets V20-V25, the plate is bent in the longitudinal direction. To do this, put the labelled plates into the apparatus with the lettering facing down (figure 6.2.1-2).

protected

6.2.2 Corrosion protection

All valves that are painted must have corrosion protection under the world sign. To do this, apply the standard primer coat (BURCHARTH'S BLUE - 60M.0120.0001) to the respective place with a sponge.

Illustrations	Description	Aids / Tools
Figure 6.2.2-1		

Illustrations	Description	Aids / Tools
Figure 6.2.2-2		Sponge
Figure 6.2.2-3	The points where the world plate will be welded must be free of paint.	

protected

6.3 Fastening to bonnets with welding spots

6.3.1 Quadratic cross-section

Illustrations	Description	Aids / Tools
Figure 6.3.1-1	For API valves, the world plate is fastened to the bonnet of the valve with welding spots. For versions of closed bonnets with a quadratic cross-section, the world plate is attached vertically to the front side of the valve approx. 5 mm above the bevelled edge.	

6.3.2 High Performance valves

For the High Performance series, the world plate is always attached to the bonnet. However, the location where the plate is attached is different for individual bonnet sizes.

a) Closed bonnets (V20 - V32)

Illustrations	Description	Aids / Tools
Figure 6.3.2-1	The world plate is attached to the bonnet (V20 - V32). For closed bonnets, the world plate is displaced 90° with respect to the eyelet for the sealing wire so that the plate is located on the opposite side of the outlet for a completely assembled valve.	

protected

b) Open bonnets (V20 - V25)

Illustrations	Description	Aids / Tools
Figure 6.3.2-2	The world plate is attached to open bonnets V20 - V25. It is attached above the cast LESER lettering and should be flush with the letter "L". The plate must be mounted so that it can be read from the right (as shown in the picture).	

c) Open bonnet (V32)

Illustrations	Description	Aids / Tools
Figure 6.3.2-3	For open bonnets V32, the world plate is displaced 90° with respect to the eyelet in front of the sealing wire so that the plate is displaced by 90° with respect to the outlet for a completely assembled valve. The top edge of the plate should be flush with the bevel of the bonnet.	

protected

d) Open bonnet (V40)
Position of the bonnet:

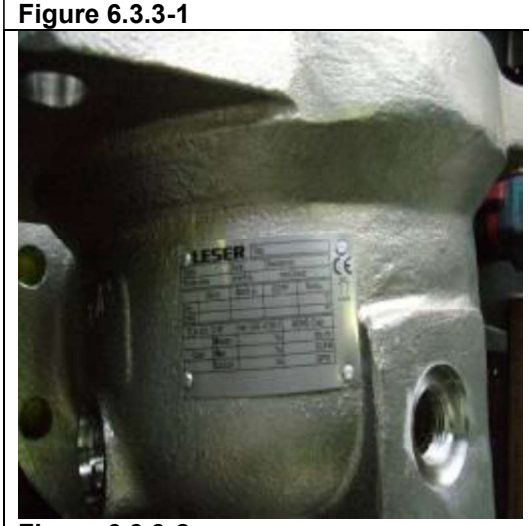
The raised identifier of the product form manufacturer (foundry) is mounted in the direction of the outlet flange.

Position of the world plate

The world plate is positioned on the free back side on the bottom edge of the bonnet.

6.3.3 Fastening with grooved pins with round heads

Illustrations	Description	Aids / Tools

 Figure 6.3.3-1	The plate is also curved for this purpose. When grooved pins with round heads are used for fastening, the world plate must be fastened at the back or at the side of the body for the API valve.	
 **Figure 6.3.3-2**		

protected

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2.Scope 1
3.References 1
4.Legend / Indices 1

1 Purpose

This LESER Global Standard (LGS) contains the information about pressure range of all springs, which are installed in valve- type 526.

2 Scope

This LGS applies to all members of the LESER quality cluster as defined in the global quality management manual.

This LGS contains information about the pressure range of all springs, which are installed in valve- type 526.
The pressure ranges of the various types are given first in pressure-unit [bar, page 2- 24].
This is followed by the pressure-unit [psig, page 25- end].

For additional information please see legend description.

3 References

LDeS 3060.01, LDeS 3265.01

4 Legend / Indices

- S = Sonderauftrag / special order
- O = oberen Spindeleinstich verwenden / use upper spindle groove
- FT oder / or SP = Sonder-Federteller / special spring plate
- Blaue Markierung/ blue marking = Drucklagereinsatz / thrust bearing use
- P = Sonderpreis / special price
- Faba = Faltenbalgeinsatz/ bellow use

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1D2				**1D2**				**1D2**				**1D2**			
0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S
0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8207.0000	
0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8207.0000	O
1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8227.0000	
1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8227.0000	O
1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8237.0000	
2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8237.0000	O
3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4367.0000	
4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4367.0000	O
6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4377.0000	O
11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4397.0000	
11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4397.0000	O
16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9437.0000	
19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9437.0000	O
24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4417.0000	
24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4417.0000	O
34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4427.0000	O
45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4437.0000	O
65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4447.0000	O
83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4447.0000 540.9477.0205	O
91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4467.0000	O

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
1 1/2D2				**1 1/2D2**				**1 1/2D2**				**1 1/2D2**			
5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8437.0000	
7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4657.0000	
11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4677.0000	
18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4687.0000	
28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4697.0000	
40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4707.0000	
58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4717.0000	
80,01	-120,00	540.5632.0000		80,01	-120,00	540.5632.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4727.0000	
120,01	-175,00	540.4734.0000		120,01	-175,00	540.4734.0000		120,01	-175,00	540.4734.0000		120,01	-175,00	540.4737.0000	
175,01	-255,40	540.5652.0000		175,01	-255,40	540.5652.0000		175,01	-255,40	540.4724.0000		175,01	-255,40	540.4727.0000	
										540.9604.0000				540.9607.0205	
1 1/2D3				**1 1/2D3**				**1 1/2D3**				**1 1/2D3**			
18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4687.0000	
28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4697.0000	
40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4707.0000	
58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4717.0000	
80,01	-120,00	540.4724.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4727.0000	
120,01	-150,00	540.4734.0000		120,01	-150,00	540.4734.0000		120,01	-150,00	540.4734.0000		120,01	-150,00	540.4737.0000	
150,01	-225,00	540.9634.0000		150,01	-225,00	540.9634.0000		150,01	-225,00	540.9634.0000		150,01	-225,00	540.9637.0000	
225,01	-310,00	540.9644.0000		225,01	-310,00	540.9644.0000		225,01	-310,00	540.9644.0000		225,01	-310,00	540.9647.0000	
310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9647.0000 540.9607.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1E2				**1E2**				**1E2**				**1E2**			
0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S
0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8204.0000		0,51	- 0,70	540.8207.0000	
0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8204.0000	O	0,71	- 1,20	540.8207.0000	O
1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8224.0000		1,21	- 1,50	540.8227.0000	
1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8224.0000	O	1,51	- 1,90	540.8227.0000	O
1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8234.0000		1,91	- 2,30	540.8237.0000	
2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8234.0000	O	2,31	- 3,20	540.8237.0000	O
3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4364.0000		3,21	- 4,30	540.4367.0000	
4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4364.0000	O	4,31	- 6,80	540.4367.0000	O
6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4374.0000	O	6,81	- 11,00	540.4377.0000	O
11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4394.0000		11,01	- 11,80	540.4397.0000	
11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4394.0000	O	11,81	- 16,30	540.4397.0000	O
16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9434.0000		16,31	- 19,50	540.9437.0000	
19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9434.0000	O	19,51	- 24,00	540.9437.0000	O
24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4414.0000		24,01	- 24,50	540.4417.0000	
24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4414.0000	O	24,51	- 34,00	540.4417.0000	O
34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4424.0000	O	34,01	- 45,00	540.4427.0000	O
45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4434.0000	O	45,01	- 65,00	540.4437.0000	O
65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4444.0000	O	65,01	- 83,00	540.4447.0000	O
83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4444.0000 540.9474.0205	O	83,01	- 91,70	540.4447.0000 540.9477.0205	O
91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4464.0000	O	91,71	-102,00	540.4467.0000	O

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
1 1/2E2				**1 1/2E2**				**1 1/2E2**				**1 1/2E2**			
5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8434.0000		5,00	- 7,50	540.8437.0000	
7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4654.0000		7,51	- 11,50	540.4657.0000	
11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4674.0000		11,51	- 18,50	540.4677.0000	
18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4684.0000		18,51	- 28,00	540.4687.0000	
28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4697.0000	
40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4707.0000	
58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4717.0000	
80,01	-120,00	540.5632.0000		80,01	-120,00	540.5632.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4727.0000	
120,01	-175,00	540.4734.0000		120,01	-175,00	540.4734.0000		120,01	-175,00	540.4734.0000		120,01	-175,00	540.4737.0000	
175,01	-255,40	540.5652.0000		175,01	-255,40	540.5652.0000		175,01	-255,40	540.4724.0000		175,01	-255,40	540.4727.0000	
										540.9604.0000				540.9607.0205	
1 1/2E3				**1 1/2E3**				**1 1/2E3**				**1 1/2E3**			
18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4684.0000		18,50	- 28,00	540.4687.0000	
28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4694.0000		28,01	- 40,00	540.4697.0000	
40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4704.0000		40,01	- 58,00	540.4707.0000	
58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4714.0000		58,01	- 80,00	540.4717.0000	
80,01	-120,00	540.4724.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4724.0000		80,01	-120,00	540.4727.0000	
120,01	-150,00	540.4734.0000		120,01	-150,00	540.4734.0000		120,01	-150,00	540.4734.0000		120,01	-150,00	540.4737.0000	
150,01	-225,00	540.9634.0000		150,01	-225,00	540.9634.0000		150,01	-225,00	540.9634.0000		150,01	-225,00	540.9637.0000	
225,01	-310,00	540.9644.0000		225,01	-310,00	540.9644.0000		225,01	-310,00	540.9644.0000		225,01	-310,00	540.9647.0000	
310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9644.0000 540.9604.0000		310,01	-413,70	540.9647.0000 540.9607.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2F2				**1 1/2F2**				**1 1/2F2**				**1 1/2F2**			
0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S
0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8407.0000	
1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8427.0000	
1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8437.0000	
2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4657.0000	
2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4667.0000	
3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4677.0000	
5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4687.0000	
8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4697.0000	
12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4707.0000	
17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4717.0000	
24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8497.0000	
33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4737.0000	
54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9637.0000	
75,61	-102,00	540.9644.0000		75,61	-102,00	540.9644.0000		75,61	-102,00	540.9644.0000		75,61	-102,00	540.9647.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2F3				**1 1/2F3**				**1 1/2F3**				**1 1/2F3**			
0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S	0,30	- 0,50	gewichtsbel.	S
0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8404.0000		0,51	- 1,20	540.8407.0000	
1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8424.0000		1,21	- 1,60	540.8427.0000	
1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8434.0000		1,61	- 2,00	540.8437.0000	
2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4654.0000		2,01	- 2,70	540.4657.0000	
2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4664.0000		2,71	- 3,60	540.4667.0000	
3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4674.0000		3,61	- 5,10	540.4677.0000	
5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4684.0000		5,11	- 8,10	540.4687.0000	
8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4694.0000		8,11	- 12,00	540.4697.0000	
12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4704.0000		12,01	- 17,00	540.4707.0000	
17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4714.0000		17,01	- 24,50	540.4717.0000	
24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8494.0000		24,51	- 33,00	540.8497.0000	
33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4734.0000		33,01	- 54,00	540.4737.0000	
54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9634.0000		54,01	- 75,60	540.9637.0000	
75,61	-102,00	540.9644.0000		75,61	-102,00	540.9644.0000		75,61	-102,00	540.9644.0000		75,61	-102,00	540.9647.0000	
102,01	-140,00	540.9654.0000		102,01	-140,00	540.9654.0000		102,01	-140,00	540.9654.0000		102,01	-140,00	540.9657.0000	
140,01	-190,00	540.9644.0000 540.9604.0000		140,01	-190,00	540.9644.0000 540.9604.0000		140,01	-190,00	540.9644.0000 540.9604.0000		140,01	-190,00	540.9647.0000 540.9607.0205	
190,01	-255,40		S	190,01	-255,40		S	190,01	-255,40		S	190,01	-255,40		S
255,41	-344,70		S	255,41	-344,70		S	255,41	-344,70		S	255,41	-344,70		S

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
1 1/2G3				**1 1/2G3**				**1 1/2G3**				**1 1/2G3**			
0,20	- 0,65	gewichtsbel.	S	0,20	- 0,65	gewichtsbel.	S	0,20	- 0,65	gewichtsbel.	S	0,20	- 0,65	gewichtsbel.	S
0,66	- 1,20	540.8404.0000		0,66	- 1,20	540.8404.0000		0,66	- 1,20	540.8404.0000		0,66	- 1,20	540.8407.0000	
1,21	- 1,70	540.8424.0000		1,21	- 1,70	540.8424.0000		1,21	- 1,70	540.8424.0000		1,21	- 1,70	540.8427.0000	
1,71	- 3,20	540.8434.0000		1,71	- 3,20	540.8434.0000		1,71	- 3,20	540.8434.0000		1,71	- 3,20	540.8437.0000	
3,21	- 5,00	540.4654.0000		3,21	- 5,00	540.4654.0000		3,21	- 5,00	540.4654.0000		3,21	- 5,00	540.4657.0000	
5,01	- 7,00	540.4664.0000		5,01	- 7,00	540.4664.0000		5,01	- 7,00	540.4664.0000		5,01	- 7,00	540.4667.0000	
7,01	- 9,00	540.4674.0000		7,01	- 9,00	540.4674.0000		7,01	- 9,00	540.4674.0000		7,01	- 9,00	540.4677.0000	
9,01	- 12,00	540.4684.0000		9,01	- 12,00	540.4684.0000		9,01	- 12,00	540.4684.0000		9,01	- 12,00	540.4687.0000	
12,01	- 17,50	540.4694.0000		12,01	- 17,50	540.4694.0000		12,01	- 17,50	540.4694.0000		12,01	- 17,50	540.4697.0000	
17,51	- 21,50	540.4704.0000		17,51	- 21,50	540.4704.0000		17,51	- 21,50	540.4704.0000		17,51	- 21,50	540.4707.0000	
21,51	- 30,00	540.4714.0000		21,51	- 30,00	540.4714.0000		21,51	- 30,00	540.4714.0000		21,51	- 30,00	540.4717.0000	
30,01	- 40,00	540.8494.0000		30,01	- 40,00	540.8494.0000		30,01	- 40,00	540.8494.0000		30,01	- 40,00	540.8497.0000	
40,01	- 52,00	540.4734.0000		40,01	- 52,00	540.4734.0000		40,01	- 52,00	540.4734.0000		40,01	- 52,00	540.4737.0000	
52,01	- 77,00	540.9634.0000		52,01	- 77,00	540.9634.0000		52,01	- 77,00	540.9634.0000		52,01	- 77,00	540.9637.0000	
77,01	-108,00	540.9644.0000		77,01	-108,00	540.9644.0000		77,01	-108,00	540.9644.0000		77,01	-108,00	540.9647.0000	
108,01	-153,10	540.9644.0000 540.9604.0000		108,01	-153,10	540.9644.0000 540.9604.0000		108,01	-153,10	540.9644.0000 540.9604.0000		108,01	-153,10	540.9647.0000 540.9607.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2G3				**2G3**				**2G3**				**2G3**			
5,00	- 7,00	540.5702.0000		5,00	- 7,00	540.5702.0000		5,00	- 7,00	540.5704.0000		5,00	- 7,00	540.5707.0000	
7,01	- 9,00	540.5712.0000		7,01	- 9,00	540.5712.0000		7,01	- 9,00	540.5714.0000		7,01	- 9,00	540.5717.0000	
9,01	- 11,50	540.5722.0000		9,01	- 11,50	540.5722.0000		9,01	- 11,50	540.5724.0000		9,01	- 11,50	540.5727.0000	
11,51	- 15,00	540.5732.0000		11,51	- 15,00	540.5732.0000		11,51	- 15,00	540.5734.0000		11,51	- 15,00	540.5737.0000	
15,01	- 19,00	540.5742.0000		15,01	- 19,00	540.5742.0000		15,01	- 19,00	540.5744.0000		15,01	- 19,00	540.5747.0000	
19,01	- 27,00	540.5752.0000		19,01	- 27,00	540.5752.0000		19,01	- 27,00	540.5754.0000		19,01	- 27,00	540.5757.0000	
27,01	- 38,00	540.5762.0000		27,01	- 38,00	540.5762.0000		27,01	- 38,00	540.5764.0000		27,01	- 38,00	540.5767.0000	
38,01	- 53,00	540.5772.0000		38,01	- 53,00	540.5772.0000		38,01	- 53,00	540.5774.0000		38,01	- 53,00	540.5777.0000	
53,01	- 75,00	540.5782.0000		53,01	- 75,00	540.5782.0000		53,01	- 75,00	540.5784.0000		53,01	- 75,00	540.5787.0000	
75,01	-105,00	540.5792.0000		75,01	-105,00	540.5792.0000		75,01	-105,00	540.5784.0000		75,01	-105,00	540.5787.0000	
105,01	-150,00	540.5802.0000		105,01	-150,00	540.5802.0000				540.9724.0205				540.9727.0205	
		540.9924.0205				540.9924.0205		105,01	-150,00	540.9494.0000		105,01	-150,00	540.9497.0000	
150,01	-219,00	540.5802.0000		150,01	-219,00	540.5802.0000		150,01	-219,00	540.9494.0000		150,01	-219,00	540.9497.0000	
		540.4982.0205				540.4982.0205				540.9724.0205				540.9727.0205	
219,01	-255,40	540.9492.0000		219,01	-255,40	540.9492.0000		219,01	-255,40	540.9494.0000		219,01	-255,40	540.9497.0000	
		540.4982.0205				540.4982.0205				540.4984.0205				540.4987.0205	
1 1/2H3				**1 1/2H3**				**1 1/2H3**				**1 1/2H3**			
0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S
0,41	- 1,00	540.8414.0000		0,41	- 1,00	540.8414.0000		0,41	- 1,00	540.8414.0000		0,41	- 1,00	540.8417.0000	
1,01	- 1,70	540.8434.0000		1,01	- 1,70	540.8434.0000		1,01	- 1,70	540.8434.0000		1,01	- 1,70	540.8437.0000	
1,71	- 2,80	540.4664.0000		1,71	- 2,80	540.4664.0000		1,71	- 2,80	540.4664.0000		1,71	- 2,80	540.4667.0000	
2,81	- 3,80	540.4674.0000		2,81	- 3,80	540.4674.0000		2,81	- 3,80	540.4674.0000		2,81	- 3,80	540.4677.0000	
3,81	- 6,50	540.4684.0000		3,81	- 6,50	540.4684.0000		3,81	- 6,50	540.4684.0000		3,81	- 6,50	540.4687.0000	
6,51	- 9,50	540.4694.0000		6,51	- 9,50	540.4694.0000		6,51	- 9,50	540.4694.0000		6,51	- 9,50	540.4697.0000	
9,51	- 12,50	540.4704.0000		9,51	- 12,50	540.4704.0000		9,51	- 12,50	540.4704.0000		9,51	- 12,50	540.4707.0000	
12,51	- 19,70	540.4714.0000		12,51	- 19,70	540.4714.0000		12,51	- 19,70	540.4714.0000		12,51	- 19,70	540.4717.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2H3				**2H3**				**2H3**				**2H3**			
0,30	- 0,60	gewichtsbel.	S	0,30	- 0,60	gewichtsbel.	S	0,30	- 0,60	gewichtsbel.	S	0,30	- 0,60	gewichtsbel.	S
0,61	- 1,00	540.8514.0000		0,61	- 1,00	540.8514.0000		0,61	- 1,00	540.8514.0000		0,61	- 1,00	540.8517.0000	
1,01	- 1,60	540.8532.0000		1,01	- 1,60	540.8532.0000		1,01	- 1,60	540.8534.0000		1,01	- 1,60	540.8537.0000	
1,61	- 2,00	540.8542.0000		1,61	- 2,00	540.8542.0000		1,61	- 2,00	540.8504.0000		1,61	- 2,00	540.8507.0000	
2,01	- 2,80	540.8542.0000	O	2,01	- 2,80	540.8542.0000	O	2,01	- 2,80	540.8504.0000	O	2,01	- 2,80	540.8507.0000	O
2,81	- 3,80	540.8552.0000	O	2,81	- 3,80	540.8552.0000	O	2,81	- 3,80	540.8554.0000	O	2,81	- 3,80	540.8557.0000	O
3,81	- 5,90	540.5712.0000		3,81	- 5,90	540.5712.0000		3,81	- 5,90	540.5714.0000		3,81	- 5,90	540.5717.0000	
5,91	- 7,50	540.5722.0000		5,91	- 7,50	540.5722.0000		5,91	- 7,50	540.5724.0000		5,91	- 7,50	540.5727.0000	
7,51	- 10,00	540.5732.0000		7,51	- 10,00	540.5732.0000		7,51	- 10,00	540.5734.0000		7,51	- 10,00	540.5737.0000	
10,01	- 14,00	540.5742.0000		10,01	- 14,00	540.5742.0000		10,01	- 14,00	540.5744.0000		10,01	- 14,00	540.5747.0000	
14,01	- 23,00	540.5752.0000		14,01	- 23,00	540.5752.0000		14,01	- 23,00	540.5754.0000		14,01	- 23,00	540.5757.0000	
23,01	- 30,00	540.5762.0000		23,01	- 30,00	540.5762.0000		23,01	- 30,00	540.5764.0000		23,01	- 30,00	540.5767.0000	
30,01	- 42,00	540.5772.0000		30,01	- 42,00	540.5772.0000		30,01	- 42,00	540.5774.0000		30,01	- 42,00	540.5777.0000	
42,01	- 56,20	540.5782.0000		42,01	- 56,20	540.5782.0000		42,01	- 56,20	540.5784.0000		42,01	- 56,20	540.5787.0000	
56,21	- 75,00	540.9752.0000 540.4962.0205		56,21	- 75,00	540.9752.0000 540.4962.0205		56,21	- 75,00	540.5774.0000 540.9724.0205		56,21	- 75,00	540.5777.0000 540.9727.0205	
75,01	-103,00	540.5802.0000		75,01	-103,00	540.5802.0000		75,01	-103,00	540.5804.0000		75,01	-103,00	540.5807.0000	
103,01	-135,00	540.5802.0000 540.9722.0205		103,01	-135,00	540.5802.0000 540.9722.0205		103,01	-135,00	540.5804.0000 540.9724.0205		103,01	-135,00	540.5807.0000 540.9727.0205	
135,01	-189,60	540.9492.0000 540.4982.0205		135,01	-189,60	540.9492.0000 540.4982.0205		135,01	-189,60	540.9494.0000 540.4984.0205		135,01	-189,60	540.9497.0000 540.4987.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2J3				**2J3**				**2J3**				**2J3**			
0,20	- 0,90	gewichtsbel.	S	0,20	- 0,90	gewichtsbel.	S	0,20	- 0,90	gewichtsbel.	S	0,20	- 0,90	gewichtsbel.	S
0,91	- 1,50	540.8532.0000		0,91	- 1,50	540.8532.0000		0,91	- 1,50	540.8534.0000		0,91	- 1,50	540.8537.0000	
1,51	- 2,50	540.5702.0000		1,51	- 2,50	540.5702.0000		1,51	- 2,50	540.5704.0000		1,51	- 2,50	540.5707.0000	
2,51	- 3,00	540.5712.0000		2,51	- 3,00	540.5712.0000		2,51	- 3,00	540.5714.0000		2,51	- 3,00	540.5717.0000	
3,01	- 4,00	540.5722.0000		3,01	- 4,00	540.5722.0000		3,01	- 4,00	540.5724.0000		3,01	- 4,00	540.5727.0000	
4,01	- 5,50	540.5732.0000		4,01	- 5,50	540.5732.0000		4,01	- 5,50	540.5734.0000		4,01	- 5,50	540.5737.0000	
5,51	- 7,50	540.5742.0000		5,51	- 7,50	540.5742.0000		5,51	- 7,50	540.5744.0000		5,51	- 7,50	540.5747.0000	
7,51	- 11,50	540.5752.0000		7,51	- 11,50	540.5752.0000		7,51	- 11,50	540.5754.0000		7,51	- 11,50	540.5757.0000	
11,51	- 15,00	540.5762.0000		11,51	- 15,00	540.5762.0000		11,51	- 15,00	540.5764.0000		11,51	- 15,00	540.5767.0000	
15,01	- 19,70	540.5772.0000		15,01	- 19,70	540.5772.0000		15,01	- 19,70	540.5774.0000		15,01	- 19,70	540.5777.0000	
3J4				**3J4**				**3J4**				**3J4**			
0,80	- 1,10	540.8624.0000		0,80	- 1,10	540.8624.0000		0,80	- 1,10	540.8624.0000		0,80	- 1,10	540.8627.0000	
1,11	- 1,50	540.8632.0000		1,11	- 1,50	540.8632.0000		1,11	- 1,50	540.8634.0000		1,11	- 1,50	540.8637.0000	
1,51	- 2,00	540.8642.0000		1,51	- 2,00	540.8642.0000		1,51	- 2,00	540.8644.0000		1,51	- 2,00	540.8647.0000	
2,01	- 2,70	540.8642.0000	O	2,01	- 2,70	540.8642.0000	O	2,01	- 2,70	540.8644.0000	O	2,01	- 2,70	540.8647.0000	O
2,71	- 4,20	540.8652.0000	O	2,71	- 4,20	540.8652.0000	O	2,71	- 4,20	540.8654.0000	O	2,71	- 4,20	540.8657.0000	O
4,21	- 6,00	540.5812.0000	O	4,21	- 6,00	540.5812.0000	O	4,21	- 6,00	540.5814.0000	O	4,21	- 6,00	540.5817.0000	O
6,01	- 7,50	540.5832.0000		6,01	- 7,50	540.5832.0000		6,01	- 7,50	540.5834.0000		6,01	- 7,50	540.5837.0000	
7,51	- 11,00	540.5842.0000		7,51	- 11,00	540.5842.0000		7,51	- 11,00	540.5844.0000		7,51	- 11,00	540.5847.0000	
11,01	- 15,50	540.5852.0000		11,01	- 15,50	540.5852.0000		11,01	- 15,50	540.5854.0000		11,01	- 15,50	540.5857.0000	
15,51	- 21,50	540.5862.0000		15,51	- 21,50	540.5862.0000		15,51	- 21,50	540.5864.0000		15,51	- 21,50	540.5867.0000	
21,51	- 30,50	540.5872.0000		21,51	- 30,50	540.5872.0000		21,51	- 30,50	540.5874.0000		21,51	- 30,50	540.5877.0000	
30,51	- 44,00	540.5882.0000		30,51	- 44,00	540.5882.0000		30,51	- 44,00	540.5884.0000		30,51	- 44,00	540.5887.0000	
44,01	- 62,50	540.5892.0000		44,01	- 62,50	540.5892.0000		44,01	- 62,50	540.5894.0000		44,01	- 62,50	540.5897.0000	
62,51	- 82,00	540.9862.0000		62,51	- 82,00	540.9862.0000		62,51	- 82,00	540.9864.0000		62,51	- 82,00	540.9867.0000	
82,01	-107,00	540.5892.0000 540.9872.0000		82,01	-107,00	540.5892.0000 540.9872.0000		82,01	-107,00	540.5894.0000 540.9874.0205		82,01	-107,00	540.5897.0000 540.9877.0000	
107,01	-126,00	540.9862.0000 540.9872.0000		107,01	-126,00	540.9862.0000 540.9872.0000		107,01	-126,00	540.9864.0000 540.9874.0205		107,01	-126,00	540.9867.0000 540.9877.0000	
126,01	-158,00	540.8682.0000 540.9872.0000		126,01	-158,00	540.8682.0000 540.9872.0000		126,01	-158,00	540.8684.0000 540.9874.0205		126,01	-158,00	540.8687.0000 540.9877.0000	
158,01	-186,20		S	158,01	-186,20		S	158,01	-186,20		S	158,01	-186,20		S

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protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3K4				**3K4**				**3K4**				**3K4**			
0,30	- 0,40	gewichtsbel.	S	0,30	- 0,40	gewichtsbel.	S	0,30	- 0,40	gewichtsbel.	S	0,30	- 0,40	gewichtsbel.	S
0,41	- 0,60	540.8612.0000		0,41	- 0,60	540.8612.0000		0,41	- 0,60	540.8614.0000		0,41	- 0,60	540.8617.0000	
0,61	- 1,00	540.8632.0000		0,61	- 1,00	540.8632.0000		0,61	- 1,30	540.8634.0000		0,61	- 1,30	540.8637.0000	
1,01	- 1,30	540.8632.0000	O	1,01	- 1,30	540.8632.0000	O								
1,31	- 2,20	540.8652.0000		1,31	- 2,20	540.8652.0000		1,31	- 2,20	540.8654.0000		1,31	- 2,20	540.8657.0000	
2,21	- 3,00	540.5812.0000		2,21	- 3,00	540.5812.0000		2,21	- 3,00	540.5814.0000		2,21	- 3,00	540.5817.0000	
3,01	- 4,00	540.5822.0000		3,01	- 4,00	540.5822.0000		3,01	- 4,00	540.5824.0000		3,01	- 4,00	540.5827.0000	
4,01	- 5,50	540.5832.0000		4,01	- 5,50	540.5832.0000		4,01	- 5,50	540.5834.0000		4,01	- 5,50	540.5837.0000	
5,51	- 7,50	540.5842.0000		5,51	- 7,50	540.5842.0000		5,51	- 7,50	540.5844.0000		5,51	- 7,50	540.5847.0000	
7,51	- 10,50	540.5852.0000		7,51	- 10,50	540.5852.0000		7,51	- 10,50	540.5854.0000		7,51	- 10,50	540.5857.0000	
10,51	- 15,50	540.5862.0000		10,51	- 15,50	540.5862.0000		10,51	- 15,50	540.5864.0000		10,51	- 15,50	540.5867.0000	
15,51	- 20,50	540.5872.0000		15,51	- 20,50	540.5872.0000		15,51	- 20,50	540.5874.0000		15,51	- 20,50	540.5877.0000	
20,51	- 28,30	540.5882.0000		20,51	- 28,30	540.5882.0000		20,51	- 28,30	540.5884.0000		20,51	- 28,30	540.5887.0000	
28,31	- 38,50	540.5892.0000		28,31	- 38,50	540.5892.0000		28,31	- 38,50	540.5894.0000		28,31	- 38,50	540.5897.0000	
38,51	- 51,00	540.9862.0000		38,51	- 51,00	540.9862.0000		38,51	- 51,00	540.9864.0000		38,51	- 51,00	540.9867.0000	
51,01	- 72,00	540.8682.0000		51,01	- 72,00	540.8682.0000		51,01	- 72,00	540.8684.0000		51,01	- 72,00	540.8687.0000	
72,01	-102,00	540.8682.0000 540.9872.0000		72,01	-102,00	540.8682.0000 540.9872.0000		72,01	-102,00	540.8684.0000 540.9874.0205		72,01	-102,00	540.8687.0000 540.9877.0205	

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3K6				**3K6**				**3K6**				**3K6**			
2,30	- 3,20	540.5912.0000		2,30	- 3,20	540.5912.0000		2,30	- 3,20	540.5914.0000		2,30	- 3,20	540.5917.0000	
3,21	- 4,40	540.5922.0000		3,21	- 4,40	540.5922.0000		3,21	- 4,40	540.5924.0000		3,21	- 4,40	540.5927.0000	
4,41	- 6,00	540.5932.0000		4,41	- 6,00	540.5932.0000		4,41	- 6,00	540.5934.0000		4,41	- 6,00	540.5937.0000	
6,01	- 8,50	540.5942.0000		6,01	- 8,50	540.5942.0000		6,01	- 8,50	540.5944.0000		6,01	- 8,50	540.5947.0000	
8,51	- 11,50	540.5952.0000		8,51	- 11,50	540.5952.0000		8,51	- 11,50	540.5954.0000		8,51	- 11,50	540.5957.0000	
11,51	- 15,00	540.5962.0000		11,51	- 15,00	540.5962.0000		11,51	- 15,00	540.5964.0000		11,51	- 15,00	540.5967.0000	
15,01	- 21,00	540.5972.0000		15,01	- 21,00	540.5972.0000		15,01	- 21,00	540.5974.0000		15,01	- 21,00	540.5977.0000	
21,01	- 29,00	540.9952.0000		21,01	- 29,00	540.9952.0000		21,01	- 29,00	540.9954.0000		21,01	- 29,00	540.9957.0000	
29,01	- 39,00	540.5984.0000		29,01	- 39,00	540.5984.0000		29,01	- 39,00	540.5984.0000		29,01	- 39,00	540.5987.0000	
39,01	- 51,70	540.4994.0000		39,01	- 51,70	540.4994.0000		39,01	- 51,70	540.4994.0000		39,01	- 51,70	540.4997.0000	
51,71	- 70,00	540.9552.0000		51,71	- 70,00	540.9552.0000		51,71	- 70,00	540.1374.0000	FT	51,71	- 70,00	540.1377.0000	FT
70,01	- 90,00	540.9952.0000 540.4994.0000		70,01	- 90,00	540.9952.0000 540.4994.0000		70,01	- 90,00	540.9954.0000 540.4994.0000		70,01	- 90,00	540.9957.0000 540.4997.0000	
90,01	-112,50	540.9962.0000 540.4994.0000		90,01	-112,50	540.9962.0000 540.4994.0000		90,01	-112,50	540.9964.0000 540.4994.0000		90,01	-112,50	540.9967.0000 540.4997.0000	
112,51	-140,70	540.9552.0000 540.9542.0205		112,51	-140,70	540.9552.0000 540.9542.0205		112,51	-153,10		S	112,51	-153,10		S
140,71	-153,10		S	140,71	-153,10		S								

protected

Ausführung (model)															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3L4				**3L4**				**3L4**				**3L4**			
0,30	- 0,50	540.8612.0000		0,30	- 0,50	540.8612.0000		0,30	- 0,50	540.8614.0000		0,30	- 0,50	540.8617.0000	
0,51	- 0,90	540.8632.0000		0,51	- 0,90	540.8632.0000		0,51	- 0,70	540.8634.0000		0,51	- 0,70	540.8637.0000	
								0,71	- 0,90	540.8634.0000	O	0,71	- 0,90	540.8637.0000	O
0,91	- 1,50	540.8652.0000		0,91	- 1,50	540.8652.0000		0,91	- 1,50	540.8654.0000		0,91	- 1,50	540.8657.0000	
1,51	- 2,00	540.5812.0000		1,51	- 2,00	540.5812.0000		1,51	- 2,00	540.5814.0000		1,51	- 2,00	540.5817.0000	
2,01	- 3,00	540.5822.0000		2,01	- 3,00	540.5822.0000		2,01	- 3,00	540.5824.0000	O	2,01	- 3,00	540.5827.0000	O
3,01	- 4,30	540.5832.0000		3,01	- 4,30	540.5832.0000		3,01	- 4,30	540.5834.0000	O	3,01	- 4,30	540.5837.0000	O
4,31	- 5,50	540.5842.0000		4,31	- 5,50	540.5842.0000		4,31	- 6,50	540.5844.0000	O	4,31	- 6,50	540.5847.0000	O
5,51	- 6,50	540.5842.0000	O	5,51	- 6,50	540.5842.0000	O								
6,51	- 7,60	540.5852.0000		6,51	- 7,60	540.5852.0000		6,51	- 9,00	540.5854.0000	O	6,51	- 9,00	540.5857.0000	O
7,61	- 9,00	540.5852.0000	O	7,61	- 9,00	540.5852.0000	O								
9,01	- 10,90	540.5862.0000		9,01	- 10,90	540.5862.0000		9,01	- 12,50	540.5864.0000	O	9,01	- 12,50	540.5867.0000	O
10,91	- 12,50	540.5862.0000	O	10,91	- 12,50	540.5862.0000	O								
12,51	- 16,50	540.5872.0000		12,51	- 16,50	540.5872.0000		12,51	- 16,50	540.5874.0000	O	12,51	- 16,50	540.5877.0000	O
16,51	- 19,70	540.5882.0000		16,51	- 19,70	540.5882.0000		16,51	- 19,70	540.5884.0000		16,51	- 19,70	540.5887.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4L6				**4L6**				**4L6**				**4L6**			
0,20	- 0,69	gewichtsbel.	S	0,20	- 0,69	gewichtsbel.	S	0,20	- 0,69	gewichtsbel.	S	0,20	- 0,69	gewichtsbel.	S
0,70	- 1,20	540.8732.0000		0,70	- 1,20	540.8732.0000		0,70	- 1,20	540.8734.0000		0,70	- 1,20	540.8737.0000	
1,21	- 1,50	540.8742.0000		1,21	- 1,50	540.8742.0000		1,21	- 1,50	540.8744.0000		1,21	- 1,50	540.8747.0000	
1,51	- 1,80	540.8752.0000		1,51	- 1,80	540.8752.0000		1,51	- 1,80	540.8754.0000		1,51	- 1,80	540.8757.0000	
1,81	- 3,00	540.5922.0000		1,81	- 3,00	540.5922.0000		1,81	- 3,00	540.5924.0000		1,81	- 3,00	540.5927.0000	
3,01	- 3,90	540.5932.0000		3,01	- 3,90	540.5932.0000		3,01	- 3,90	540.5934.0000		3,01	- 3,90	540.5937.0000	
3,91	- 5,50	540.5942.0000		3,91	- 5,50	540.5942.0000		3,91	- 5,50	540.5944.0000		3,91	- 5,50	540.5947.0000	
5,51	- 7,30	540.5952.0000		5,51	- 7,30	540.5952.0000		5,51	- 7,30	540.5954.0000		5,51	- 7,30	540.5957.0000	
7,31	- 9,80	540.5962.0000		7,31	- 9,80	540.5962.0000		7,31	- 9,80	540.5964.0000		7,31	- 9,80	540.5967.0000	
9,81	- 13,50	540.5972.0000		9,81	- 13,50	540.5972.0000		9,81	- 13,50	540.5974.0000		9,81	- 13,50	540.5977.0000	
13,51	- 16,60	540.9952.0000		13,51	- 16,60	540.9952.0000		13,51	- 16,60	540.9954.0000		13,51	- 16,60	540.9957.0000	
16,61	- 20,40	540.5982.0000		16,61	- 20,40	540.5982.0000		16,61	- 20,40	540.5984.0000		16,61	- 20,40	540.5987.0000	
20,41	- 25,50	540.4994.0000		20,41	- 25,50	540.4994.0000		20,41	- 25,50	540.4994.0000		20,41	- 25,50	540.4997.0000	
25,51	- 35,20	540.5982.0000 540.9534.0000		25,51	- 35,20	540.5982.0000 540.9534.0000		25,51	- 35,20	540.5984.0000 540.9534.0000		25,51	- 35,20	540.5987.0000 540.9537.0000	
35,21	- 43,00	540.9962.0000 540.9534.0000		35,21	- 43,00	540.9962.0000 540.9534.0000		35,21	- 43,00	540.9964.0000 540.9534.0000		35,21	- 43,00	540.9967.0000 540.9537.0000	
43,01	- 53,00	540.9962.0000 540.4994.0000		43,01	- 53,00	540.9962.0000 540.4994.0000		43,01	- 53,00	540.9964.0000 540.4994.0000		43,01	- 53,00	540.9967.0000 540.4997.0000	
53,01	- 67,00	540.9552.0000 540.9542.0205		53,01	- 67,00	540.9552.0000 540.9542.0205		53,01	- 67,00		FT;S	53,01	- 67,00	540.1377.0000 540.1487.0205	FT
67,01	- 88,00	540.1392.0000 540.1482.0205	FT	67,01	- 88,00	540.1392.0000 540.1482.0205	FT	67,01	- 88,00	540.1384.0000 540.1494.0205	FT	67,01	- 88,00	540.1387.0000 540.1497.0205	FT
88,01	-103,40	540.1392.0000 540.1492.0205	FT	88,01	-103,40	540.1392.0000 540.1492.0205	FT	88,01	-103,40	540.1392.0000 540.1492.0205	FT/ Faba	88,01	-103,40	540.1397.0000 540.1497.0205	FT

Disclosure cat.:	II	proofread by:	MD	publish date:	3/25/15	effect.dat	3/15
author:	Schm	released by:	JR	replaces:	060-30	status:	publishe
resp. depart.:	TB	date of	3/25/15	revision No.:	3		
doc. type:	LGS	change rep.	00841A	retention	10y.		

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4M6				**4M6**				**4M6**				**4M6**			
0,20	- 0,50	gewichtsbel.	S	0,20	- 0,50	gewichtsbel.	S	0,20	- 0,50	gewichtsbel.	S	0,20	- 0,50	gewichtsbel.	S
0,51	- 0,75	540.8732.0000		0,51	- 0,75	540.8732.0000		0,51	- 0,75	540.8734.0000		0,51	- 0,75	540.8737.0000	
0,76	- 0,90	540.8742.0000		0,76	- 0,90	540.8742.0000		0,76	- 0,90	540.8744.0000		0,76	- 0,90	540.8747.0000	
0,91	- 1,40	540.8752.0000		0,91	- 1,40	540.8752.0000		0,91	- 1,40	540.8754.0000		0,91	- 1,40	540.8757.0000	
1,41	- 2,00	540.5912.0000		1,41	- 2,00	540.5912.0000		1,41	- 2,00	540.5914.0000		1,41	- 2,00	540.5917.0000	
2,01	- 2,90	540.5922.0000		2,01	- 2,90	540.5922.0000		2,01	- 2,90	540.5924.0000		2,01	- 2,90	540.5927.0000	
2,91	- 3,80	540.5932.0000		2,91	- 3,80	540.5932.0000		2,91	- 3,80	540.5934.0000		2,91	- 3,80	540.5937.0000	
3,81	- 5,50	540.5942.0000		3,81	- 5,50	540.5942.0000		3,81	- 5,50	540.5944.0000		3,81	- 5,50	540.5947.0000	
5,51	- 7,00	540.5952.0000		5,51	- 7,00	540.5952.0000		5,51	- 7,00	540.5954.0000		5,51	- 7,00	540.5957.0000	
7,01	- 10,00	540.5962.0000		7,01	- 10,00	540.5962.0000		7,01	- 10,00	540.5964.0000		7,01	- 10,00	540.5967.0000	
10,01	- 12,50	540.5972.0000		10,01	- 12,50	540.5972.0000		10,01	- 12,50	540.5974.0000		10,01	- 12,50	540.5977.0000	
12,51	- 15,50	540.9952.0000		12,51	- 15,50	540.9952.0000		12,51	- 15,50	540.9954.0000		12,51	- 15,50	540.9957.0000	
15,51	- 20,00	540.5982.0000		15,51	- 20,00	540.5982.0000		15,51	- 20,00	540.5984.0000		15,51	- 20,00	540.5987.0000	
20,01	- 27,00	540.9962.0000		20,01	- 27,00	540.9962.0000		20,01	- 27,00	540.9964.0000		20,01	- 27,00	540.9967.0000	
27,01	- 34,00	540.9952.0000 540.9982.0205		27,01	- 34,00	540.9952.0000 540.9982.0205		27,01	- 34,00	540.9954.0000 540.9984.0205		27,01	- 34,00	540.9957.0000 540.9987.0205	
34,01	- 44,00	540.9962.0000 540.9982.0205		34,01	- 44,00	540.9962.0000 540.9982.0205		34,01	- 44,00	540.9964.0000 540.9984.0205		34,01	- 44,00	540.9967.0000 540.9987.0205	
44,01	- 56,70	540.9962.0000 540.4992.0000		44,01	- 56,70	540.9962.0000 540.4992.0000		44,01	- 49,60	540.9964.0000 540.4994.0000		44,01	- 49,60	540.9967.0000 540.4997.0000	
								49,61	- 56,70	540.9962.0000 540.4992.0000	S; Faba	49,61	- 56,70	540.9967.0000 540.4997.0000	
56,71	- 75,80	540.9552.0000 540.9542.0205		56,71	- 75,80	540.9552.0000 540.9542.0205		56,71	- 75,80	540.9552.0000 540.9542.0205	S; Faba	56,71	- 73,00	540.9557.0000 540.9547.0205	
												73,01	- 75,80		S

Disclosure cat.:	II	proofread by:	MD	publish date:	3/25/15	effect.dat	3/15
author:	Schm	released by:	JR	replaces:	060-30	status:	publishe
resp. depart.:	TB	date of	3/25/15	revision No.:	3		
doc. type:	LGS	change rep.	00841A	retention	10y.		

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4N6				**4N6**				**4N6**				**4N6**			
0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S	0,20	- 0,40	gewichtsbel.	S
0,41	- 0,70	540.8732.0000		0,41	- 0,70	540.8732.0000		0,41	- 0,70	540.8734.0000		0,41	- 0,70	540.8737.0000	
0,71	- 1,45	540.8752.0000		0,71	- 1,45	540.8752.0000		0,71	- 1,45	540.8754.0000		0,71	- 1,45	540.8757.0000	
1,46	- 2,30	540.5922.0000		1,46	- 2,30	540.5922.0000		1,46	- 2,30	540.5924.0000		1,46	- 2,30	540.5927.0000	
2,31	- 3,10	540.5932.0000		2,31	- 3,10	540.5932.0000		2,31	- 3,10	540.5934.0000		2,31	- 3,10	540.5937.0000	
3,11	- 4,00	540.5942.0000		3,11	- 4,00	540.5942.0000		3,11	- 4,00	540.5944.0000		3,11	- 4,00	540.5947.0000	
4,01	- 5,80	540.5952.0000		4,01	- 5,80	540.5952.0000		4,01	- 5,80	540.5954.0000		4,01	- 5,80	540.5957.0000	
5,81	- 8,00	540.5962.0000		5,81	- 8,00	540.5962.0000		5,81	- 8,00	540.5964.0000		5,81	- 8,00	540.5967.0000	
8,01	- 10,50	540.5972.0000		8,01	- 10,50	540.5972.0000		8,01	- 10,50	540.5974.0000		8,01	- 10,50	540.5977.0000	
10,51	- 13,50	540.9952.0000		10,51	- 13,50	540.9952.0000		10,51	- 13,50	540.9954.0000		10,51	- 13,50	540.9957.0000	
13,51	- 17,00	540.5982.0000		13,51	- 17,00	540.5982.0000		13,51	- 17,00	540.5984.0000		13,51	- 17,00	540.5987.0000	
17,01	- 21,50	540.4992.0000		17,01	- 21,50	540.4992.0000		17,01	- 21,50	540.4994.0000		17,01	- 21,50	540.4997.0000	
21,51	- 26,00	540.5972.0000 540.9534.0000		21,51	- 26,00	540.5972.0000 540.9534.0000		21,51	- 26,00	540.5974.0000 540.9534.0000		21,51	- 26,00	540.5977.0000 540.9537.0000	
26,01	- 31,50	540.5982.0000 540.9534.0000		26,01	- 31,50	540.5982.0000 540.9534.0000		26,01	- 31,50	540.5984.0000 540.9534.0000		26,01	- 31,50	540.5987.0000 540.9537.0000	
31,51	- 37,50	540.9962.0000 540.9534.0000		31,51	- 37,50	540.9962.0000 540.9534.0000		31,51	- 37,50	540.9964.0000 540.9534.0000		31,51	- 37,50	540.9967.0000 540.9537.0000	
37,51	- 45,00	540.9962.0000 540.4992.0000		37,51	- 45,00	540.9962.0000 540.4992.0000		37,51	- 45,00	540.9964.0000 540.4994.0000		37,51	- 45,00	540.9967.0000 540.4997.0000	
45,01	- 53,00	540.9552.0000 540.4992.0000		45,01	- 53,00	540.9552.0000 540.4992.0000		45,01	- 53,00		FT; S	45,01	- 53,00	540.1377.0000 540.1487.0205	FT
53,01	- 68,90	540.1374.0000 540.1492.0205	FT	53,01	- 68,90	540.1374.0000 540.1492.0205	FT	53,01	- 68,90		FT; S	53,01	- 68,90		FT; S

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4P6				**4P6**				**4P6**				**4P6**			
0,12	- 0,35	gewichtsbel.	S	0,12	- 0,35	gewichtsbel.	S	0,12	- 0,35	gewichtsbel.	S	0,12	- 0,35	gewichtsbel.	S
0,36	- 0,55	540.8732.0000		0,36	- 0,55	540.8732.0000		0,36	- 0,55	540.8734.0000		0,36	- 0,55	540.8737.0000	
0,56	- 0,70	540.8742.0000		0,56	- 0,70	540.8742.0000		0,56	- 0,70	540.8744.0000		0,56	- 0,70	540.8747.0000	
0,71	- 1,10	540.8752.0000		0,71	- 1,10	540.8752.0000		0,71	- 1,10	540.8754.0000		0,71	- 1,10	540.8757.0000	
1,11	- 1,70	540.5912.0000		1,11	- 1,70	540.5912.0000		1,11	- 1,70	540.5914.0000		1,11	- 1,70	540.5917.0000	
1,71	- 2,10	540.5922.0000		1,71	- 2,10	540.5922.0000		1,71	- 2,10	540.5924.0000		1,71	- 2,10	540.5927.0000	
2,11	- 3,10	540.5932.0000		2,11	- 3,10	540.5932.0000		2,11	- 3,10	540.5934.0000		2,11	- 3,10	540.5937.0000	
3,11	- 4,40	540.5942.0000		3,11	- 4,40	540.5942.0000		3,11	- 4,40	540.5944.0000		3,11	- 4,40	540.5947.0000	
4,41	- 6,20	540.5952.0000		4,41	- 6,20	540.5952.0000		4,41	- 6,20	540.5954.0000		4,41	- 6,20	540.5957.0000	
6,21	- 8,40	540.5962.0000		6,21	- 8,40	540.5962.0000		6,21	- 8,40	540.5964.0000		6,21	- 8,40	540.5967.0000	
8,41	- 11,50	540.5972.0000		8,41	- 11,50	540.5972.0000		8,41	- 11,50	540.5974.0000		8,41	- 11,50	540.5977.0000	
11,51	- 13,80	540.9952.0000		11,51	- 13,80	540.9952.0000		11,51	- 13,80	540.9954.0000		11,51	- 13,80	540.9957.0000	
13,81	- 19,70	540.5982.0000		13,81	- 19,70	540.5982.0000		13,81	- 19,70		S	13,81	- 19,70	540.5987.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [bar] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
4P6 300-900#				**4P6 300-900#**				**4P6 300-900#**				**4P6 300-900#**			
0,25	- 0,40	gewichtsbel.	S	0,25	- 0,40	gewichtsbel.	S	0,25	- 0,40	gewichtsbel.	S	0,25	- 0,40	gewichtsbel.	S
0,41	- 0,60	540.8832.0000	O	0,41	- 0,60	540.8832.0000	O	0,41	- 0,60	540.8834.0000	O	0,41	- 0,60	540.8837.0000	O
0,61	- 0,90	540.8842.0000	O	0,61	- 0,90	540.8842.0000	O	0,61	- 0,90	540.8844.0000	O	0,61	- 0,90	540.8847.0000	O
0,91	- 1,40	540.8862.0000	O	0,91	- 1,40	540.8862.0000	O	0,91	- 1,40	540.8864.0000	O	0,91	- 1,40	540.8867.0000	O
1,41	- 2,10	540.8872.0000	O	1,41	- 2,10	540.8872.0000	O	1,41	- 2,10	540.8874.0000	O	1,41	- 2,10	540.8877.0000	O
2,11	- 3,00	540.8882.0000	O	2,11	- 3,00	540.8882.0000	O	2,11	- 3,00	540.8884.0000	O	2,11	- 3,00	540.8887.0000	O
3,01	- 4,00	540.8892.0000	O	3,01	- 4,00	540.8892.0000	O	3,01	- 4,00	540.8894.0000	O	3,01	- 4,00	540.8897.0000	O
4,01	- 5,40	540.8902.0000	O	4,01	- 5,40	540.8902.0000	O	4,01	- 5,40	540.8904.0000	O	4,01	- 5,40	540.8907.0000	O
5,41	- 7,20	540.8852.0000 540.8982.0205	O	5,41	- 7,20	540.8852.0000 540.8982.0205	O	5,41	- 7,20	540.8854.0000 540.8984.0205	O	5,41	- 7,20	540.8857.0000 540.8987.0205	O
7,21	- 9,30	540.8912.0000	O	7,21	- 9,30	540.8912.0000	O	7,21	- 9,30	540.8914.0000	O	7,21	- 9,30	540.8917.0000	O
9,31	- 12,50	540.8922.0000	O	9,31	- 12,50	540.8922.0000	O	9,31	- 12,50	540.8924.0000	O	9,31	- 12,50	540.8927.0000	O
12,51	- 16,00	540.8942.0000	O	12,51	- 16,00	540.8942.0000	O	12,51	- 16,00	540.8944.0000	O	12,51	- 16,00	540.8947.0000	O
16,01	- 21,00	540.8942.0000 540.8972.0205	O	16,01	- 21,00	540.8942.0000 540.8972.0205	O	16,01	- 21,00	540.8944.0000 540.8974.0205	O	16,01	- 21,00	540.8947.0000 540.8977.0205	O
21,01	- 27,00	540.8942.0000 540.8982.0205 540.0044.0000	O	21,01	- 27,00	540.8942.0000 540.8982.0205 540.0044.0000	O	21,01	- 27,00	540.8944.0000 540.8984.0205 540.0044.0000	O	21,01	- 27,00	540.8947.0000 540.8987.0205 540.0047.0000	O
27,01	- 34,00	540.9552.0000 540.9982.0205	FT; O	27,01	- 34,00	540.9552.0000 540.9982.0205	FT; O	27,01	- 34,00	540.9554.0000 540.9984.0205	FT; O	27,01	- 34,00	540.9557.0000 540.9987.0205	O
34,01	- 42,50	540.9552.0000 540.9542.0205	FT; O	34,01	- 42,50	540.9552.0000 540.9542.0205	FT; O	34,01	- 42,50	540.9554.0000 540.9544.0205	FT; O				
42,51	- 49,00	540.9842.0000 540.9542.0205	FT; O	42,51	- 49,00	540.9842.0000 540.9542.0205	FT; O	42,51	- 49,00	540.9842.0000 540.9542.0205	FT;S;O Faba				
49,01	- 59,00	540.9832.0000 540.9542.0205	FT; O	49,01	- 59,00	540.9832.0000 540.9542.0205	FT; O	49,01	- 59,00	540.9832.0000 540.9542.0205	FT;S;O Faba				
59,01	- 68,90	540.9832.0000 540.9992.0205	FT; O	59,01	- 68,90	540.9832.0000 540.9992.0205	FT; O	59,01	- 68,90	540.9832.0000 540.9992.0205	FT;S;O Faba				

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
6Q8				**6Q8**				**6Q8**				**6Q8**			
0,20	- 0,33	gewichtsbel.	S	0,20	- 0,33	gewichtsbel.	S	0,20	- 0,33	gewichtsbel.	S	0,20	- 0,33	gewichtsbel.	S
0,34	- 0,60	540.8832.0000	O	0,34	- 0,60	540.8832.0000	O	0,34	- 0,60	540.8834.0000	O	0,34	- 0,60	540.8837.0000	O
0,61	- 0,86	540.8842.0000	O	0,61	- 0,86	540.8842.0000	O	0,61	- 0,86	540.8844.0000	O	0,61	- 0,86	540.8847.0000	O
0,87	- 1,50	540.8862.0000	O	0,87	- 1,50	540.8862.0000	O	0,87	- 1,50	540.8864.0000	O	0,87	- 1,50	540.8867.0000	O
1,51	- 2,20	540.8872.0000	O	1,51	- 2,20	540.8872.0000	O	1,51	- 2,20	540.8874.0000	O	1,51	- 2,20	540.8877.0000	O
2,21	- 2,80	540.8882.0000	O	2,21	- 2,80	540.8882.0000	O	2,21	- 2,80	540.8884.0000	O	2,21	- 2,80	540.8887.0000	O
2,81	- 3,80	540.8892.0000	O	2,81	- 3,80	540.8892.0000	O	2,81	- 3,80	540.8894.0000	O	2,81	- 3,80	540.8897.0000	O
3,81	- 4,60	540.8902.0000	O	3,81	- 4,60	540.8902.0000	O	3,81	- 4,60	540.8904.0000	O	3,81	- 4,60	540.8907.0000	O
4,61	- 5,90	540.8852.0000 540.1132.0205	O	4,61	- 5,90	540.8852.0000 540.1132.0205	O	4,61	- 5,90	540.8854.0000 540.1134.0205	O	4,61	- 5,90	540.8857.0000 540.1137.0205	O
5,91	- 7,90	540.8912.0000	O	5,91	- 7,90	540.8912.0000	O	5,91	- 7,90	540.8914.0000	O	5,91	- 7,90	540.8917.0000	O
7,91	- 9,85	540.8902.0000 540.1132.0205	O	7,91	- 9,85	540.8902.0000 540.1132.0205	O	7,91	- 9,85	540.8904.0000 540.1134.0205	O	7,91	- 9,85	540.8907.0000 540.1137.0205	O
9,86	- 13,70	540.8942.0000	O	9,86	- 13,70	540.8942.0000	O	9,86	- 13,70	540.1124.0000 540.1024.0000		9,86	- 13,70	540.1127.0000 540.1027.0000	
13,71	- 18,50	540.8942.0000 540.8972.0205	O	13,71	- 18,50	540.8942.0000 540.8972.0205	O	13,71	- 18,50	540.1124.0000 540.1144.0205		13,71	- 18,50	540.1127.0000 540.1147.0205	
18,51	- 20,70	540.1262.0000		18,51	- 20,70	540.1262.0000		18,51	- 20,70	540.1124.0000 540.1144.0205 540.1024.0000		18,51	- 20,70	540.1127.0000 540.1147.0205 540.1027.0000	
20,71	- 25,00	540.1262.0000 540.1042.0000		20,71	- 25,00	540.1262.0000 540.1042.0000		20,71	- 25,00	540.1262.0000 540.1042.0000	Faba	20,71	- 25,00	540.1267.0000 540.1047.0000	
25,01	- 32,60	540.1262.0000 540.1152.0205		25,01	- 32,60	540.1262.0000 540.1152.0205		25,01	- 32,60	540.1262.0000 540.1152.0205	Faba	25,01	- 32,60	540.1267.0000 540.1157.0205	
32,61	- 35,40	540.1262.0000 540.1152.0205 540.1042.0000		32,61	- 35,40	540.1262.0000 540.1152.0205 540.1042.0000		32,61	- 35,40	540.1262.0000 540.1152.0205 540.1042.0000	Faba	32,61	- 35,40	540.1267.0000 540.1157.0205 540.1047.0000	
35,41	- 41,40	540.1272.0000 540.1152.0205 540.1042.0000		35,41	- 41,40	540.1272.0000 540.1152.0205 540.1042.0000		35,41	- 41,40	540.1272.0000 540.1152.0205 540.1042.0000	Faba	35,41	- 41,40		S
41,41	- 47,00	540.1602.0000 540.1612.0205	FT	41,41	- 47,00	540.1602.0000 540.1612.0205	FT	41,41	- 47,00	540.1602.0000 540.1612.0205	FT;S Faba				

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar] **von** **p1** *up*	**bis** **p2** *to*	**Feder-Sachnummer** *stock no.*	**Indices**	**p [bar]** **von** **p1** *up*	**bis** **p2** *to*	**Feder-Sachnummer** *stock no.*	**Indices**	**p [bar]** **von** **p1** *up*	**bis** **p2** *to*	**Feder-Sachnummer** *stock no.*	**Indices**	**p [bar]** **von** **p1** *up*	**bis** **p2** *to*	**Feder-Sachnummer** *stock no.*	**Indices**
6Q8				**6Q8**				**6Q8**							
47,01	- 55,00	540.1602.0000 540.1622.0205	FT	47,01	- 55,00	540.1602.0000 540.1622.0205	FT	47,01	- 55,00	540.1602.0000 540.1622.0205	FT;S Faba				
55,01	- 64,00	540.1602.0000 540.1632.0205	FT	55,01	- 64,00	540.1602.0000 540.1632.0205	FT	55,01	- 64,00	540.1602.0000 540.1632.0205	FT;S Faba				
64,01	- 70,00	540.1702.0000 540.1632.0205	FT	64,01	- 70,00	540.1702.0000 540.1632.0205	FT	64,01	- 70,00	540.1702.0000 540.1632.0205	FT;S Faba				
6R8				**6R8**				**6R8**				**6R8**			
0,20	- 0,40	540.8832.0000		0,20	- 0,40	540.8832.0000		0,20	- 0,40	540.8834.0000		0,20	- 0,40	540.8837.0000	
0,41	- 0,65	540.8842.0000		0,41	- 0,65	540.8842.0000		0,41	- 0,65	540.8844.0000		0,41	- 0,65	540.8847.0000	
0,66	- 1,00	540.8862.0000		0,66	- 1,00	540.8862.0000		0,66	- 1,00	540.8864.0000		0,66	- 1,00	540.8867.0000	
1,01	- 1,55	540.8872.0000		1,01	- 1,55	540.8872.0000		1,01	- 1,55	540.8874.0000		1,01	- 1,55	540.8877.0000	
1,56	- 2,15	540.8882.0000		1,56	- 2,15	540.8882.0000		1,56	- 2,15	540.8884.0000		1,56	- 2,15	540.8887.0000	
2,16	- 3,05	540.8892.0000	O from 2,90	2,16	- 3,05	540.8892.0000	O from 2,90	2,16	- 3,05	540.8894.0000	O from 2,90	2,16	- 3,05	540.8897.0000	O from 2,90
3,06	- 4,05	540.8902.0000	O	3,06	- 4,05	540.8902.0000	O	3,06	- 4,05	540.8904.0000	O	3,06	- 4,05	540.8907.0000	O
4,06	- 5,10	540.8882.0000		4,06	- 5,10	540.8882.0000		4,06	- 5,10	540.8884.0000		4,06	- 5,10	540.8887.0000	
		540.8972.0205				540.8972.0205				540.8974.0205				540.8977.0205	
5,11	- 6,05	540.8892.0000 540.8972.0205		5,11	- 6,05	540.8892.0000 540.8972.0205		5,11	- 6,05	540.8894.0000 540.8974.0205		5,11	- 6,05	540.8897.0000 540.8977.0205	
6,06	- 6,90	540.8892.0000 540.8982.0205		6,06	- 6,90	540.8892.0000 540.8982.0205		6,06	- 6,90	540.8894.0000 540.8984.0205		6,06	- 6,90	540.8897.0000 540.8987.0205	
6,91	- 10,0		S	6,91	- 10,0		S	6,91	- 10,0		S	6,91	- 10,0		S

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**
6R10				**6R10**				**6R10**				**6R10**			
0,20	- 0,40	540.8832.0000	O	0,20	- 0,40	540.8832.0000	O	0,20	- 0,40	540.8834.0000	O	0,20	- 0,40	540.8837.0000	O
0,41	- 0,70	540.8842.0000	O	0,41	- 0,70	540.8842.0000	O	0,41	- 0,70	540.8844.0000	O	0,41	- 0,70	540.8847.0000	O
0,71	- 1,00	540.8862.0000	O	0,71	- 1,00	540.8862.0000	O	0,71	- 1,00	540.8864.0000	O	0,71	- 1,00	540.8867.0000	O
1,01	- 1,50	540.8872.0000	O	1,01	- 1,50	540.8872.0000	O	1,01	- 1,50	540.8874.0000	O	1,01	- 1,50	540.8877.0000	O
1,51	- 2,00	540.8882.0000	O	1,51	- 2,00	540.8882.0000	O	1,51	- 2,00	540.8884.0000	O	1,51	- 2,00	540.8887.0000	O
2,01	- 3,00	540.8892.0000	O	2,01	- 3,00	540.8892.0000	O	2,01	- 3,00	540.8894.0000	O	2,01	- 3,00	540.8897.0000	O
3,01	- 3,90	540.8902.0000	O	3,01	- 3,90	540.8902.0000	O	3,01	- 3,90	540.8904.0000	O	3,01	- 3,90	540.8907.0000	O
3,90	- 5,00	540.8882.0000 540.8982.0205	O	3,90	- 5,00	540.8882.0000 540.8982.0205	O	3,90	- 5,00	540.8884.0000 540.8984.0205	O	3,90	- 5,00	540.8887.0000 540.8987.0205	O
5,01	- 6,50	540.9112.0000		5,01	- 6,50	540.9112.0000		5,01	- 6,50	540.9112.0000	Faba	5,01	- 6,50	540.9117.0000	FT;S;P
6,51	- 8,40	540.9122.0000		6,51	- 8,40	540.9122.0000		6,51	- 8,40	540.9122.0000	Faba	6,51	- 8,40	540.9127.0000	FT;S;P
8,41	- 11,25	540.9132.0000		8,41	- 11,25	540.9132.0000		8,41	- 11,25	540.9132.0000	Faba	8,41	- 11,25	540.9137.0000	FT;S;P
11,26	- 15,00	540.9132.0000 540.9092.0205		11,26	- 15,00	540.9132.0000 540.9092.0205		11,26	- 15,00	540.9132.0000 540.9092.0205	Faba	11,26	- 15,00	540.9137.0000 540.9097.0205	FT;S;P
15,01	- 20,70	540.9152.0000 540.9092.0205		15,01	- 20,70	540.9152.0000 540.9092.0205		15,01	- 20,70	540.9152.0000 540.9092.0205	Faba	15,01	- 20,70	540.9157.0000 540.9097.0205	FT;S;P
20,71	- 27,00	840.0332.1000 540.9092.0205	FT	20,71	- 27,00	840.0332.1000 540.9092.0205	FT	20,71	- 27,00	840.0332.1000 540.9092.0205	FT;S Faba				
27,01	- 35,00	840.0332.1000 840.0962.1205	FT	27,01	- 35,00	840.0332.1000 840.0962.1205	FT	27,01	- 35,00	840.0332.1000 840.0962.1205	FT;S Faba				
35,01	- 44,00	840.0332.1000 540.1662.0205	FT	35,01	- 44,00	840.0332.1000 540.1662.0205	FT	35,01	- 44,00	840.0332.1000 540.1662.0205	FT;S Faba				
44,01	- 55,00	540.0992.0000 840.1732.0205	FT	44,01	- 55,00	540.0992.0000 840.1732.0205	FT	44,01	- 55,00	540.0992.0000 840.1732.0205	FT;S Faba				
55,01	- 63,00	540.0992.0000 540.1662.0205 540.1682.0000	FT	55,01	- 63,00	540.0992.0000 540.1662.0205 540.1682.0000	FT	55,01	- 63,00	540.0992.0000 540.1662.0205 540.1682.0000	FT;S Faba				

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [bar]				**p [bar]**				**p [bar]**				**p [bar]**			
von *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**	**von** *up* **p1**	**bis** *to* **p2**	**Feder-Sachnummer** *stock no.*	**Indices**
8T10				**8T10**				**8T10**				**8T10**			
0,25	- 0,41	540.8842.0000	O	0,25	- 0,41	540.8842.0000	O	0,25	- 0,41	540.8844.0000	O	0,25	- 0,41	540.8847.0000	O
0,42	- 0,70	540.8862.0000	O	0,42	- 0,70	540.8862.0000	O	0,42	- 0,70	540.8864.0000	O	0,42	- 0,70	540.8867.0000	O
0,71	- 1,05	540.8872.0000	O	0,71	- 1,05	540.8872.0000	O	0,71	- 1,05	540.8874.0000	O	0,71	- 1,05	540.8877.0000	O
1,06	- 1,50	540.8882.0000	O	1,06	- 1,50	540.8882.0000	O	1,06	- 1,50	540.8884.0000	O	1,06	- 1,50	540.8887.0000	O
1,51	- 2,20	540.8892.0000	O	1,51	- 2,20	540.8892.0000	O	1,51	- 2,20	540.8894.0000	O	1,51	- 2,20	540.8897.0000	O
2,20	- 2,90	540.8902.0000	O	2,20	- 2,90	540.8902.0000	O	2,20	- 2,90	540.8904.0000	O	2,20	- 2,90	540.8907.0000	O
2,91	- 3,75	540.8912.0000	O	2,91	- 3,75	540.8912.0000	O	2,91	- 3,75	540.8914.0000	O	2,91	- 3,75	540.8917.0000	O
3,76	- 4,84	540.9112.0000	FT	3,76	- 4,84	540.9112.0000	FT	3,76	- 4,84	540.9112.0000	FT, Faba	3,76	- 4,84	540.9117.0000	FT;S;P
4,85	- 6,25	540.9122.0000	FT	4,85	- 6,25	540.9122.0000	FT	4,85	- 6,25	540.9122.0000	FT, Faba	4,85	- 6,25	540.9127.0000	FT;S;P
6,26	- 8,10	540.9132.0000	FT	6,26	- 8,10	540.9132.0000	FT	6,26	- 8,10	540.9132.0000	FT, Faba	6,26	- 8,10	540.9137.0000	FT;S;P
8,11	- 10,50	540.9132.0000 540.9092.0205	FT	8,11	- 10,50	540.9132.0000 540.9092.0205	FT	8,11	- 10,50	540.9132.0000 540.9092.0205	FT;S Faba	8,11	- 10,50	540.9137.0000 540.9097.0205	FT;S;P
10,51	- 13,70	540.9152.0000 540.9092.0205	FT	10,51	- 13,70	540.9152.0000 540.9092.0205	FT	10,51	- 13,70	540.9152.0000 540.9092.0205	FT;S Faba	10,51	- 13,70	540.9157.0000 540.9097.0205	FT;S;P
13,71	- 18,00	540.1752.0000	FT	13,71	- 18,00	540.1752.0000	FT	13,71	- 18,00	540.1752.0000	FT;S; Faba	13,71	- 20,70		S
18,01	- 23,00	540.0952.0000	FT	18,01	- 23,00	540.0952.0000	FT	18,01	- 23,00	540.0952.0000	FT;S; Faba				
23,01	- 27,00	540.0952.0000 540.1762.0205	FT	23,01	- 27,00	540.0952.0000 540.1762.0205	FT	23,01	- 27,00	540.0952.0000 540.1762.0205	FT;S Faba				
27,01	- 32,00	540.0952.0000 540.1772.0205	FT	27,01	- 32,00	540.0952.0000 540.1772.0205	FT	27,01	- 32,00	540.0952.0000 540.1772.0205	FT;S Faba				
32,01	- 36,00	540.0952.0000 840.2362.0205	S	32,01	- 36,00	540.0952.0000 840.2362.0205	S	32,01	- 36,00	540.0952.0000 840.2362.0205	FT;S Faba				

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1D2				**1D2**				**1D2**				**1D2**			
4 - 7		weight-loaded	S	4 - 7		weight-loaded	S	4 - 7		weight-loaded	S	4 - 7		weight-loaded	S
7 - 10		540.8204.0000		7 - 10		540.8204.0000		7 - 10		540.8204.0000		7 - 10		540.8207.0000	
10 - 17		540.8204.0000	O	10 - 17		540.8204.0000	O	10 - 17		540.8204.0000	O	10 - 17		540.8207.0000	O
17 - 22		540.8224.0000		17 - 22		540.8224.0000		17 - 22		540.8224.0000		17 - 22		540.8227.0000	
22 - 28		540.8224.0000	O	22 - 28		540.8224.0000	O	22 - 28		540.8224.0000	O	22 - 28		540.8227.0000	O
28 - 33		540.8234.0000		28 - 33		540.8234.0000		28 - 33		540.8234.0000		28 - 33		540.8237.0000	
33 - 46		540.8234.0000	O	33 - 46		540.8234.0000	O	33 - 46		540.8234.0000	O	33 - 46		540.8237.0000	O
46 - 62		540.4364.0000		46 - 62		540.4364.0000		46 - 62		540.4364.0000		46 - 62		540.4367.0000	
62 - 99		540.4364.0000	O	62 - 99		540.4364.0000	O	62 - 99		540.4364.0000	O	62 - 99		540.4367.0000	O
99 - 160		540.4374.0000	O	99 - 160		540.4374.0000	O	99 - 160		540.4374.0000	O	99 - 160		540.4377.0000	O
160 - 171		540.4394.0000		160 - 171		540.4394.0000		160 - 171		540.4394.0000		160 - 171		540.4397.0000	
171 - 236		540.4394.0000	O	171 - 236		540.4394.0000	O	171 - 236		540.4394.0000	O	171 - 236		540.4397.0000	O
236 - 283		540.9434.0000		236 - 283		540.9434.0000		236 - 283		540.9434.0000		236 - 283		540.9437.0000	
283 - 348		540.9434.0000	O	283 - 348		540.9434.0000	O	283 - 348		540.9434.0000	O	283 - 348		540.9437.0000	O
348 - 355		540.4414.0000		348 - 355		540.4414.0000		348 - 355		540.4414.0000		348 - 355		540.4417.0000	
355 - 493		540.4414.0000	O	355 - 493		540.4414.0000	O	355 - 493		540.4414.0000	O	355 - 493		540.4417.0000	O
493 - 653		540.4424.0000	O	493 - 653		540.4424.0000	O	493 - 653		540.4424.0000	O	493 - 653		540.4427.0000	O
653 - 943		540.4434.0000	O	653 - 943		540.4434.0000	O	653 - 943		540.4434.0000	O	653 - 943		540.4437.0000	O
943 - 1204		540.4444.0000	O	943 - 1204		540.4444.0000	O	943 - 1204		540.4444.0000	O	943 - 1204		540.4447.0000	O
1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4447.0000 540.9477.0205	O
1330 - 1479		540.4464.0000	O	1330 - 1479		540.4464.0000	O	1330 - 1479		540.4464.0000	O	1330 - 1479		540.4467.0000	O

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2D2				**1 1/2D2**				**1 1/2D2**				**1 1/2D2**			
73	- 109	540.8434.0000		73	- 109	540.8434.0000		73	- 109	540.8434.0000		73	- 109	540.8437.0000	
109	- 167	540.4654.0000		109	- 167	540.4654.0000		109	- 167	540.4654.0000		109	- 167	540.4657.0000	
167	- 268	540.4674.0000		167	- 268	540.4674.0000		167	- 268	540.4674.0000		167	- 268	540.4677.0000	
268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4687.0000	
406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4697.0000	
580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4707.0000	
841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4717.0000	
1160	- 1740	540.5632.0000		1160	- 1740	540.5632.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4727.0000	
1740	- 2538	540.4734.0000		1740	- 2538	540.4734.0000		1740	- 2538	540.4734.0000		1740	- 2538	540.4737.0000	
2538	- 3705	540.5652.0000		2538	- 3705	540.5652.0000		2538	- 3705	540.4724.0000		2538	- 3705	540.4727.0000	
										540.9604.0000				540.9607.0205	
1 1/2D3				**1 1/2D3**				**1 1/2D3**				**1 1/2D3**			
268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4687.0000	
406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4697.0000	
580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4707.0000	
841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4717.0000	
1160	- 1740	540.4724.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4727.0000	
1740	- 2175	540.4734.0000		1740	- 2175	540.4734.0000		1740	- 2175	540.4734.0000		1740	- 2175	540.4737.0000	
2175	- 3263	540.9634.0000		2175	- 3263	540.9634.0000		2175	- 3263	540.9634.0000		2175	- 3263	540.9637.0000	
3263	- 4495	540.9644.0000		3263	- 4495	540.9644.0000		3263	- 4495	540.9644.0000		3263	- 4495	540.9647.0000	
4495	- 6000	540.9644.0000		4495	- 6000	540.9644.0000		4495	- 6000	540.9644.0000		4495	- 6000	540.9647.0000	
		540.9604.0000				540.9604.0000				540.9604.0000				540.9607.0205	

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1E2				**1E2**				**1E2**				**1E2**			
4 - 7		weight-loaded	S	4 - 7		weight-loaded	S	4 - 7		weight-loaded	S	4 - 7		weight-loaded	S
7 - 10		540.8204.0000		7 - 10		540.8204.0000		7 - 10		540.8204.0000		7 - 10		540.8207.0000	
10 - 17		540.8204.0000	O	10 - 17		540.8204.0000	O	10 - 17		540.8204.0000	O	10 - 17		540.8207.0000	O
17 - 22		540.8224.0000		17 - 22		540.8224.0000		17 - 22		540.8224.0000		17 - 22		540.8227.0000	
22 - 28		540.8224.0000	O	22 - 28		540.8224.0000	O	22 - 28		540.8224.0000	O	22 - 28		540.8227.0000	O
28 - 33		540.8234.0000		28 - 33		540.8234.0000		28 - 33		540.8234.0000		28 - 33		540.8237.0000	
33 - 46		540.8234.0000	O	33 - 46		540.8234.0000	O	33 - 46		540.8234.0000	O	33 - 46		540.8237.0000	O
46 - 62		540.4364.0000		46 - 62		540.4364.0000		46 - 62		540.4364.0000		46 - 62		540.4367.0000	
62 - 99		540.4364.0000	O	62 - 99		540.4364.0000	O	62 - 99		540.4364.0000	O	62 - 99		540.4367.0000	O
99 - 160		540.4374.0000	O	99 - 160		540.4374.0000	O	99 - 160		540.4374.0000	O	99 - 160		540.4377.0000	O
160 - 171		540.4394.0000		160 - 171		540.4394.0000		160 - 171		540.4394.0000		160 - 171		540.4397.0000	
171 - 236		540.4394.0000	O	171 - 236		540.4394.0000	O	171 - 236		540.4394.0000	O	171 - 236		540.4397.0000	O
236 - 283		540.9434.0000		236 - 283		540.9434.0000		236 - 283		540.9434.0000		236 - 283		540.9437.0000	
283 - 348		540.9434.0000	O	283 - 348		540.9434.0000	O	283 - 348		540.9434.0000	O	283 - 348		540.9437.0000	O
348 - 355		540.4414.0000		348 - 355		540.4414.0000		348 - 355		540.4414.0000		348 - 355		540.4417.0000	
355 - 493		540.4414.0000	O	355 - 493		540.4414.0000	O	355 - 493		540.4414.0000	O	355 - 493		540.4417.0000	O
493 - 653		540.4424.0000	O	493 - 653		540.4424.0000	O	493 - 653		540.4424.0000	O	493 - 653		540.4427.0000	O
653 - 943		540.4434.0000	O	653 - 943		540.4434.0000	O	653 - 943		540.4434.0000	O	653 - 943		540.4437.0000	O
943 - 1204		540.4444.0000	O	943 - 1204		540.4444.0000	O	943 - 1204		540.4444.0000	O	943 - 1204		540.4447.0000	O
1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4444.0000 540.9474.0205	O	1204 - 1330		540.4447.0000 540.9477.0205	O
1330 - 1479		540.4464.0000	O	1330 - 1479		540.4464.0000	O	1330 - 1479		540.4464.0000	O	1330 - 1479		540.4467.0000	O

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2E2				**1 1/2E2**				**1 1/2E2**				**1 1/2E2**			
73	- 109	540.8434.0000		73	- 109	540.8434.0000		73	- 109	540.8434.0000		73	- 109	540.8437.0000	
109	- 167	540.4654.0000		109	- 167	540.4654.0000		109	- 167	540.4654.0000		109	- 167	540.4657.0000	
167	- 268	540.4674.0000		167	- 268	540.4674.0000		167	- 268	540.4674.0000		167	- 268	540.4677.0000	
268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4687.0000	
406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4697.0000	
580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4707.0000	
841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4717.0000	
1160	- 1740	540.5632.0000		1160	- 1740	540.5632.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4727.0000	
1740	- 2538	540.4734.0000		1740	- 2538	540.4734.0000		1740	- 2538	540.4734.0000		1740	- 2538	540.4737.0000	
2538	- 3705	540.5652.0000		2538	- 3705	540.5652.0000		2538	- 3705	540.4724.0000		2538	- 3705	540.4727.0000	
										540.9604.0000				540.9607.0205	
1 1/2E3				**1 1/2E3**				**1 1/2E3**				**1 1/2E3**			
268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4684.0000		268	- 406	540.4687.0000	
406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4694.0000		406	- 580	540.4697.0000	
580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4704.0000		580	- 841	540.4707.0000	
841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4714.0000		841	- 1160	540.4717.0000	
1160	- 1740	540.4724.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4724.0000		1160	- 1740	540.4727.0000	
1740	- 2175	540.4734.0000		1740	- 2175	540.4734.0000		1740	- 2175	540.4734.0000		1740	- 2175	540.4737.0000	
2175	- 3263	540.9634.0000		2175	- 3263	540.9634.0000		2175	- 3263	540.9634.0000		2175	- 3263	540.9637.0000	
3263	- 4495	540.9644.0000		3263	- 4495	540.9644.0000		3263	- 4495	540.9644.0000		3263	- 4495	540.9647.0000	
4495	- 6000	540.9644.0000		4495	- 6000	540.9644.0000		4495	- 6000	540.9644.0000		4495	- 6000	540.9647.0000	
		540.9604.0000				540.9604.0000				540.9604.0000				540.9607.0205	

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2F2				**1 1/2F2**				**1 1/2F2**				**1 1/2F2**			
4	- 7	weight-loaded	S	4	- 7	weight-loaded	S	4	- 7	weight-loaded	S	4	- 7	weight-loaded	S
7	- 17	540.8404.0000		7	- 17	540.8404.0000		7	- 17	540.8404.0000		7	- 17	540.8407.0000	
18	- 23	540.8424.0000		18	- 23	540.8424.0000		18	- 23	540.8424.0000		18	- 23	540.8427.0000	
23	- 29	540.8434.0000		23	- 29	540.8434.0000		23	- 29	540.8434.0000		23	- 29	540.8437.0000	
29	- 39	540.4654.0000		29	- 39	540.4654.0000		29	- 39	540.4654.0000		29	- 39	540.4657.0000	
39	- 52	540.4664.0000		39	- 52	540.4664.0000		39	- 52	540.4664.0000		39	- 52	540.4667.0000	
52	- 74	540.4674.0000		52	- 74	540.4674.0000		52	- 74	540.4674.0000		52	- 74	540.4677.0000	
74	- 117	540.4684.0000		74	- 117	540.4684.0000		74	- 117	540.4684.0000		74	- 117	540.4687.0000	
118	- 174	540.4694.0000		118	- 174	540.4694.0000		118	- 174	540.4694.0000		118	- 174	540.4697.0000	
174	- 247	540.4704.0000		174	- 247	540.4704.0000		174	- 247	540.4704.0000		174	- 247	540.4707.0000	
247	- 355	540.4714.0000		247	- 355	540.4714.0000		247	- 355	540.4714.0000		247	- 355	540.4717.0000	
355	- 479	540.8494.0000		355	- 479	540.8494.0000		355	- 479	540.8494.0000		355	- 479	540.8497.0000	
479	- 783	540.4734.0000		479	- 783	540.4734.0000		479	- 783	540.4734.0000		479	- 783	540.4737.0000	
783	- 1096	540.9634.0000		783	- 1096	540.9634.0000		783	- 1096	540.9634.0000		783	- 1096	540.9637.0000	
1096	- 1480	540.9644.0000		1096	- 1480	540.9644.0000		1096	- 1480	540.9644.0000		1096	- 1480	540.9647.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2F3				**1 1/2F3**				**1 1/2F3**				**1 1/2F3**			
4	- 7	weight-loaded	S	4	- 7	weight-loaded	S	4	- 7	weight-loaded	S	4	- 7	weight-loaded	S
7	- 17	540.8404.0000		7	- 17	540.8404.0000		7	- 17	540.8404.0000		7	- 17	540.8407.0000	
18	- 23	540.8424.0000		18	- 23	540.8424.0000		18	- 23	540.8424.0000		18	- 23	540.8427.0000	
23	- 29	540.8434.0000		23	- 29	540.8434.0000		23	- 29	540.8434.0000		23	- 29	540.8437.0000	
29	- 39	540.4654.0000		29	- 39	540.4654.0000		29	- 39	540.4654.0000		29	- 39	540.4657.0000	
39	- 52	540.4664.0000		39	- 52	540.4664.0000		39	- 52	540.4664.0000		39	- 52	540.4667.0000	
52	- 74	540.4674.0000		52	- 74	540.4674.0000		52	- 74	540.4674.0000		52	- 74	540.4677.0000	
74	- 117	540.4684.0000		74	- 117	540.4684.0000		74	- 117	540.4684.0000		74	- 117	540.4687.0000	
118	- 174	540.4694.0000		118	- 174	540.4694.0000		118	- 174	540.4694.0000		118	- 174	540.4697.0000	
174	- 247	540.4704.0000		174	- 247	540.4704.0000		174	- 247	540.4704.0000		174	- 247	540.4707.0000	
247	- 355	540.4714.0000		247	- 355	540.4714.0000		247	- 355	540.4714.0000		247	- 355	540.4717.0000	
355	- 479	540.8494.0000		355	- 479	540.8494.0000		355	- 479	540.8494.0000		355	- 479	540.8497.0000	
479	- 783	540.4734.0000		479	- 783	540.4734.0000		479	- 783	540.4734.0000		479	- 783	540.4737.0000	
783	- 1096	540.9634.0000		783	- 1096	540.9634.0000		783	- 1096	540.9634.0000		783	- 1096	540.9637.0000	
1096	- 1479	540.9644.0000		1096	- 1479	540.9644.0000		1096	- 1479	540.9644.0000		1096	- 1479	540.9647.0000	
1479	- 2030	540.9654.0000		1479	- 2030	540.9654.0000		1479	- 2030	540.9654.0000		1479	- 2030	540.9657.0000	
2030	- 2755	540.9644.0000 540.9604.0000		2030	- 2755	540.9644.0000 540.9604.0000		2030	- 2755	540.9644.0000 540.9604.0000		2030	- 2755	540.9647.0000 540.9607.0205	
2755	- 3703		S	2755	- 3703		S	2755	- 3703		S	2755	- 3703		S
3703	- 5000		S	3703	- 5000		S	3703	- 5000		S	3703	- 5000		S

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
1 1/2G3				**1 1/2G3**				**1 1/2G3**				**1 1/2G3**			
3	- 9	weight-loaded	S	3	- 9	weight-loaded	S	3	- 9	weight-loaded	S	3	- 9	weight-loaded	S
10	- 17	540.8404.0000		10	- 17	540.8404.0000		10	- 17	540.8404.0000		10	- 17	540.8407.0000	
18	- 25	540.8424.0000		18	- 25	540.8424.0000		18	- 25	540.8424.0000		18	- 25	540.8427.0000	
25	- 46	540.8434.0000		25	- 46	540.8434.0000		25	- 46	540.8434.0000		25	- 46	540.8437.0000	
47	- 73	540.4654.0000		47	- 73	540.4654.0000		47	- 73	540.4654.0000		47	- 73	540.4657.0000	
73	- 102	540.4664.0000		73	- 102	540.4664.0000		73	- 102	540.4664.0000		73	- 102	540.4667.0000	
102	- 131	540.4674.0000		102	- 131	540.4674.0000		102	- 131	540.4674.0000		102	- 131	540.4677.0000	
131	- 174	540.4684.0000		131	- 174	540.4684.0000		131	- 174	540.4684.0000		131	- 174	540.4687.0000	
174	- 254	540.4694.0000		174	- 254	540.4694.0000		174	- 254	540.4694.0000		174	- 254	540.4697.0000	
254	- 312	540.4704.0000		254	- 312	540.4704.0000		254	- 312	540.4704.0000		254	- 312	540.4707.0000	
312	- 435	540.4714.0000		312	- 435	540.4714.0000		312	- 435	540.4714.0000		312	- 435	540.4717.0000	
435	- 580	540.8494.0000		435	- 580	540.8494.0000		435	- 580	540.8494.0000		435	- 580	540.8497.0000	
580	- 754	540.4734.0000		580	- 754	540.4734.0000		580	- 754	540.4734.0000		580	- 754	540.4737.0000	
754	- 1117	540.9634.0000		754	- 1117	540.9634.0000		754	- 1117	540.9634.0000		754	- 1117	540.9637.0000	
1117	- 1566	540.9644.0000		1117	- 1566	540.9644.0000		1117	- 1566	540.9644.0000		1117	- 1566	540.9647.0000	
1566	- 2220	540.9644.0000 540.9604.0000		1566	- 2220	540.9644.0000 540.9604.0000		1566	- 2220	540.9644.0000 540.9604.0000		1566	- 2220	540.9647.0000 540.9607.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2G3				**2G3**				**2G3**				**2G3**			
73	- 102	540.5702.0000		73	- 102	540.5702.0000		73	- 102	540.5704.0000		73	- 102	540.5707.0000	
102	- 131	540.5712.0000		102	- 131	540.5712.0000		102	- 131	540.5714.0000		102	- 131	540.5717.0000	
131	- 167	540.5722.0000		131	- 167	540.5722.0000		131	- 167	540.5724.0000		131	- 167	540.5727.0000	
167	- 218	540.5732.0000		167	- 218	540.5732.0000		167	- 218	540.5734.0000		167	- 218	540.5737.0000	
218	- 276	540.5742.0000		218	- 276	540.5742.0000		218	- 276	540.5744.0000		218	- 276	540.5747.0000	
276	- 392	540.5752.0000		276	- 392	540.5752.0000		276	- 392	540.5754.0000		276	- 392	540.5757.0000	
392	- 551	540.5762.0000		392	- 551	540.5762.0000		392	- 551	540.5764.0000		392	- 551	540.5767.0000	
551	- 769	540.5772.0000		551	- 769	540.5772.0000		551	- 769	540.5774.0000		551	- 769	540.5777.0000	
769	- 1088	540.5782.0000		769	- 1088	540.5782.0000		769	- 1088	540.5784.0000		769	- 1088	540.5787.0000	
1088	- 1523	540.5792.0000		1088	- 1523	540.5792.0000		1088	- 1523	540.5784.0000		1088	- 1523	540.5787.0000	
1523	- 2175	540.5802.0000		1523	- 2175	540.5802.0000		1523	- 2175	540.9724.0205		1523	- 2175	540.9727.0205	
		540.9924.0205				540.9924.0205				540.9494.0000				540.9497.0000	
2175	- 3176	540.5802.0000		2175	- 3176	540.5802.0000		2175	- 3176	540.9494.0000		2175	- 3176	540.9497.0000	
		540.4982.0205				540.4982.0205				540.9724.0205				540.9727.0205	
3176	- 3705	540.9492.0000		3176	- 3705	540.9492.0000		3176	- 3705	540.9494.0000		3176	- 3705	540.9497.0000	
		540.4982.0205				540.4982.0205				540.4984.0205				540.4987.0205	
1 1/2H3				**1 1/2H3**				**1 1/2H3**				**1 1/2H3**			
3	- 6	gewichtsbel.	S	3	- 6	gewichtsbel.	S	3	- 6	gewichtsbel.	S	3	- 6	gewichtsbel.	S
6	- 15	540.8414.0000		6	- 15	540.8414.0000		6	- 15	540.8414.0000		6	- 15	540.8417.0000	
15	- 25	540.8434.0000		15	- 25	540.8434.0000		15	- 25	540.8434.0000		15	- 25	540.8437.0000	
25	- 41	540.4664.0000		25	- 41	540.4664.0000		25	- 41	540.4664.0000		25	- 41	540.4667.0000	
41	- 55	540.4674.0000		41	- 55	540.4674.0000		41	- 55	540.4674.0000		41	- 55	540.4677.0000	
55	- 94	540.4684.0000		55	- 94	540.4684.0000		55	- 94	540.4684.0000		55	- 94	540.4687.0000	
94	- 138	540.4694.0000		94	- 138	540.4694.0000		94	- 138	540.4694.0000		94	- 138	540.4697.0000	
138	- 181	540.4704.0000		138	- 181	540.4704.0000		138	- 181	540.4704.0000		138	- 181	540.4707.0000	
181	- 285	540.4714.0000		181	- 285	540.4714.0000		181	- 285	540.4714.0000		181	- 285	540.4717.0000	

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2H3				**2H3**				**2H3**				**2H3**			
4 - 9		weight-loaded	S	4 - 9		weight-loaded	S	4 - 9		weight-loaded	S	4 - 9		weight-loaded	S
9 - 15		540.8514.0000		9 - 15		540.8514.0000		9 - 15		540.8514.0000		9 - 15		540.8517.0000	
15 - 23		540.8532.0000		15 - 23		540.8532.0000		15 - 23		540.8534.0000		15 - 23		540.8537.0000	
23 - 29		540.8542.0000		23 - 29		540.8542.0000		23 - 29		540.8504.0000		23 - 29		540.8507.0000	
29 - 41		540.8542.0000	O	29 - 41		540.8542.0000	O	29 - 41		540.8504.0000	O	29 - 41		540.8507.0000	O
41 - 55		540.8552.0000	O	41 - 55		540.8552.0000	O	41 - 55		540.8554.0000	O	41 - 55		540.8557.0000	O
55 - 86		540.5712.0000		55 - 86		540.5712.0000		55 - 86		540.5714.0000		55 - 86		540.5717.0000	
86 - 109		540.5722.0000		86 - 109		540.5722.0000		86 - 109		540.5724.0000		86 - 109		540.5727.0000	
109 - 145		540.5732.0000		109 - 145		540.5732.0000		109 - 145		540.5734.0000		109 - 145		540.5737.0000	
145 - 203		540.5742.0000		145 - 203		540.5742.0000		145 - 203		540.5744.0000		145 - 203		540.5747.0000	
203 - 334		540.5752.0000		203 - 334		540.5752.0000		203 - 334		540.5754.0000		203 - 334		540.5757.0000	
334 - 435		540.5762.0000		334 - 435		540.5762.0000		334 - 435		540.5764.0000		334 - 435		540.5767.0000	
435 - 609		540.5772.0000		435 - 609		540.5772.0000		435 - 609		540.5774.0000		435 - 609		540.5777.0000	
609 - 815		540.5782.0000		609 - 815		540.5782.0000		609 - 815		540.5784.0000		609 - 815		540.5787.0000	
815 - 1088		540.9752.0000 540.4962.0205		815 - 1088		540.9752.0000 540.4962.0205		815 - 1088		540.5774.0000 540.9724.0205		815 - 1088		540.5777.0000 540.9727.0205	
1088 - 1494		540.5802.0000		1088 - 1494		540.5802.0000		1088 - 1494		540.5804.0000		1088 - 1494		540.5807.0000	
1494 - 1958		540.5802.0000 540.9722.0205		1494 - 1958		540.5802.0000 540.9722.0205		1494 - 1958		540.5804.0000 540.9724.0205		1494 - 1958		540.5807.0000 540.9727.0205	
1958 - 2750		540.9492.0000 540.4982.0205		1958 - 2750		540.9492.0000 540.4982.0205		1958 - 2750		540.9494.0000 540.4984.0205		1958 - 2750		540.9497.0000 540.4987.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
2J3				**2J3**				**2J3**				**2J3**			
3 - 13		weight-loaded	S	3 - 13		weight-loaded	S	3 - 13		weight-loaded	S	3 - 13		weight-loaded	S
13 - 22		540.8532.0000		13 - 22		540.8532.0000		13 - 22		540.8534.0000		13 - 22		540.8537.0000	
22 - 36		540.5702.0000		22 - 36		540.5702.0000		22 - 36		540.5704.0000		22 - 36		540.5707.0000	
36 - 44		540.5712.0000		36 - 44		540.5712.0000		36 - 44		540.5714.0000		36 - 44		540.5717.0000	
44 - 58		540.5722.0000		44 - 58		540.5722.0000		44 - 58		540.5724.0000		44 - 58		540.5727.0000	
58 - 80		540.5732.0000		58 - 80		540.5732.0000		58 - 80		540.5734.0000		58 - 80		540.5737.0000	
80 - 109		540.5742.0000		80 - 109		540.5742.0000		80 - 109		540.5744.0000		80 - 109		540.5747.0000	
109 - 167		540.5752.0000		109 - 167		540.5752.0000		109 - 167		540.5754.0000		109 - 167		540.5757.0000	
167 - 218		540.5762.0000		167 - 218		540.5762.0000		167 - 218		540.5764.0000		167 - 218		540.5767.0000	
218 - 285		540.5772.0000		218 - 285		540.5772.0000		218 - 285		540.5774.0000		218 - 285		540.5777.0000	
3J4				**3J4**				**3J4**				**3J4**			
12 - 16		540.8624.0000		12 - 16		540.8624.0000		12 - 16		540.8624.0000		12 - 16		540.8627.0000	
16 - 22		540.8632.0000		16 - 22		540.8632.0000		16 - 22		540.8634.0000		16 - 22		540.8637.0000	
22 - 29		540.8642.0000		22 - 29		540.8642.0000		22 - 29		540.8644.0000		22 - 29		540.8647.0000	
29 - 39		540.8642.0000	O	29 - 39		540.8642.0000	O	29 - 39		540.8644.0000	O	29 - 39		540.8647.0000	O
39 - 61		540.8652.0000	O	39 - 61		540.8652.0000	O	39 - 61		540.8654.0000	O	39 - 61		540.8657.0000	O
61 - 87		540.5812.0000	O	61 - 87		540.5812.0000	O	61 - 87		540.5814.0000	O	61 - 87		540.5817.0000	O
87 - 109		540.5832.0000		87 - 109		540.5832.0000		87 - 109		540.5834.0000		87 - 109		540.5837.0000	
109 - 160		540.5842.0000		109 - 160		540.5842.0000		109 - 160		540.5844.0000		109 - 160		540.5847.0000	
160 - 225		540.5852.0000		160 - 225		540.5852.0000		160 - 225		540.5854.0000		160 - 225		540.5857.0000	
225 - 312		540.5862.0000		225 - 312		540.5862.0000		225 - 312		540.5864.0000		225 - 312		540.5867.0000	
312 - 442		540.5872.0000		312 - 442		540.5872.0000		312 - 442		540.5874.0000		312 - 442		540.5877.0000	
442 - 638		540.5882.0000		442 - 638		540.5882.0000		442 - 638		540.5884.0000		442 - 638		540.5887.0000	
638 - 906		540.5892.0000		638 - 906		540.5892.0000		638 - 906		540.5894.0000		638 - 906		540.5897.0000	
906 - 1189		540.9862.0000		906 - 1189		540.9862.0000		906 - 1189		540.9864.0000		906 - 1189		540.9867.0000	
1189 - 1552		540.5892.0000 540.9872.0000		1189 - 1552		540.5892.0000 540.9872.0000		1189 - 1552		540.5894.0000 540.9874.0205		1189 - 1552		540.5897.0000 540.9877.0000	
1552 - 1827		540.9862.0000 540.9872.0000		1552 - 1827		540.9862.0000 540.9872.0000		1552 - 1827		540.9864.0000 540.9874.0205		1552 - 1827		540.9867.0000 540.9877.0000	
1827 - 2291		540.8682.0000 540.9872.0000		1827 - 2291		540.8682.0000 540.9872.0000		1827 - 2291		540.8684.0000 540.9874.0205		1827 - 2291		540.8687.0000 540.9877.0000	
2291 - 2700			S	2291 - 2700			S	2291 - 2700			S	2291 - 2700			S

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doc. type:	LGS	change rep.	00841A	retention	10y.		

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3K4				**3K4**				**3K4**				**3K4**			
4 - 6		weight-loaded	S	4 - 6		weight-loaded	S	4 - 6		weight-loaded	S	4 - 6		weight-loaded	S
6 - 9		540.8612.0000		6 - 9		540.8612.0000		6 - 9		540.8614.0000		6 - 9		540.8617.0000	
9 - 15		540.8632.0000		9 - 15		540.8632.0000		9 - 19		540.8634.0000		9 - 19		540.8637.0000	
15 - 19		540.8632.0000	O	15 - 19		540.8632.0000	O								
19 - 32		540.8652.0000		19 - 32		540.8652.0000		19 - 32		540.8654.0000		19 - 32		540.8657.0000	
32 - 44		540.5812.0000		32 - 44		540.5812.0000		32 - 44		540.5814.0000		32 - 44		540.5817.0000	
44 - 58		540.5822.0000		44 - 58		540.5822.0000		44 - 58		540.5824.0000		44 - 58		540.5827.0000	
58 - 80		540.5832.0000		58 - 80		540.5832.0000		58 - 80		540.5834.0000		58 - 80		540.5837.0000	
80 - 109		540.5842.0000		80 - 109		540.5842.0000		80 - 109		540.5844.0000		80 - 109		540.5847.0000	
109 - 152		540.5852.0000		109 - 152		540.5852.0000		109 - 152		540.5854.0000		109 - 152		540.5857.0000	
152 - 225		540.5862.0000		152 - 225		540.5862.0000		152 - 225		540.5864.0000		152 - 225		540.5867.0000	
225 - 297		540.5872.0000		225 - 297		540.5872.0000		225 - 297		540.5874.0000		225 - 297		540.5877.0000	
297 - 410		540.5882.0000		297 - 410		540.5882.0000		297 - 410		540.5884.0000		297 - 410		540.5887.0000	
410 - 558		540.5892.0000		410 - 558		540.5892.0000		410 - 558		540.5894.0000		410 - 558		540.5897.0000	
558 - 740		540.9862.0000		558 - 740		540.9862.0000		558 - 740		540.9864.0000		558 - 740		540.9867.0000	
740 - 1044		540.8682.0000		740 - 1044		540.8682.0000		740 - 1044		540.8684.0000		740 - 1044		540.8687.0000	
1044 - 1480		540.8682.0000 540.9872.0000		1044 - 1480		540.8682.0000 540.9872.0000		1044 - 1480		540.8684.0000 540.9874.0205		1044 - 1480		540.8687.0000 540.9877.0205	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3K6				**3K6**				**3K6**				**3K6**			
33	- 46	540.5912.0000		33	- 46	540.5912.0000		33	- 46	540.5914.0000		33	- 46	540.5917.0000	
47	- 64	540.5922.0000		47	- 64	540.5922.0000		47	- 64	540.5924.0000		47	- 64	540.5927.0000	
64	- 87	540.5932.0000		64	- 87	540.5932.0000		64	- 87	540.5934.0000		64	- 87	540.5937.0000	
87	- 123	540.5942.0000		87	- 123	540.5942.0000		87	- 123	540.5944.0000		87	- 123	540.5947.0000	
123	- 167	540.5952.0000		123	- 167	540.5952.0000		123	- 167	540.5954.0000		123	- 167	540.5957.0000	
167	- 218	540.5962.0000		167	- 218	540.5962.0000		167	- 218	540.5964.0000		167	- 218	540.5967.0000	
218	- 305	540.5972.0000		218	- 305	540.5972.0000		218	- 305	540.5974.0000		218	- 305	540.5977.0000	
305	- 421	540.9952.0000		305	- 421	540.9952.0000		305	- 421	540.9954.0000		305	- 421	540.9957.0000	
421	- 566	540.5984.0000		421	- 566	540.5984.0000		421	- 566	540.5984.0000		421	- 566	540.5987.0000	
566	- 750	540.4994.0000		566	- 750	540.4994.0000		566	- 750	540.4994.0000		566	- 750	540.4997.0000	
750	- 1015	540.9552.0000		750	- 1015	540.9552.0000		750	- 1015	540.1374.0000	FT	750	- 1015	540.1377.0000	FT
1015	- 1305	540.9952.0000 540.4994.0000		1015	- 1305	540.9952.0000 540.4994.0000		1015	- 1305	540.9954.0000 540.4994.0000		1015	- 1305	540.9957.0000 540.4997.0000	
1305	- 1631	540.9962.0000 540.4994.0000		1305	- 1631	540.9962.0000 540.4994.0000		1305	- 1631	540.9964.0000 540.4994.0000		1305	- 1631	540.9967.0000 540.4997.0000	
1631	- 2040	540.9552.0000 540.9542.0205		1631	- 2040	540.9552.0000 540.9542.0205		1631	- 2020		S	1631	- 2020		S
2040	- 2220	540.9832.0000 540.9982.0205		2040	- 2220	540.9832.0000 540.9982.0205									

protected

Ausführung (model)

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
3L4				**3L4**				**3L4**				**3L4**			
4	- 7	540.8612.0000		4	- 7	540.8612.0000		4	- 7	540.8614.0000		4	- 7	540.8617.0000	
7	- 13	540.8632.0000		7	- 13	540.8632.0000		7	- 13	540.8634.0000		7	- 13	540.8637.0000	
										540.8634.0000	O			540.8637.0000	O
13	- 22	540.8652.0000		13	- 22	540.8652.0000		13	- 22	540.8654.0000		13	- 22	540.8657.0000	
22	- 29	540.5812.0000		22	- 29	540.5812.0000		22	- 29	540.5814.0000		22	- 29	540.5817.0000	
29	- 44	540.5822.0000		29	- 44	540.5822.0000		29	- 44	540.5824.0000	O	29	- 44	540.5827.0000	O
44	- 62	540.5832.0000		44	- 62	540.5832.0000		44	- 62	540.5834.0000	O	44	- 62	540.5837.0000	O
62	- 80	540.5842.0000		62	- 80	540.5842.0000		62	- 80	540.5844.0000	O	62	- 80	540.5847.0000	O
80	- 94	540.5842.0000	O	80	- 94	540.5842.0000	O	80	- 94			80	- 94		
94	- 110	540.5852.0000		94	- 110	540.5852.0000		94	- 110	540.5854.0000	O	94	- 110	540.5857.0000	O
110	- 131	540.5852.0000	O	110	- 131	540.5852.0000	O	110	- 131			110	- 131		
131	- 158	540.5862.0000		131	- 158	540.5862.0000		131	- 158	540.5864.0000	O	131	- 158	540.5867.0000	O
158	- 181	540.5862.0000	O	158	- 181	540.5862.0000	O	158	- 181			158	- 181		
181	- 239	540.5872.0000		181	- 239	540.5872.0000		181	- 239	540.5874.0000	O	181	- 239	540.5877.0000	O
239	- 285	540.5882.0000		239	- 285	540.5882.0000		239	- 285	540.5884.0000		239	- 285	540.5887.0000	

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
4L6				**4L6**				**4L6**				**4L6**			
3 - 10		weight-loaded	S	3 - 10		weight-loaded	S	3 - 10		weight-loaded	S	3 - 10		weight-loaded	S
10 - 17		540.8732.0000		10 - 17		540.8732.0000		10 - 17		540.8734.0000		10 - 17		540.8737.0000	
18 - 22		540.8742.0000		18 - 22		540.8742.0000		18 - 22		540.8744.0000		18 - 22		540.8747.0000	
22 - 26		540.8752.0000		22 - 26		540.8752.0000		22 - 26		540.8754.0000		22 - 26		540.8757.0000	
26 - 44		540.5922.0000		26 - 44		540.5922.0000		26 - 44		540.5924.0000		26 - 44		540.5927.0000	
44 - 57		540.5932.0000		44 - 57		540.5932.0000		44 - 57		540.5934.0000		44 - 57		540.5937.0000	
57 - 80		540.5942.0000		57 - 80		540.5942.0000		57 - 80		540.5944.0000		57 - 80		540.5947.0000	
80 - 106		540.5952.0000		80 - 106		540.5952.0000		80 - 106		540.5954.0000		80 - 106		540.5957.0000	
106 - 142		540.5962.0000		106 - 142		540.5962.0000		106 - 142		540.5964.0000		106 - 142		540.5967.0000	
142 - 196		540.5972.0000		142 - 196		540.5972.0000		142 - 196		540.5974.0000		142 - 196		540.5977.0000	
196 - 241		540.9952.0000		196 - 241		540.9952.0000		196 - 241		540.9954.0000		196 - 241		540.9957.0000	
241 - 296		540.5982.0000		241 - 296		540.5982.0000		241 - 296		540.5984.0000		241 - 296		540.5987.0000	
296 - 370		540.4994.0000		296 - 370		540.4994.0000		296 - 370		540.4994.0000		296 - 370		540.4997.0000	
370 - 510		540.5982.0000 540.9534.0000		370 - 510		540.5982.0000 540.9534.0000		370 - 510		540.5984.0000 540.9534.0000		370 - 510		540.5987.0000 540.9537.0000	
511 - 624		540.9962.0000 540.9534.0000		511 - 624		540.9962.0000 540.9534.0000		511 - 624		540.9964.0000 540.9534.0000		511 - 624		540.9967.0000 540.9537.0000	
624 - 769		540.9962.0000 540.4994.0000		624 - 769		540.9962.0000 540.4994.0000		624 - 769		540.9964.0000 540.4994.0000		624 - 769		540.9967.0000 540.4997.0000	
769 - 972		540.9552.0000 540.9542.0205		769 - 972		540.9552.0000 540.9542.0205		769 - 972			FT; S	769 - 972		540.1377.0000 540.1487.0205	FT
972 - 1276		540.1392.0000 540.1482.0205	FT	972 - 1276		540.1392.0000 540.1482.0205	FT	972 - 1276		540.1384.0000 540.1494.0205	FT	972 - 1276		540.1387.0000 540.1497.0205	FT
1276 - 1500		540.1392.0000 540.1492.0205	FT	1276 - 1500		540.1392.0000 540.1492.0205	FT	1276 - 1500		540.1392.0000 540.1492.0205	FT / Faba	1276 - 1500		540.1397.0000 540.1497.0205	FT

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
4M6				**4M6**				**4M6**				**4M6**			
3 - 7		weight-loaded	S	3 - 7		weight-loaded	S	3 - 7		weight-loaded	S	3 - 7		weight-loaded	S
7 - 11		540.8732.0000		7 - 11		540.8732.0000		7 - 11		540.8734.0000		7 - 11		540.8737.0000	
11 - 13		540.8742.0000		11 - 13		540.8742.0000		11 - 13		540.8744.0000		11 - 13		540.8747.0000	
13 - 20		540.8752.0000		13 - 20		540.8752.0000		13 - 20		540.8754.0000		13 - 20		540.8757.0000	
20 - 29		540.5912.0000		20 - 29		540.5912.0000		20 - 29		540.5914.0000		20 - 29		540.5917.0000	
29 - 42		540.5922.0000		29 - 42		540.5922.0000		29 - 42		540.5924.0000		29 - 42		540.5927.0000	
42 - 55		540.5932.0000		42 - 55		540.5932.0000		42 - 55		540.5934.0000		42 - 55		540.5937.0000	
55 - 80		540.5942.0000		55 - 80		540.5942.0000		55 - 80		540.5944.0000		55 - 80		540.5947.0000	
80 - 102		540.5952.0000		80 - 102		540.5952.0000		80 - 102		540.5954.0000		80 - 102		540.5957.0000	
102 - 145		540.5962.0000		102 - 145		540.5962.0000		102 - 145		540.5964.0000		102 - 145		540.5967.0000	
145 - 181		540.5972.0000		145 - 181		540.5972.0000		145 - 181		540.5974.0000		145 - 181		540.5977.0000	
181 - 225		540.9952.0000		181 - 225		540.9952.0000		181 - 225		540.9954.0000		181 - 225		540.9957.0000	
225 - 290		540.5982.0000		225 - 290		540.5982.0000		225 - 290		540.5984.0000		225 - 290		540.5987.0000	
290 - 392		540.9962.0000		290 - 392		540.9962.0000		290 - 392		540.9964.0000		290 - 392		540.9967.0000	
392 - 493		540.9952.0000 540.9982.0205		392 - 493		540.9952.0000 540.9982.0205		392 - 493		540.9954.0000 540.9984.0205		392 - 493		540.9957.0000 540.9987.0205	
493 - 638		540.9962.0000 540.9982.0205		493 - 638		540.9962.0000 540.9982.0205		493 - 638		540.9964.0000 540.9984.0205		493 - 638		540.9967.0000 540.9987.0205	
638 - 822		540.9962.0000 540.4992.0000		638 - 822		540.9962.0000 540.4992.0000		638 - 719		540.9964.0000 540.4994.0000		638 - 719		540.9967.0000 540.4997.0000	
								719 - 822		540.9962.0000 540.4992.0000	S; Faba	719 - 822		540.9967.0000 540.4997.0000	
822 - 1100		540.9552.0000 540.9542.0205		822 - 1100		540.9552.0000 540.9542.0205		822 - 1100		540.9552.0000 540.9542.0205	S; Faba	822 - 1058		540.9557.0000 540.9547.0205	
												1058 - 1100			S

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protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4N6				**4N6**				**4N6**				**4N6**			
3	- 6	weight-loaded	S	3	- 6	weight-loaded	S	3	- 6	weight-loaded	S	3	- 6	weight-loaded	S
6	- 10	540.8732.0000		6	- 10	540.8732.0000		6	- 10	540.8734.0000		6	- 10	540.8737.0000	
10	- 21	540.8752.0000		10	- 21	540.8752.0000		10	- 21	540.8754.0000		10	- 21	540.8757.0000	
21	- 33	540.5922.0000		21	- 33	540.5922.0000		21	- 33	540.5924.0000		21	- 33	540.5927.0000	
33	- 45	540.5932.0000		33	- 45	540.5932.0000		33	- 45	540.5934.0000		33	- 45	540.5937.0000	
45	- 58	540.5942.0000		45	- 58	540.5942.0000		45	- 58	540.5944.0000		45	- 58	540.5947.0000	
58	- 84	540.5952.0000		58	- 84	540.5952.0000		58	- 84	540.5954.0000		58	- 84	540.5957.0000	
84	- 116	540.5962.0000		84	- 116	540.5962.0000		84	- 116	540.5964.0000		84	- 116	540.5967.0000	
116	- 152	540.5972.0000		116	- 152	540.5972.0000		116	- 152	540.5974.0000		116	- 152	540.5977.0000	
152	- 196	540.9952.0000		152	- 196	540.9952.0000		152	- 196	540.9954.0000		152	- 196	540.9957.0000	
196	- 247	540.5982.0000		196	- 247	540.5982.0000		196	- 247	540.5984.0000		196	- 247	540.5987.0000	
247	- 312	540.4992.0000		247	- 312	540.4992.0000		247	- 312	540.4994.0000		247	- 312	540.4997.0000	
312	- 377	540.5972.0000 540.9534.0000		312	- 377	540.5972.0000 540.9534.0000		312	- 377	540.5974.0000 540.9534.0000		312	- 377	540.5977.0000 540.9537.0000	
377	- 457	540.5982.0000 540.9534.0000		377	- 457	540.5982.0000 540.9534.0000		377	- 457	540.5984.0000 540.9534.0000		377	- 457	540.5987.0000 540.9537.0000	
457	- 544	540.9962.0000 540.9534.0000		457	- 544	540.9962.0000 540.9534.0000		457	- 544	540.9964.0000 540.9534.0000		457	- 544	540.9967.0000 540.9537.0000	
544	- 653	540.9962.0000 540.4992.0000		544	- 653	540.9962.0000 540.4992.0000		544	- 653	540.9964.0000 540.4994.0000		544	- 653	540.9967.0000 540.4997.0000	
653	- 769	540.9552.0000 540.4992.0000		653	- 769	540.9552.0000 540.4992.0000		653	- 769		FT;S	653	- 769	540.1377.0000 540.1487.0205	FT
769	- 1000	540.1374.0000 540.1492.0205	FT	769	- 1000	540.1374.0000 540.1492.0205	FT	769	- 1000		FT;S	769	- 1000		FT;S

protected

Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4P6				**4P6**				**4P6**				**4P6**			
2 - 5		weight-loaded	S	2 - 5		weight-loaded	S	2 - 5		weight-loaded	S	2 - 5		weight-loaded	S
5 - 8		540.8732.0000		5 - 8		540.8732.0000		5 - 8		540.8734.0000		5 - 8		540.8737.0000	
8 - 10		540.8742.0000		8 - 10		540.8742.0000		8 - 10		540.8744.0000		8 - 10		540.8747.0000	
10 - 16		540.8752.0000		10 - 16		540.8752.0000		10 - 16		540.8754.0000		10 - 16		540.8757.0000	
16 - 25		540.5912.0000		16 - 25		540.5912.0000		16 - 25		540.5914.0000		16 - 25		540.5917.0000	
25 - 30		540.5922.0000		25 - 30		540.5922.0000		25 - 30		540.5924.0000		25 - 30		540.5927.0000	
31 - 45		540.5932.0000		31 - 45		540.5932.0000		31 - 45		540.5934.0000		31 - 45		540.5937.0000	
45 - 64		540.5942.0000		45 - 64		540.5942.0000		45 - 64		540.5944.0000		45 - 64		540.5947.0000	
64 - 90		540.5952.0000		64 - 90		540.5952.0000		64 - 90		540.5954.0000		64 - 90		540.5957.0000	
90 - 122		540.5962.0000		90 - 122		540.5962.0000		90 - 122		540.5964.0000		90 - 122		540.5967.0000	
122 - 167		540.5972.0000		122 - 167		540.5972.0000		122 - 167		540.5974.0000		122 - 167		540.5977.0000	
167 - 200		540.9952.0000		167 - 200		540.9952.0000		167 - 200		540.9954.0000		167 - 200		540.9957.0000	
200 - 285		540.5982.0000		200 - 285		540.5982.0000		200 - 285			S	200 - 285		540.5987.0000	

protected

Ausführung *(model)*															
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
4P6 300-900#				**4P6 300-900#**				**4P6 300-900#**				**4P6 300-900#**			
4	- 6	weight-loaded	S	4	- 6	weight-loaded	S	4	- 6	weight-loaded	S	4	- 6	weight-loaded	S
6	- 9	540.8832.0000	O	6	- 9	540.8832.0000	O	6	- 9	540.8834.0000	O	6	- 9	540.8837.0000	O
9	- 13	540.8842.0000	O	9	- 13	540.8842.0000	O	9	- 13	540.8844.0000	O	9	- 13	540.8847.0000	O
13	- 20	540.8862.0000	O	13	- 20	540.8862.0000	O	13	- 20	540.8864.0000	O	13	- 20	540.8867.0000	O
20	- 30	540.8872.0000	O	20	- 30	540.8872.0000	O	20	- 30	540.8874.0000	O	20	- 30	540.8877.0000	O
31	- 44	540.8882.0000	O	31	- 44	540.8882.0000	O	31	- 44	540.8884.0000	O	31	- 44	540.8887.0000	O
44	- 58	540.8892.0000	O	44	- 58	540.8892.0000	O	44	- 58	540.8894.0000	O	44	- 58	540.8897.0000	O
58	- 78	540.8902.0000	O	58	- 78	540.8902.0000	O	58	- 78	540.8904.0000	O	58	- 78	540.8907.0000	O
78	- 104	540.8852.0000 540.8982.0205	O	78	- 104	540.8852.0000 540.8982.0205	O	78	- 104	540.8854.0000 540.8984.0205	O	78	- 104	540.8857.0000 540.8987.0205	O
105	- 135	540.8912.0000	O	105	- 135	540.8912.0000	O	105	- 135	540.8914.0000	O	105	- 135	540.8917.0000	O
135	- 181	540.8922.0000	O	135	- 181	540.8922.0000	O	135	- 181	540.8924.0000	O	135	- 181	540.8927.0000	O
181	- 232	540.8942.0000	O	181	- 232	540.8942.0000	O	181	- 232	540.8944.0000	O	181	- 232	540.8947.0000	O
232	- 305	540.8942.0000 540.8972.0205	O	232	- 305	540.8942.0000 540.8972.0205	O	232	- 305	540.8944.0000 540.8974.0205	O	232	- 305	540.8947.0000 540.8977.0205	O
305	- 392	540.8942.0000 540.8982.0205 540.0044.0000	O	305	- 392	540.8942.0000 540.8982.0205 540.0044.0000	O	305	- 392	540.8944.0000 540.8984.0205 540.0044.0000	O	305	- 392	540.8947.0000 540.8987.0205 540.0047.0000	O
392	- 493	540.9552.0000 540.9982.0205	FT; O	392	- 493	540.9552.0000 540.9982.0205	FT; O	392	- 493	540.9554.0000 540.9984.0205	FT; O	392	- 493	540.9557.0000 540.9987.0205	O
493	- 616	540.9552.0000 540.9542.0205	FT; O	493	- 616	540.9552.0000 540.9542.0205	FT; O	493	- 616	540.9554.0000 540.9544.0205	FT; O				
616	- 711	540.9842.0000 540.9542.0205	FT; O	616	- 711	540.9842.0000 540.9542.0205	FT; O	616	- 711	540.9842.0000 540.9542.0205	FT;S;O Faba				
711	- 856	540.9832.0000 540.9542.0205	FT; O	711	- 856	540.9832.0000 540.9542.0205	FT; O	711	- 856	540.9832.0000 540.9542.0205	FT;S;O Faba				
856	- 1000	540.9832.0000 540.9992.0205	FT; O	856	- 1000	540.9832.0000 540.9992.0205	FT; O	856	- 1000	540.9832.0000 540.9992.0205	FT;S;O Faba				

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
6Q8				**6Q8**				**6Q8**				**6Q8**			
3	- 5	weight-loaded	S	3	- 5	weight-loaded	S	3	- 5	weight-loaded	S	3	- 5	weight-loaded	S
5	- 9	540.8832.0000	O	5	- 9	540.8832.0000	O	5	- 9	540.8834.0000	O	5	- 9	540.8837.0000	O
9	- 12	540.8842.0000	O	9	- 12	540.8842.0000	O	9	- 12	540.8844.0000	O	9	- 12	540.8847.0000	O
13	- 22	540.8862.0000	O	13	- 22	540.8862.0000	O	13	- 22	540.8864.0000	O	13	- 22	540.8867.0000	O
22	- 32	540.8872.0000	O	22	- 32	540.8872.0000	O	22	- 32	540.8874.0000	O	22	- 32	540.8877.0000	O
32	- 41	540.8882.0000	O	32	- 41	540.8882.0000	O	32	- 41	540.8884.0000	O	32	- 41	540.8887.0000	O
41	- 55	540.8892.0000	O	41	- 55	540.8892.0000	O	41	- 55	540.8894.0000	O	41	- 55	540.8897.0000	O
55	- 67	540.8902.0000	O	55	- 67	540.8902.0000	O	55	- 67	540.8904.0000	O	55	- 67	540.8907.0000	O
67	- 86	540.8852.0000 540.1132.0205	O	67	- 86	540.8852.0000 540.1132.0205	O	67	- 86	540.8854.0000 540.1134.0205	O	67	- 86	540.8857.0000 540.1137.0205	O
86	- 115	540.8912.0000	O	86	- 115	540.8912.0000	O	86	- 115	540.8914.0000	O	86	- 115	540.8917.0000	O
115	- 143	540.8902.0000 540.1132.0205	O	115	- 143	540.8902.0000 540.1132.0205	O	115	- 143	540.8904.0000 540.1134.0205	O	115	- 143	540.8907.0000 540.1137.0205	O
143	- 199	540.8942.0000	O	143	- 199	540.8942.0000	O	143	- 199	540.1124.0000 540.1024.0000		143	- 199	540.1127.0000 540.1027.0000	
199	- 268	540.8942.0000 540.8972.0205	O	199	- 268	540.8942.0000 540.8972.0205	O	199	- 268	540.1124.0000 540.1144.0205		199	- 268	540.1127.0000 540.1147.0205	
268	- 300	540.1262.0000		268	- 300	540.1262.0000		268	- 300	540.1124.0000 540.1144.0205 540.1024.0000		268	- 300	540.1127.0000 540.1147.0205 540.1027.0000	
300	- 363	540.1262.0000 540.1042.0000		300	- 363	540.1262.0000 540.1042.0000		300	- 363	540.1262.0000 540.1042.0000		300	- 363	540.1267.0000 540.1047.0000	
363	- 473	540.1262.0000 540.1152.0205		363	- 473	540.1262.0000 540.1152.0205		363	- 473	540.1262.0000 540.1152.0205		363	- 473	540.1267.0000 540.1157.0205	
473	- 513	540.1262.0000 540.1152.0205 540.1042.0000		473	- 513	540.1262.0000 540.1152.0205 540.1042.0000		473	- 513	540.1262.0000 540.1152.0205 540.1042.0000		473	- 513	540.1267.0000 540.1157.0205 540.1047.0000	
513	- 600	540.1272.0000 540.1152.0205 540.1042.0000		513	- 600	540.1272.0000 540.1152.0205 540.1042.0000		513	- 600	540.1272.0000 540.1152.0205 540.1042.0000		513	- 600		S
600	- 682	540.1602.0000 540.1612.0205	FT	600	- 682	540.1602.0000 540.1612.0205	FT	600	- 682	540.1602.0000 540.1612.0205	FT; S				

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Ausführung *(model)*

warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices	p [psig] von p1 *up*	bis p2 *to*	Feder-Sachnummer *stock no.*	Indices
6Q8				**6Q8**				**6Q8**							
682	- 797	540.1602.0000 540.1622.0205	FT	682	- 797	540.1602.0000 540.1622.0205	FT	682	- 797	540.1602.0000 540.1622.0205	FT;S Faba				
797	- 928	540.1602.0000 540.1632.0205	FT	797	- 928	540.1602.0000 540.1632.0205	FT	797	- 928	540.1602.0000 540.1632.0205	FT;S Faba				
928	- 1015	540.1702.0000 540.1632.0205	FT	928	- 1015	540.1702.0000 540.1632.0205	FT	928	- 1015	540.1702.0000 540.1632.0205	FT;S Faba				
6R8				**6R8**				**6R8**				**6R8**			
3	- 6	540.8832.0000		3	- 6	540.8832.0000		3	- 6	540.8834.0000		3	- 6	540.8837.0000	
6	- 9	540.8842.0000		6	- 9	540.8842.0000		6	- 9	540.8844.0000		6	- 9	540.8847.0000	
10	- 15	540.8862.0000		10	- 15	540.8862.0000		10	- 15	540.8864.0000		10	- 15	540.8867.0000	
15	- 22	540.8872.0000		15	- 22	540.8872.0000		15	- 22	540.8874.0000		15	- 22	540.8877.0000	
23	- 31	540.8882.0000		23	- 31	540.8882.0000		23	- 31	540.8884.0000		23	- 31	540.8887.0000	
31	- 44	540.8892.0000	O from 42	31	- 44	540.8892.0000	O from 42	31	- 44	540.8894.0000	O from 42	31	- 44	540.8897.0000	O from 42
44	- 59	540.8902.0000	O	44	- 59	540.8902.0000	O	44	- 59	540.8904.0000	O	44	- 59	540.8907.0000	O
59	- 74	540.8882.0000		59	- 74	540.8882.0000		59	- 74	540.8884.0000		59	- 74	540.8887.0000	
		540.8972.0205				540.8972.0205				540.8974.0205				540.8977.0205	
74	- 88	540.8892.0000 540.8972.0205		74	- 88	540.8892.0000 540.8972.0205		74	- 88	540.8894.0000 540.8974.0205		74	- 88	540.8897.0000 540.8977.0205	
88	- 100	540.8892.0000 540.8982.0205		88	- 104	540.8892.0000 540.8982.0205		88	- 104	540.8894.0000 540.8984.0205		88	- 104	540.8897.0000 540.8987.0205	
100	- 145		S	100	- 145		S	100	- 145		S	100	- 145		S

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
6R10				**6R10**				**6R10**				**6R10**			
3	- 6	540.8832.0000	O	3	- 6	540.8832.0000	O	3	- 6	540.8834.0000	O	3	- 6	540.8837.0000	O
6	- 10	540.8842.0000	O	6	- 10	540.8842.0000	O	6	- 10	540.8844.0000	O	6	- 10	540.8847.0000	O
10	- 15	540.8862.0000	O	10	- 15	540.8862.0000	O	10	- 15	540.8864.0000	O	10	- 15	540.8867.0000	O
15	- 22	540.8872.0000	O	15	- 22	540.8872.0000	O	15	- 22	540.8874.0000	O	15	- 22	540.8877.0000	O
22	- 29	540.8882.0000	O	22	- 29	540.8882.0000	O	22	- 29	540.8884.0000	O	22	- 29	540.8887.0000	O
29	- 44	540.8892.0000	O	29	- 44	540.8892.0000	O	29	- 44	540.8894.0000	O	29	- 44	540.8897.0000	O
44	- 57	540.8902.0000	O	44	- 57	540.8902.0000	O	44	- 57	540.8904.0000	O	44	- 57	540.8907.0000	O
57	- 73	540.8882.0000 540.8982.0205	O	57	- 73	540.8882.0000 540.8982.0205	O	57	- 73	540.8884.0000 540.8984.0205	O	57	- 73	540.8887.0000 540.8987.0205	O
73	- 94	540.9112.0000		73	- 94	540.9112.0000		73	- 94	540.9112.0000		73	- 94	540.9117.0000	FT;S;P
94	- 122	540.9122.0000		94	- 122	540.9122.0000		94	- 122	540.9122.0000		94	- 122	540.9127.0000	FT;S;P
122	- 163	540.9132.0000		122	- 163	540.9132.0000		122	- 163	540.9132.0000		122	- 163	540.9137.0000	FT;S;P
163	- 218	540.9132.0000 540.9092.0205		163	- 218	540.9132.0000 540.9092.0205		163	- 218	540.9132.0000 540.9092.0205		163	- 218	540.9137.0000 540.9097.0205	FT;S;P
218	- 300	540.9152.0000 540.9092.0205		218	- 300	540.9152.0000 540.9092.0205		218	- 300	540.9152.0000 540.9092.0205		218	- 300	540.9157.0000 540.9097.0205	FT;S;P
300	- 391	840.0332.1000 540.9092.0205	FT	300	- 391	840.0332.1000 540.9092.0205	FT	300	- 391	840.0332.1000 540.9092.0205	FT;S Faba				
391	- 507	840.0332.1000 840.0962.1205	FT	391	- 507	840.0332.1000 840.0962.1205	FT	391	- 507	840.0332.1000 840.0962.1205	FT;S Faba				
507	- 638	840.0332.1000 540.1662.0205	FT	507	- 638	840.0332.1000 540.1662.0205	FT	507	- 638	840.0332.1000 540.1662.0205	FT;S Faba				
638	- 797	540.0992.0000 840.1732.0205	FT	638	- 797	540.0992.0000 840.1732.0205	FT	638	- 797	540.0992.0000 840.1732.0205	FT;S Faba				
797	- 913	540.0992.0000 540.1662.0205 540.1682.0000	FT	797	- 913	540.0992.0000 540.1662.0205 540.1682.0000	FT	797	- 913	540.0992.0000 540.1662.0205 540.1682.0000	FT;S Faba				

protected

Ausführung *(model)*																	
warmfest *(creep-resistant steel)*				**hochwarmfest** *(high creep-resistant steel)*				**korrosionsfest** *(stainless steel)*				**Inconel X750**			
p [psig]				**p [psig]**				**p [psig]**				**p [psig]**			
von	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**		**von**	**bis**	**Feder-**	
p1	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**	**p1**	**p2**	**Sachnummer**	**Indices**
up	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*		*up*	*to*	*stock no.*	
8T10				**8T10**				**8T10**				**8T10**			
4 - 6		540.8842.0000	O	4 - 6		540.8842.0000	O	4 - 6		540.8844.0000	O	4 - 6		540.8847.0000	O
6 - 10		540.8862.0000	O	6 - 10		540.8862.0000	O	6 - 10		540.8864.0000	O	6 - 10		540.8867.0000	O
10 - 15		540.8872.0000	O	10 - 15		540.8872.0000	O	10 - 15		540.8874.0000	O	10 - 15		540.8877.0000	O
15 - 22		540.8882.0000	O	15 - 22		540.8882.0000	O	15 - 22		540.8884.0000	O	15 - 22		540.8887.0000	O
22 - 32		540.8892.0000	O	22 - 32		540.8892.0000	O	22 - 32		540.8894.0000	O	22 - 32		540.8897.0000	O
32 - 42		540.8902.0000	O	32 - 42		540.8902.0000	O	32 - 42		540.8904.0000	O	32 - 42		540.8907.0000	O
42 - 54		540.8912.0000	O	42 - 54		540.8912.0000	O	42 - 54		540.8914.0000	O	42 - 54		540.8917.0000	O
55 - 70		540.9112.0000	FT	55 - 70		540.9112.0000	FT	55 - 70		540.9112.0000	FT, Faba	55 - 70		540.9117.0000	FT;S;P
70 - 91		540.9122.0000	FT	70 - 91		540.9122.0000	FT	70 - 91		540.9122.0000	FT, Faba	70 - 91		540.9127.0000	FT;S;P
91 - 117		540.9132.0000	FT	91 - 117		540.9132.0000	FT	91 - 117		540.9132.0000	FT, Faba	91 - 117		540.9137.0000	FT;S;P
118 - 152		540.9132.0000 540.9092.0205	FT	118 - 152		540.9132.0000 540.9092.0205	FT	118 - 152		540.9132.0000 540.9092.0205	FT;S Faba	118 - 152		540.9137.0000 540.9097.0205	FT;S;P
152 - 199		540.9152.0000 540.9092.0205	FT	152 - 199		540.9152.0000 540.9092.0205	FT	152 - 199		540.9152.0000 540.9092.0205	FT;S Faba	152 - 199		540.9157.0000 540.9097.0205	FT;S;P
199 - 261		540.1752.0000	FT	199 - 261		540.1752.0000	FT	199 - 261		540.1752.0000	FT;S; Faba	199 - 300			S
261 - 333		540.0952.0000	FT	261 - 333		540.0952.0000	FT	261 - 333		540.0952.0000	FT;S; Faba				
333 - 391		540.0952.0000 540.1762.0205	FT	333 - 391		540.0952.0000 540.1762.0205	FT	333 - 391		540.0952.0000 540.1762.0205	FT;S; Faba				
391 - 464		540.0952.0000 540.1772.0205	FT	391 - 464		540.0952.0000 540.1772.0205	FT	391 - 464		540.0952.0000 540.1772.0205	FT;S; Faba				
464 - 522		540.0952.0000 840.2362.0205	S	464 - 522		540.0952.0000 840.2362.0205	S	464 - 522		540.0952.0000 840.2362.0205	FT;S; Faba				

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Content

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protected

1 Purpose

This LESER Deutschland Standard (LDeS) describes the definition of CDTP and the use of CDTP correction for LESER safety valves.

2 Scope

This LDeS applies to the LESER sites Hamburg and Hohenwestedt.

3 References

None

4 Introduction

According to international standards like ASME VIII and ISO 4126-1 and 4126-4 the service conditions are to be considered for setting at ambient temperature.

5 What is CDTP?

Cold differential test pressure (CDTP) is defined in standard

- DIN EN ISO 4126-1 Edition 2004, chapter 3.2.5
- ASME Sec. VIII, Div. 1, Edition 2010, UG 136 (d) 4
- API 520-1 8. Edition 2008, chapter 3.4.1
- ASME PTC 25 - 2008 chapter 2.7

CDTP is used if correction of set pressure of safety valves according to deviation of service conditions is necessary.

Extract from ASME Sec. VIII, Div. 1, UG 136 (d) 4:
When a valve is adjusted to correct for service conditions of superimposed back pressure, temperature, or the differential in popping pressure between steam and air, the actual test pressure (cold differential test pressure) shall be marked on the valve per 129

Extract from DIN EN ISO 4126-1 chapter 3.2.5:
statischer Druck auf der Eintrittsseite, bei dem ein Sicherheitsventil auf dem Prüfstand zu öffnen beginnt.
ANMERKUNG Dieser Druck schließt Korrekturen für Betriebsbedingungen, z. B. Gegendruck und/oder Temperatur, ein.

Extract from API 520 chapter 3.13:
Cold differential test pressure
The pressure at which a pressure relief valve is adjusted to open on the test stand. The cold differential test pressure includes corrections for the service conditions of backpressure or temperature or both.

Extract from API 520 chapter 4.2.3:
The actual service conditions under which a pressure relief valve is required to open, may be different form the conditions at which the pressure relief valve is set to operate on a test stand. To compensate for this effect, a CDTP is specified for adjusting the set pressure of the valve on the test stand. The CDTP may include a correction for actual service conditions of back pressure and/or temperature.

Extract from ASME PTC 25-2008 chapter 2.7:
the inlet static pressure at which a pressure relief valve is adjusted to open on the test stand. This test pressure includes corrections for service conditions of superimposed back pressure and/ or temperature.

protected

6 What is CDTP Correction?

The CDTP correction is the correction of set pressure at test bench conditions to achieve the correct set pressure at service conditions.

7 Which influences on safety valves are covered with the setting at CDTP?

The set pressure on test bench deviating from service condition is influenced by:

- temperature
- superimposed back pressure

Basically effects at the setting by:

- set pressure tolerance
- medium

The CDTP only covers influences of superimposed back pressure and/or temperature.

8 How is the CDTP Correction calculated?

The CDTP correction is provided by the manufacturer. LESER has done measurements on steam test laboratory at high temperature service conditions. These measurements have been monitored and plotted as curve which has been approved by German TÜV Nord. In case of superimposed back pressure and temperature the corrected set pressure is calculated with a formula. This formula is valid for conventional or balanced bellows design.
The formula is valid for LESER standard spring materials only, 1.1200, 1.7102, 1.8159, 1.4310. For High Alloy and Tungsten spring material the correction is not used, exclusive Inconel as defined in table in chapter 8.2.

The term $(p_{set} - p_a)$ considers influences of superimposed backpressure.
The factor k_T covers influences of temperature.

Design	Superimposed backpressure variable (0 – x) [bar g]	Superimposed backpressure constant y [bar g]	Built-up backpressure [bar g]
Conventional	p_a = x	p_a = y	Not valid for calculation
Bellows	p_a = 0	p_a = 0	Not valid for calculation

Table 1: backpressure according to different safety valve design

8.1 Description of formula

$$p_{cdtp} = (p_{set} - p_a) * k_T$$

p_{set}: set pressure at service conditions [psig or barg]
p_a: superimposed back pressure, constant or variable [psig or barg]. If variable and conventional design, the max. superimposed back pressure should be used. If balanced bellows design is used p_a is set to 0 bar or 0 psig.
k_T: correction factor for CDTP [-], this is depending on valve design/conventional design/balanced bellows design/open or closed bonnet
T: temperature in [°C]

8.2 Calculation formula:

Open or closed bonnet with balanced bellows	k_T=0,97339+0,00039(T-200)-0,0000015477(T-200)²+0,0000000029977(T-200)³	equation (1)
Closed bonnet conventional design	k_T=0,97339+0,00039T-0,0000015477T²+0,0000000029977T³	equation (2)
Open bonnet	k_T=0,97339+0,00039(T-50)-	

protected

conventional design	0,0000015477(T-50)²+0,0000000029977(T-50)³	equation (3)

Table 2: Formulas of k_T calculation

protected

LESER datasheet of CDTP (Cold differential test pressure)

$$p_{cdtp} = (p_{set} - p_a) * k_T \qquad p_{cdtp} = (p_{set} * k_{af}) * k_T$$ **(Type 459/462 only)**

p_{cdtp}: cold differential test pressure [psig or barg]
p_{set}: set pressure at service conditions [psig or barg]
p_a: superimposed back pressure, constant (p_a is equal p_{af}) [psig or barg]
k_T : correction factor for CDTP , temperature influence [-]
k_{af}: correction factor for type 459 / 462, deviating effective area influence [-]

°C	°F	Open bonnet conventional	Closed bonnet conventional	Open bonnet balanced bellows or Inconel spring with or without bellows	Closed bonnet balanced bellows or Inconel spring with or without bellows
550	1022	Limitation at 427°C (only with balanced bellows)	Limitation at 350°C (only with balanced bellows)	1,049	1,049
500	932			1,032	1,032
450	842			1,021	1,021
400	752	1,049		1,013	1,013
350	662	1,032	1,049	1,007	1,007
300	572	1,021	1,032	1,000	1,000
250	482	1,013	1,021		
200	392	1,007	1,013		
150	302	1,000	1,007		
100	212	No influence of service condition on CDTP, correction factor: 1,000			
50	122				
0	32				
-50	-58				
-100	-148				
-150	-238				
-200	-328				
-250	-418				

Table 3: correction factor k_T depending ond safety valve design

protected

LESER diagram k_{af} for for type 459 / 462

$p_{af}/p * 100$ [%]	d_0 = 9 [mm]	d_0= 17,5 [mm]	$p_{af}/p * 100$ [%]	d_0 = 9 [mm]	d_0= 17,5 [mm]
0,0	0,999	0,998	20,0	1,083	0,872
1,0	1,001	0,990	22,0	1,097	0,863
2,0	1,003	0,983	24,0	1,111	0,855
3,0	1,005	0,975	26,0	1,126	0,847
4,0	1,008	0,968	28,0	1,143	0,840
5,0	1,011	0,961	30,0	1,160	0,833
6,0	1,014	0,954	32,0	1,178	0,827
7,0	1,018	0,947	34,0	1,197	0,822
8,0	1,021	0,940	35,0	1,207	0,819
9,0	1,025	0,934			
10,0	1,029	0,927			
12,0	1,038	0,915			
14,0	1,048	0,904			
16,0	1,059	0,893			
18,0	1,070	0,882			

Note: Types 459/462 with do = 13mm is not influenced by correction factor k_{af}. It is in all case = 1.correction factor k_T depending on safety valve design

protected

9 How does LESER set the safety valves depending on different service conditions with temperature and back pressure?

LESER has made steam tests on LESER test laboratory. These measurements have been monitored, evaluated and processed into a correction curve. This curve was approved by German TÜV Nord to be an adequate practicable procedure to correct set pressure to cold differential test pressure concerning deviation of service conditions. The original confirmation of TÜV Nord and an English translation is attached in chapter 9.
Please note, that for gas service the setting is defined as “first audible discharge”. For full opening of valve please add another 10%.

10 How is the influence of balanced bellows?

10.1 How is the influence of balanced bellows in general for safety valves?

The stainless steel bellows protect the upper area of safety valves against temperature and compensate backpressure. The medium cannot get in contact with the spring. This

avoids changes of mechanical properties of spring material and influences the setting. This effect is valid until limits of spring material.

Conventional design:

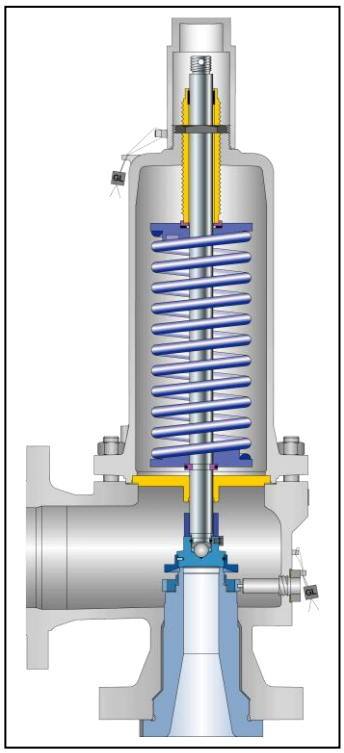


Figure 3:

Balanced bellows design:

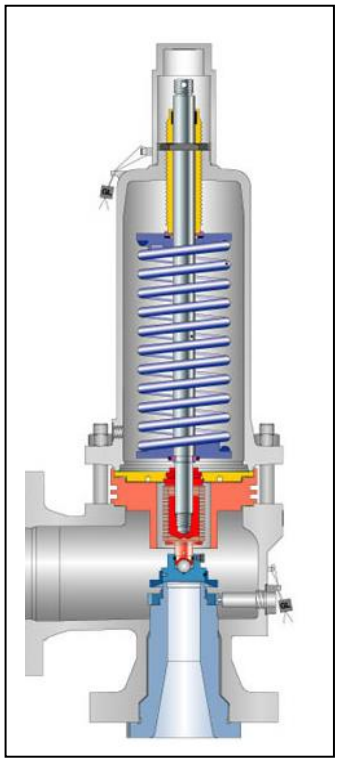


Figure 4:

protected

10.2 How is the influence of balanced bellows in case of type 459 / 462 safety valves?

For these two types the different discharge diameters d_o= 9, 13 and 17,5 mm have influence on the correction of CDTP. This is based on the design of balanced bellows. The same stainless steel bellows are implemented in all three d_o's. The effective area of d_o = 13mm design is equal to the balancing area of stainless steel bellows. A correction for differing effective areas (d_o = 9 mm and d_o = 17,5 mm) of seat area and balancing area have to be considered with the additional correction factor k_{af} .
Please refer to LDeS 1037.07 for detailed information.

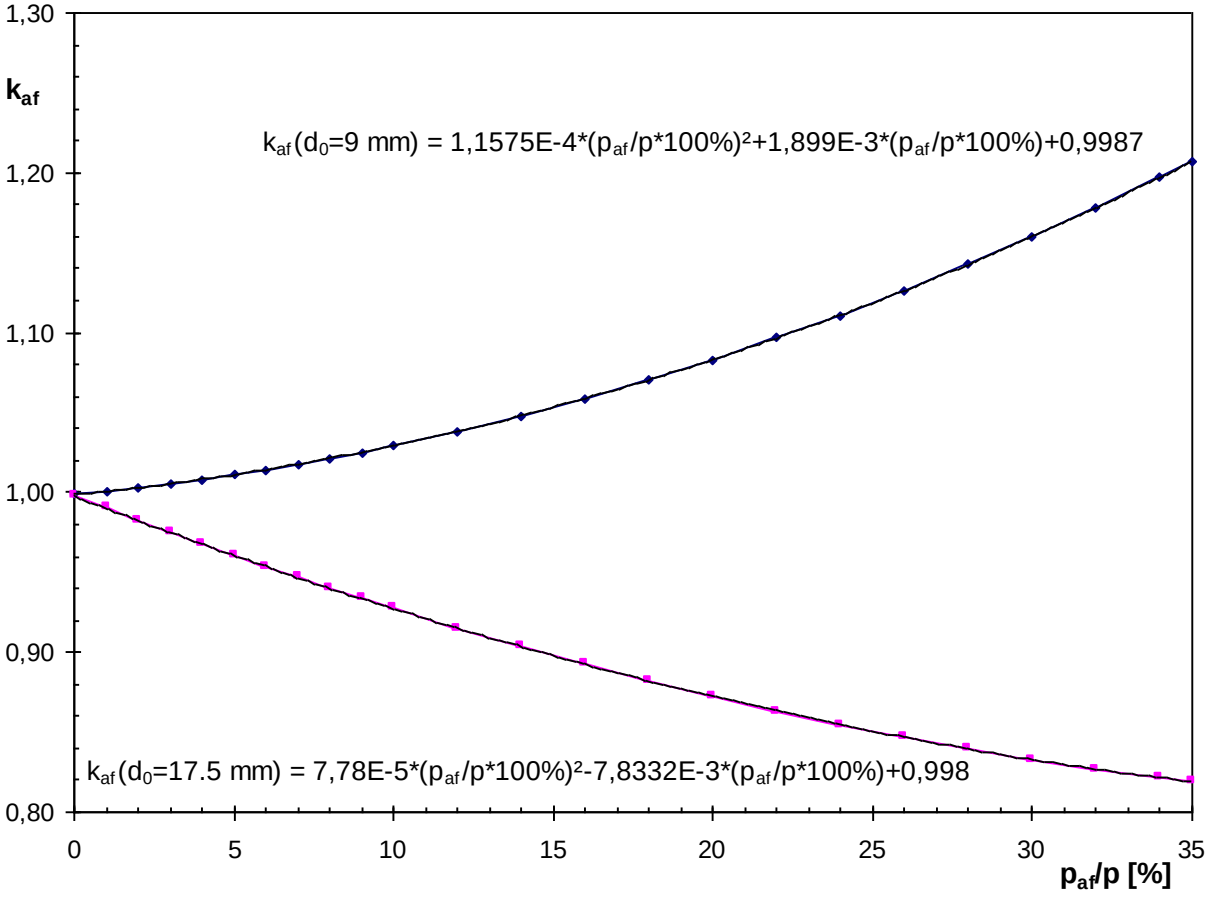


Diagram 1: correction factor k_{af} for balanced bellows design for type 459 / 462

protected

11 How does an open/closed bonnet influence the CDTP?

The bonnet design could be open or closed design.

Open Design:

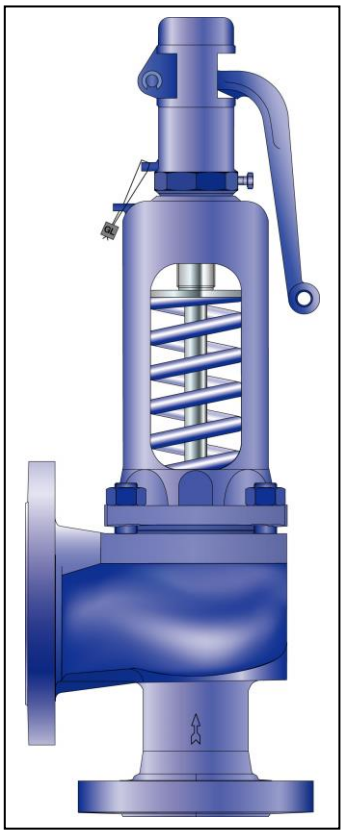


Figure 5:

Closed Design:

Figure 6:

Open design is recommended for applications which are not harmful for the environment. Closed design is recommended for applications with higher safety aspects. This has to be preselected by the customer.

The open bonnet design allows higher temperatures of medium because of the cooling effect with free circulation of air. The temperature increase in comparison to closed bonnet design is smaller. The correction factor is listed in table 1.

protected

12 How does the spring material influence the CDTP?

The spring material limits the maximum temperature at the spring. These limits are documented by spring purchaser or in LDeS 1001.52.
The formula is valid for LESER standard spring materials only, 1.1200, 1.7102, 1.8159, 1.4310. For High Alloy and Tungsten spring material the correction is not used, exclusive Inconel as defined in table in chapter 8.2.

Spring material	DIN designation	ASME designation	Maximum medium temperature	Temperature range, temperature measured at spring
Carbon	1.1200 / **Sort SH**	-	200°C (392°F)	-30°C - 100 °C (-22°F - 212°F)
Creep resistant	1.8159 / **51CrV4** 1.7102 / **54SiCr6**	ASTM A322 Grade 6150	550°C (1022°F)	-60°C - 220 °C (-76°F - 428°F)
Stainless steel	1.4310 / **X10CrNi18-8**	ASTM A313 Grade 302	550°C (1022°F)	-196°C - 280 °C (-321°F - 536°F)
Inconel	2.4669 / **NiCr15Fe7TiAl**	ASTM B 637-98	600°C (1112°F)	-200°C - 500 °C (-328°F - 932°F)
Hastelloy C4	2.4610 / **NiMo16Cr16Ti**	ASTM B 574-99	550°C (1022°F)	Max. 450°C (842°F)
Tungsten BH12	1.2605 / **X35CrWMoV5**	EN ISO 4957 (12/1999)	550°C (1022°F)	Max. 500°C (932°F)

Table 4: material and temperature limits

If these limits are exceeded the spring characteristics are no more valid. The influence on relaxation is stated in DIN EN 13906-1 or DIN 2089 (old invalid version).

The effect on CDTP correction is covered with the stated correction factor in chapter 3.
The spring material has no significant effect on the test results.

13 How does the medium influence the CDTP?

The medium has no significant influence on CDTP.

protected

14 Where can CDTP values be found?

CGA:

LESER The Safety Valve

LESER CERTIFICATE FOR GLOBAL APPLICATION

Inspection certificate 3.1 according to DIN EN 10204
Declaration of conformity according to Pressure Equipment Directive 97/23/EC

LESER GmbH & Co. KG Postfach 26 16 51, 20506 Hamburg, Germany

Customers Order- No.:
LESER – Job – No.:
LESER – Customers-No.:
LESER – Contact:
Fon:
Fax:
eMail:

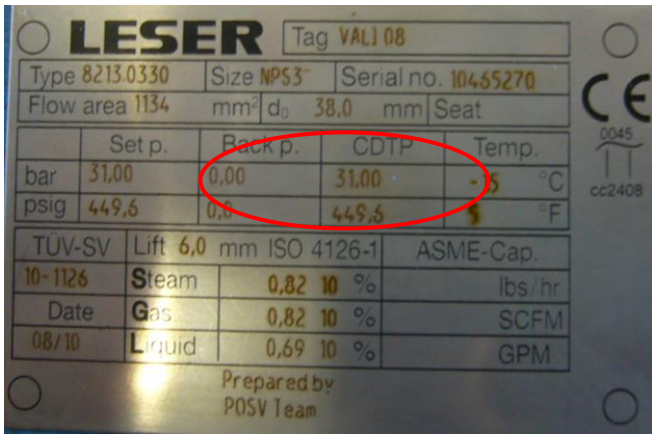
This LESER CGA confirms that the undermentioned LESER-safety valves are manufactured and certified according to the rules world-wide. LESER makes the world-wide employment possible of the safety valves by the reference on these regulations.

1 Test object

API Series , type 526, closed bonnet, gastight cap H2 for steam, gases and liquids.

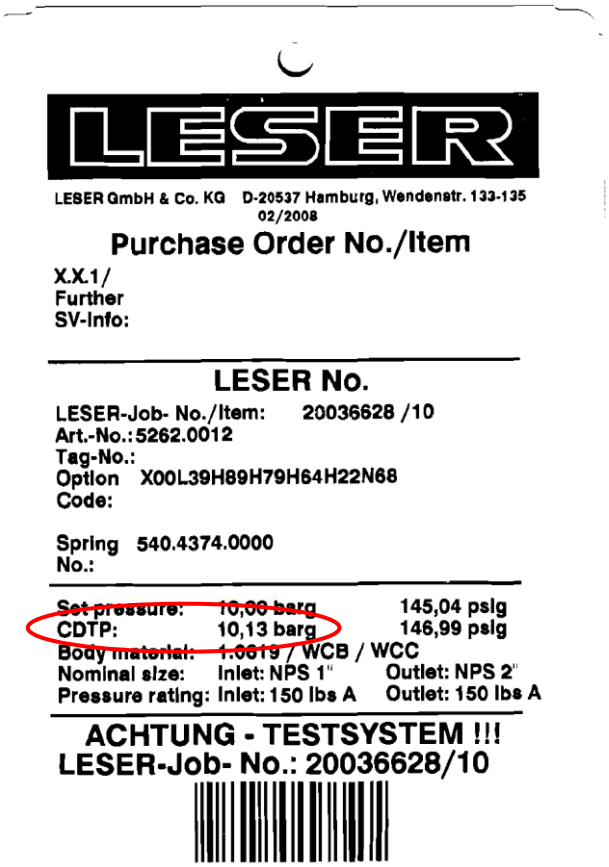
Art.-No.:	Cold differential test pressure		Option Code:
5262.0012	10,13 barg	147,00 psig	Further SV-Info:

Nameplate ASME:



protected

LESER-TAG:



15 Example

15.1 Example: Temperature influence

Design: Type 441, open bonnet
Service condition: p_{set} = 10barg (145 psig), p_a = 0barg, t = 320°C (608°F), Steam

$$p_{cdtp} = (p_{set} - p_a) * k_T$$

k_T: according to equation (3) in chapter 3:
k_T = 1,025
p_a = 0, because of no backpressure

p_{cdtp} = 10 barg * 1,025 = 10,25 barg (148,66 psig)

Set pressure tolerance: 0–3%

$p_{cdtpmin}$ = 10,25 barg +0,00*10,25 barg = 10,25 barg (148,66 psig)
$p_{cdtpmin}$ = 10,25 barg +0,03*10,25 barg = 10,56 barg (153,16 psig)

protected

15.2 Example: Temperature and constant backpressure influence

Design: Type 459 do = 9mm, closed bonnet, balanced bellows
Service condition: p_{set} = 50barg (725 psig), p_a = 5barg (72,5 psig), t = 400°C (752°F), Air

$$p_{cdtp} = (p_{set} * k_{af}) * k_T$$

k_T: according to equation (1) in chapter 3:
k_T = 1,013
k_{af}: According to diagram 1 in chapter 5.1:
k_{af} = 1,029

p_{cdtp} = 50 barg * 1,029 * 1,013= 52,12 barg (755,74 psig)

Set pressure tolerance: 0–3%

$p_{cdtpmin}$ = 52,12 barg +0,00*52,12 barg = 52,12 barg (755,74 psig)
$p_{cdtpmin}$ = 52,12 barg +0,03*52,12 barg = 53,68 barg (778,36 psig)

15.3 Example: Temperature and variable backpressure influence

Design: Type 441, closed bonnet,
Service condition: p_{set} = 10barg (145 psig), p_a = 0 – 1,5 barg, t = 320°C (608°F), air

k_T: according to equation (2) in chapter 3:
k_T = 1,038
p_a = 1,5 barg, because of conventional design and worst case situation

p_{cdtp} = (10 barg – 1,5barg) * 1,038 = 8,82 barg (127,93 psig)

Set pressure tolerance: 0–3%

$p_{cdtpmin}$ = 8,82 barg +0,00*8,82 barg = 8,82 barg (127,89 psig)
$p_{cdtpmin}$ = 8,82 barg +0,03*8,82 barg = 9,09 barg (131,81 psig)

protected

16 Original confirmation of German TÜV Nord

Technischer Überwachungs-Verein Nord e. V.

TÜV NORD

TÜV Nord e. V. · Postfach 54 02 20 · 22502 Hamburg

Leser GmbH & Co. KG
z. Hd. Herrn Stremme
Wendenstrasse 133-135

20537 Hamburg

Ihr Zeichen	Ihre Nachricht vom	Durchwahl (040)	Bitte bei Antwort angeben	Datum
		8557-2613 Herr Schwenn	BM SV LESER ALLG	05.06.96

Kalteinstellung von Sicherheitsventilen

Sehr geehrter Herr Stremme,

den Weg, die Temperatur bei Kalteinstellungen von Sicherheitsventilen nach dem beigefügten Diagramm zu berücksichtigen, halten wir für realistisch.
Aus dem beigefügten Diagramm kann der Multiplikatiosfaktor für die Kalteinstellung bei der vorgesehenen Temperatur entnommen werden.
Dieses Verfahren wird nur dann zur Anwendung kommen, wenn der Kunde dieses ausdrücklich wünscht und in der Spalte "zusätzliche Herstellerangaben" vermerkt.

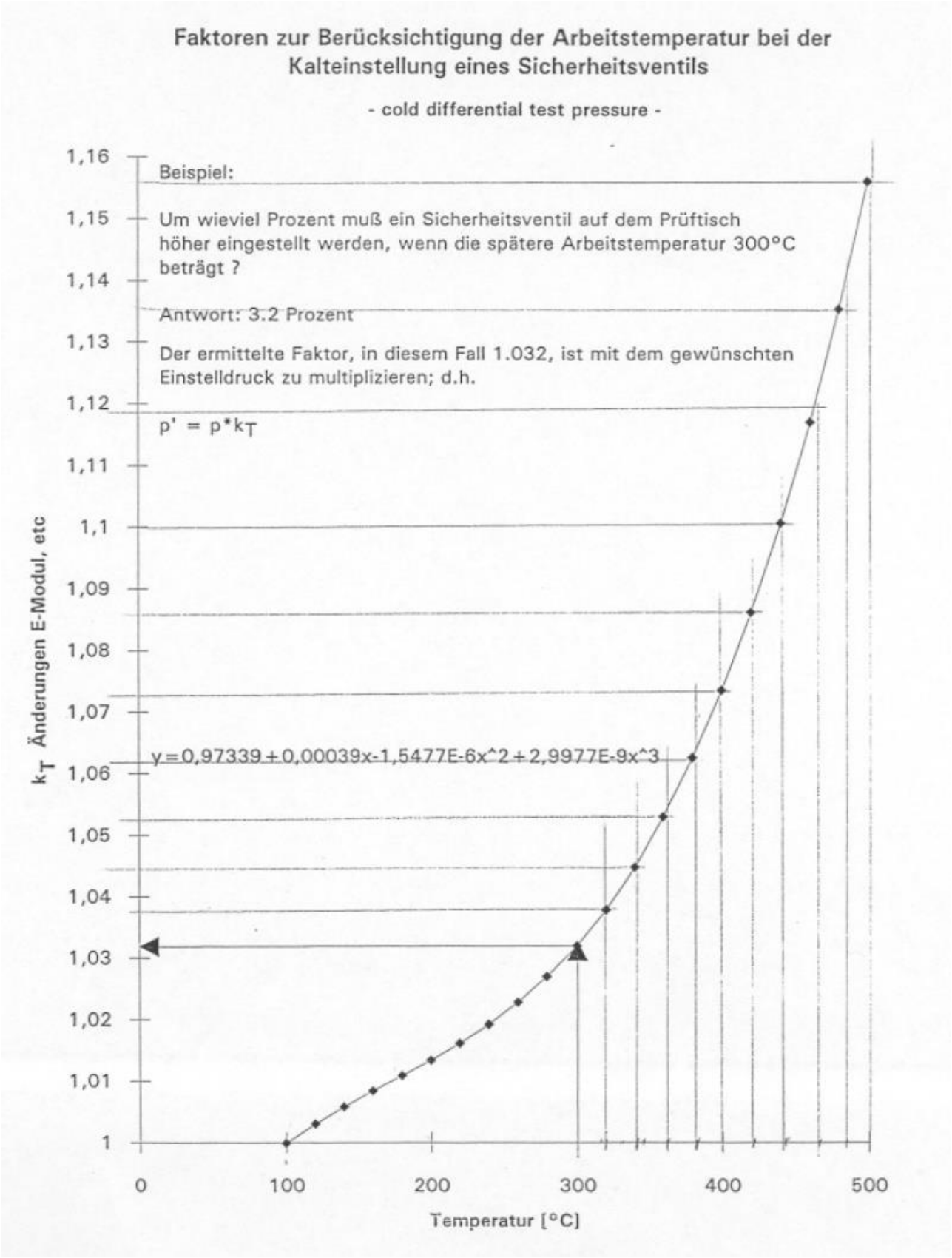
Mit freundlichem Gruß

Abteilung Anlagen-
und Verfahrenssicherheit
Fachgruppe Armaturen
Der Leiter

Schwenn

Anlage
1 Diagramm

protected


Faktoren zur Berücksichtigung der Arbeitstemperatur bei der Kalteinstellung eines Sicherheitsventils
- cold differential test pressure -
Beispiel:
Um wieviel Prozent muß ein Sicherheitsventil auf dem Prüftisch höher eingestellt werden, wenn die spätere Arbeitstemperatur 300°C beträgt ?
Antwort: 3.2 Prozent
Der ermittelte Faktor, in diesem Fall 1.032, ist mit dem gewünschten Einstelldruck zu multiplizieren; d.h.
p' = p*kT
y=0,97339+0,00039x-1,5477E-6x^2+2,9977E-9x^3
kT Änderungen E-Modul, etc
1,16
1,15
1,14
1,13
1,12
1,11
1,1
1,09
1,08
1,07
1,06
1,05
1,04
1,03
1,02
1,01
1
0
100
200
300
400
500
Temperatur [°C]

protected

Translation by LESER:
Dear Mr. Stremme,

We think it is a realistic way to consider the temperature at the Cold Differential Test Pressure of safety valves according to the enclosed diagram.

The multiplication factor for the Cold Differential Test Pressure at the operating temperature is given by the enclosed diagram.

This procedure will be applied only if the customer states it explicitly and annotated this on the column "further manufacturers' instructions".

Sincerely yours

Schwenn
TÜV Inspector

protected

17 CDTP for POSV

(Separate chapter beside spring loaded safety valve)

Which influences on safety valves are covered with the setting at CDTP?
The set pressure on test bench deviating from service condition is influence by:

- Temperature

Basically effects at the setting by:

- set pressure tolerance
- medium

The CDTP only covers influences of temperature. The superimposed back pressure does not affect the set pressure, because it is completely balanced design.

18 How is the CDTP correction calculated?

The calculation is based on pressure testing under temperature of POSV. The results have been curves which are composed in formulas.

The formula is as follows:

$$y = 1+ (((0{,}0221*\text{operating temp.}) - 0{,}5348)/100)$$

Formula for Pop Action with boarders: > 3 bar and > 100°C.
Formula for Modulate Action with boarders: >3 bar and < -20°C or > 100°C.

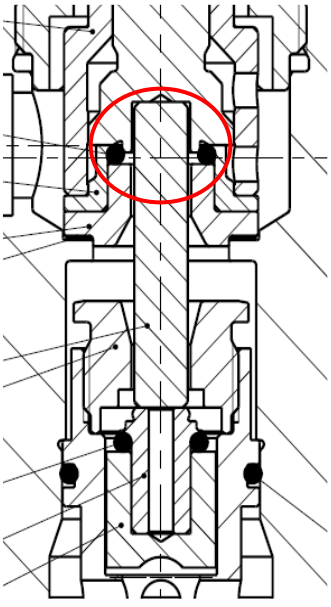
°C	°F	Pop Action Pilot	Modulate Action Pilot
180	356	1,0344	
150	302	1,0278	
100	212	1,0168	
50	122	No influence	No influence
20	68		
-20	-4		0,9902
-40	-40		0,9858

table 5: Correction factor k_T for LESER POSV

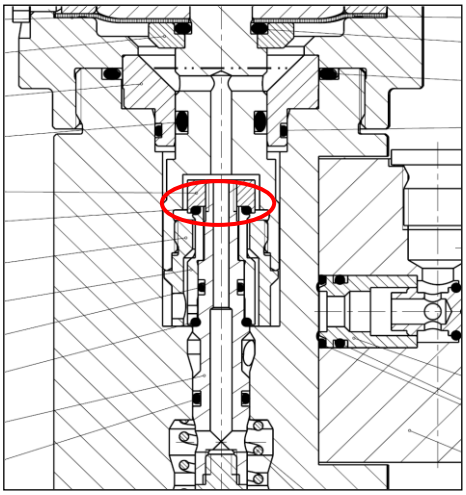
protected

19 How does the design of pilot control have influence on the CDTP?

The pressure chambers in the Pop Action Pilot are sealed with soft sealing discs. Above temperatures of 100°C the effective area of o-ring geometry is influenced. The result is a deviation of set pressure.



The Modulate Action Pilot design is based on several soft sealings to tighten the pressure chambers. If the temperature is lower than -20°C or higher than 100°C the effective area of o-ring geometry is influenced. The result is a deviation of set pressure.



In which documents you will find the CDTP-value?

See chapter 9

Sample

Temperature influence
Design: Pop Action Pilot
Service condition: p_{set} = 10barg (145 psig), pa = 0barg, t = 125°C (257°F), gases

p_{cdtp} = (1+ (((0,0221*operating temp.) - 0,5348)/100))*p_{set}
p_{cdtp} = (1+ (((0,0221*125) - 0,5348)/100))*10 bar = 10,22 bar (148,19 psig)

20 CDTP Correction for Precipitate Installation of Spring Loaded Safety Valves

This correction factor is used with exeption of above-mentioned operating conditions such as bellows design for mounting position (precipitate) of the valves. As the valves' pressure is set for upright mounting position, the weights of moving parts incl. valve spring apply a closing pressure on the valve sealing surfaces. In case of precipitate installation, the share of load pressure of these weights is missing, however, as closing force on the valve sealing surfaces and consequently, the valve would open sooner without a correction of the set pressure. In order to guarantee that the valves open in time and correctly when installed precipitately, the valve pressure must be set with this correction factor.
The calculation basis for the CDTP correction of the set pressure for precipitate installation can be found under following folder:
N:\TB\1_Sekretariat\TB Informationsdateien\berechnung_p_Einbau_kopfüber_boy

21 Example

21.1 Example 1: Influence of temperature and precipitate mounting position:

Design: Type 441 DN80, open bonnet
Service condition: p_{set} = 4,2barg (61,51 psig), p_a = 0barg, t = 320°C (608°F), superheated steam

a.) CDTP – correction for temperature influence:

$$p_{cdtp} = (p_{set} - p_a) * k_T$$

k_T: acc. to equation (3) in chapter 3:
k_T = 1,022
p_a = 0, as no back pressure

p_{cdtp} = 4,2 barg * 1,022 = 4,29 barg (62,2 psig)

b.) CDTP – correction for precipitate mounting position: Pkcdtp= 0,2barg (see link)

c.) Total correction factor = Pcdtp+Pkctdp= 4,29barg+0,2barg=4,49barg(65,1 psig)

protected

Content

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6 Test description 7

protected

1 Purpose

This LESER Global (LGS) describes professional application of the test procedures. It summarises the user information in a target-group-oriented manner.

2 Scope

This LGS applies to all members of the LESER quality cluster as defined in the global quality management manual.

3 References

LGS 0201, LGS 4430, LGS 4432, LGS 4433, LGS 4455, LGS 4431,

The standards that are taken into consideration and applied by LESER for testing for leaks are established in LGS 0201.
It also contains the

- standard requirements for functional seal tightness (seat seal tightness) as well as
- increased seal tightness requirements of the functional seal tightness (seat seal tightness) for
- gas-tight and non-gas-tight valves.

4 Introduction

Performing Leak Tests

The instructions for leak testing presented here describe the leak tests that are used for:

- safety valves in a gas-tight design and
- safety valves in a non-gas-tight design

protected

Information:
Always keep the test manual
at the assembly test bench.
The manual must always be immediately available.

4.1 Improper use

Uses of the test equipment other than those given in this document are forbidden. Improper use may have adverse effects on the operation and consequently lead to inaccurate test results.

4.2 Informal measures

The operating manual must always be kept at the testing station and used in the event of any unclarity in the test procedure.

protected

4.3 Operational materials and supplies

The operational materials and supplies given in the following must be ready for use in testing safety valves in a gas-tight and non-gas-tight design.

Leak detection spray
Material no.: 0161.0000

Fig. 1: Leak detection

Valve-specific test caps
Material no.: not yet defined

Fig. 2: Test caps

Valve-specific test plugs
Material no.: 0172.0001

Fig. 3: Test plugs

protected

Bubble counting unit (Kellog Tester)
Material no.: 0172.0001

Fig. 4: Bubble counting

protected

Accessories for threaded valves
Material no.: 0151.0002

Fig. 5: Accessories

Water expansion kit
Material no.: 0171.0001

Fig. 6: Water expansion kit

5 Distinguishing features of valve designs

5.1 Safety valves in a gas-tight design

Flanged valves			Threaded valves
Closed bonnet	Closed lever (H4)	Closed lever (H2)	

protected

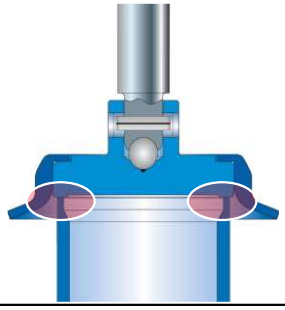
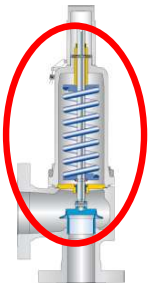
5.2 Safety valves in a non-gas-tight design

Flanged valves	
Open bonnet	Open lever (H3)

6 Test description

6.1 Safety valves in a gas-tight design

6.1.1 Flanged valves

1.	**Valve assembly:** The safety valve is assembled and adjusted to the set pressure (see assembly documentation) • LWN 369.30 • LWN 369.32 • LWN 369.33	
2.	**Testing of the functional seal tightness (seat seal tightness):** • Testing of functional seal tightness with air • Testing of functional seal tightness with water	
3.	**Testing of the body seal:** Testing of body seal tightness with air and application of a test liquid	
4.	**Testing of the back seal:** Testing of the interconnection points and the entire outlet area with the aid of air and by application of a test liquid.	

protected

1. Valve assembly:

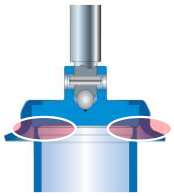
The valve must be assembled according to the assembly documentation.

- LGS 4430
- LGS 4432
- LGS 4433

Fig. 7: API gas-tight

protected

2. Testing of the functional seal tightness with air and water:



Test data for testing the functional seal tightness with air:
The following test data must be observed when testing the functional seal tightness with gas-tight valves.

	Test data
Test characteristic	Seal tightness between the seat and disc
Testing standard	Number of bubbles per second, see LGS 0201, Attachment 1-3
Testing depth	Every safety valve, 100% testing
Test medium	Air
Test pressure	90% of set pressure
Testing device	Bubble counting unit
Length of test	Settling time of at least 10 seconds + testing time of 10 seconds

Test data for testing the functional seal tightness with water:
The following test data must be observed when testing the functional seal tightness with gas-tight valves.

	Test data
Test characteristic	Seal tightness between the seat and disc
Testing standard	Leak volume [cm³/min.] depending on the nominal diameter, see LGS 0201, TABLE 3
Testing depth	Only at the request of the customer
Test medium	Water
Test pressure	90% of set pressure
Testing device	Water expansion kit, LGS 4455

Auxiliary materials:

The following auxiliary materials must be available when testing the functional seal tightness.

Auxiliary material	Material no.
Valve-specific test caps	not yet defined
Valve-specific test plugs	0172.0001
Bubble counting unit (Kellog tester)	0172.0001
Water expansion kit (on customer request)	0171.0001

protected

Note:

Tests with water are only permissible if the functional operation of the safety valve will not be adversely affected. A qualitative assessment of the leak volume as per LGS 0201 Table 3 cannot be conducted in a technically reasonable way.

If a quantitative statement is requested (leak rate) on the functional seal tightness for safety valves that must be set with water, then the functional seal tightness of the valves will be tested with air after finishing the adjustment of the set pressure.

Testing of the functional seal tightness with water can only represent a quantitative statement.

Testing of functional seal tightness with air

Operations:

a) The inlet side of the safety valve must be vertically attached to the chuck.

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 8: Clamped on valve

b) Select the correct test cap and then install the gas-tight test cap on the bonnet.

Tighten the test cap finger-tight.
No test air may escape.

Fig. 9: Select the test cap

c) Select a tapered end-plug to fit the outlet and insert the test plug in the outlet flange of the safety valve.

Fig. 10: Install the test plug

d) Trigger the safety valve once. Then lower the pressure by 10% of the set pressure, or more precisely, by 0.35 bar (5.08 psi) for set pressures ≤3.5 bar (50.76 psi).

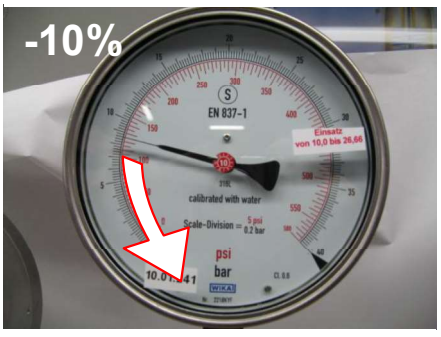


Fig. 11: Test pressure reduction

protected

e) If the pressure has been set as described, then place the hose of the bubble counting device on the already-installed end plug.

Fig. 12: Installation of the test hose

No test air may escape from the connection.

protected

f) First, switch on the test lighting in the bubble counting device. Then count the bubbles per minute as per LWN 220.01.

Allow a settling time of 10 seconds before counting the bubbles.

The number of air bubbles that are determined must be less than or equal to the tolerance specification (LWN 220.01, Appendix 1-3).

Test passed:
If the number of bubbles is less than or equal to the specification, then the test has been passed.

Test not passed:
If the number of bubbles is greater than the specification in LWN 220.01 Appendix 1-3, then then test has not been passed. In this case, the valve will be reworked
(see Reworking 369.37) and the test performed again.

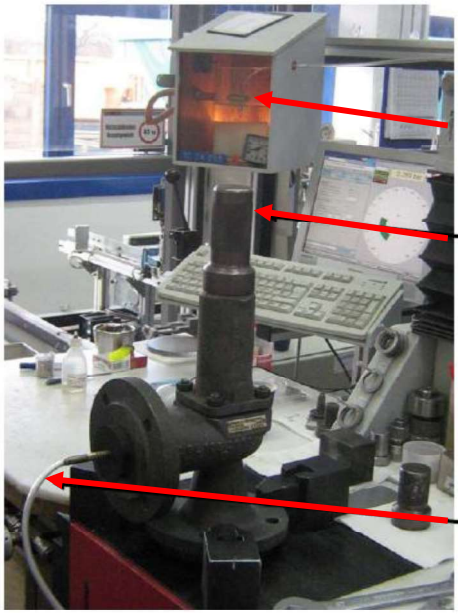


Fig. 13 Test setup

Testing of functional seal tightness with water

Operations:

a) The inlet side of the safety valve must be vertically attached to the chuck.

Fig. 14: Clamping on the valve

Clean sealing surfaces are a basic requirement for accurate measurement results.

b) Pressure must be applied to the safety valve with the help of the water expansion kit (see LWN 369.55) and caused to trigger one time.

Fig. 15: Water expansion kit

c) Then lower the pressure by 10% of the set pressure, or more precisely by 0.35 bar (5.08 psi) for set pressures ≤3.5 bar (50.76 psi).

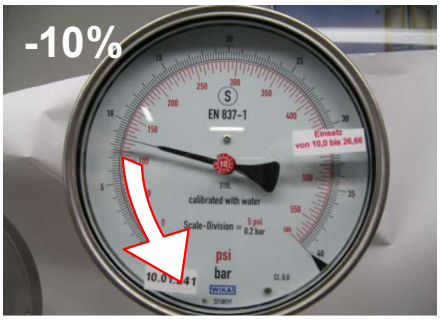


Fig .16: Pressure reduction by 10%

d) After a settling time of 10 seconds, a qualitative assessment of the leak volume must be performed as per LWN 220-01.

A quantitative assessment of the leak volume cannot be conducted in a technically reasonable way.

An additional test of functional seal tightness with air is necessary.

Fig .17: Functional seal tightness with water

protected

3. Testing body seal tightness:

Test data:
The following test data must be observed when testing the seal tightness of the pressure-bearing body.

	Test data
Test characteristic	Testing the body seal tightness
Testing standard	The valve must not have any visual signs of leaks
Testing depth	Every safety valve with a cast body and a rolled-in seat, 100% testing
Test medium	Air
Test pressure	The test pressure is 6 bar (87.02 psi)
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds + 15 seconds up to DN 50 60 seconds up to DN 200 180 seconds above DN 200

protected

Auxiliary materials:
The following auxiliary materials must be provided when testing the body seal tightness.

Auxiliary material	Material no.
Leak detection spray	0161.0000

Operations:

a) The inlet side of the safety valve must be vertically attached to the chuck.

Fig. 18: Clamped on valve

Clean sealing surfaces are the basic requirement for accurate measurement results.

b) Apply test pressure of 6 bar (87.02) psi to the safety valve.

Fig. 19: Test pressure 6 bar

c) When the test pressure of 6 bar (87.02 psi) is reached, spray the body with test liquid on the inlet side between the markings (see Figure 19).

Allow a settling time of 10 seconds before the test.

Test passed:
If there is no foam formation on the body, then the test has been passed.

Test not passed:
If there is foam formation on the body, then the test has not been passed.
If it is possible to repair the damage, then the test must be conducted again.

Fig. 20: Testing zone

protected

4. Testing of the back seal:

Test data:
The following test data must be observed when testing the back seal.

	Test data
Test characteristic	Testing of the seal tightness of the valve on the outlet side
Testing standard	The valve must not have any visual signs of leaks
Testing depth	Every safety valve with a gas-tight design, 100% testing
Test medium	Air
Test pressure	6 bar (87.02 psi)
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds + 15 seconds up to DN 200 30 seconds above DN 200

protected

Auxiliary materials:
The following auxiliary materials must be provided when testing the back seal.

Auxiliary material	Material no.
Leak detection spray	0161.0000

Operations:

a) The outlet side of the safety valve must be attached to the chuck.

Clean sealing surfaces are the basic requirement for accurate measurement results.

Fig.: 21: Clamping on the valve

b) Apply test pressure of 6 bar (87.02) psi to the safety valve with the help of the hand-wheel needle valves.

Fig. 22: Test pressure 6 bar

c) When the test pressure of 6 bar (87.02 psi) is reached, spray the body with test liquid on the outlet side between the markings (see Figure 23).

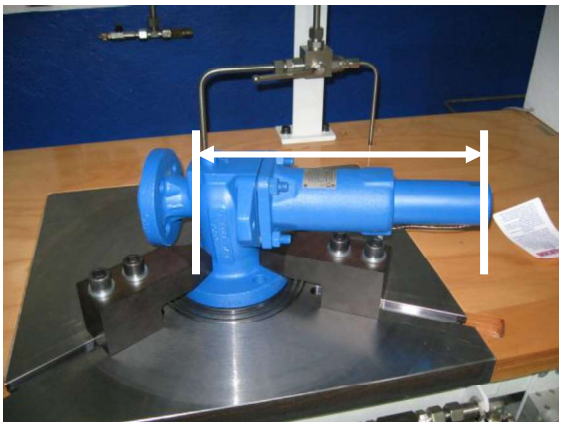


Fig. 23: Testing zone

Allow a settling time of 10 seconds before testing.

protected

Test passed:
If there is no foam formation on the surface of the valve,
then the test has been passed.

Test not passed:
If there is foam formation on the surface of the valve,
then the test has not been passed.

If it is possible to repair the damage,
then the test must be conducted again.

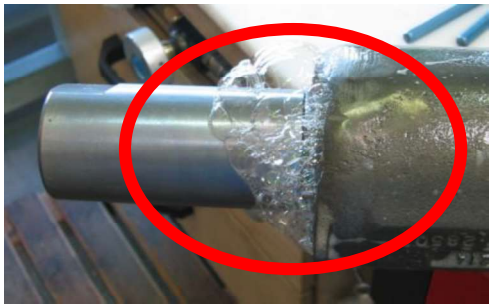
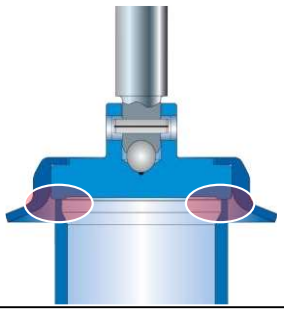


Fig. 24: Foam formation

protected

6.1.2 Threaded valves

1.	**Valve assembly:** The safety valve is assembled and adjusted to the set pressure (see assembly documentation) • LWN 369.31	
2.	**Testing of functional seal tightness (seat seal tightness):** • Testing of the functional seal tightness with air • Testing of the functional seal tightness with water	
3.	**Testing body seal tightness:** Testing of the body seal tightness with air and application of testing liquid	
4.	**Testing of the back seal:** Testing of the interconnection points and the entire outlet area with the help of air and by applying test liquid.	

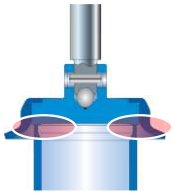
protected

1. Valve assembly:

The valve must be assembled according to the assembly documentation.

- LGS 4431

Fig. 30: CP valve



2. Testing of functional seal tightness with air and water:

protected

Test data for testing functional seal tightness with air:
The following test data must be observed when testing the functional seal tightness with gas-tight valves.

	Test data
Test characteristic	Seal tightness between the seat and disc
Testing standard	Number of bubbles per second, see LGS 0201, Attachment 1-3
Testing depth	Every safety valve, 100% testing
Test medium	Air
Test pressure	90% of set pressure
Testing device	Bubble counting unit
Length of test	Settling time of at least 10 seconds + testing time of 10 seconds

Test data for testing functional seal tightness with water:
The following test data must be observed when testing the functional seal tightness with gas-tight valves.

	Test data
Test characteristic	Seal tightness between the seat and disc
Testing standard	Leak volume [cm³/min.] depending on the nominal diameter, see LGS 0201, TABLE 3
Testing depth	Only at the request of the customer
Test medium	Water
Test pressure	90% of set pressure
Testing device	Water expansion kit, LGS 4455

Auxiliary materials:
The following auxiliary materials must be provided when testing the seal tightness of the seat for threaded valves.

Auxiliary material	Material no.
Valve-specific test plugs	0172.0001
Accessories for threaded valves	0151.0002
Bubble counting unit (Kellog tester)	0172.0001
Water expansion kit (on customer request)	0171.0001

protected

Note:
Tests with water are only permissible if the functional operation of the safety valve will not be adversely affected. A quantitative assessment of the leak volume as per LGS 0201 Table 3 cannot be conducted in a technically reasonable way.

If a quantitative statement is requested (leak rate) on the functional seal tightness for safety valves that must be set with water, then the functional seal tightness of the valves will be tested with air after finishing the adjustment of the set pressure.

Testing of the functional seal tightness with water can only represent a quantitative statement.

Testing of functional seal tightness with air:

Operations:

a) The inlet side of the safety valve must be vertically attached to the clamping device (see LWN 0121.0001).

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 32: Clamping the valve in the clamping device

protected

b) If the test is performed on the Manual Basic Test Bench, then the valve must be attached to the test bench with the help of the accessories for threaded valves (material no.: 0151.0002) as shown in Figure 33.

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 33: Clamping on the Manual Basic Test Bench

c) Select a tapered end-plug to fit the outlet and insert the test plug in the outlet flange of the safety valve.

Fig. 34: Inserting the test plug

d) Trigger the safety valve to trigger once. Then lower the pressure by 10% of the set pressure, or more precisely, by 0.35 bar (5.08 psi) for set pressures ≤3.5 bar (50.76 psi).

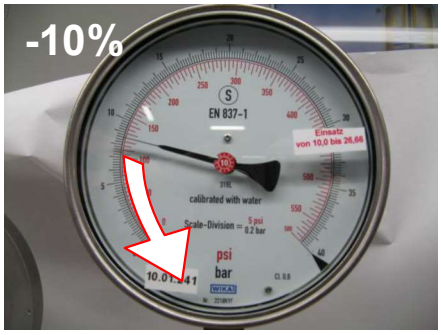


Fig. 35: Pressure reduction by 10%

e) If the pressure has been set as described, then place the hose of the bubble counting device on the already installed end-plug.

No test air may escape from the connection.

Fig. 36: Mounting the bubble hose

protected

f) First, switch on the test lighting in the bubble counting device. Then count the bubbles per minute as per LWN 220.01.

Allow a settling time of 10 seconds before counting the bubbles.

The number of air bubbles that are determined must be less than or equal to the tolerance specification (LWN 220.01).

Test passed:
If the number of bubbles is less than or equal to the tolerance specification, the the test has been passed.

Test not passed:
If the number of bubbles is greater than the tolerance specification, then the test has not been passed. In this case, the valve will be reworked (see LWN 369.37) and the test performed again.

Fig. 37: Counting bubbles

protected

Testing of the functional seal tightness with water:

Operations:

a) The inlet side of the safety valve must be attached to the testing device with the help of the additional screw connections (material no. 0151.0002). To do this, the respective thread adapter must be first screwed on.

Fig. 38: Thread adapter

Clean sealing surfaces are a basic requirement for accurate measurement results.

b) In addition, the base unit of the accessories for threaded valves (material no. 0151.0002) must be attached to the test bench.

Fig. 39: Fixing the base unit in position

c) The safety valve must be attached to the base unit with the adapter.

Fig. 40: Screwing in the valve

protected

d) Pressure must be applied to the safety valve with the help of the water expansion kit (see LWN 369.55) and caused to trigger one time.

Fig. 43: Water expansion kit

protected

e) Then lower the pressure by 10% of the set pressure, or more precisely, by 0.35 bar (5.08 psi) for set pressures ≤3.5 bar (50.76 psi).

Fig .44: Pressure reduction by 10%

f) After a settling time of 10 seconds, a qualitative assessment of the leak volume must be performed as per LWN 220-01.

A quantitative assessment of the leak volume cannot be conducted in a technically reasonable way.

An additional test of the functional seal tightness with air is necessary.

Fig .45: Functional seal tightness with water

3. Testing body seal tightness:

Test data:
The following test data must be observed when testing the body seal tightness.

	Test data
Test characteristic	Testing of the seal tightness of the pressure-bearing body
Testing standard	The body must not have any visual signs of leaks
Testing depth	Every safety valve with a cast body and a rolled-in seat, 100% testing
Test medium	Air
Test pressure	6 bar (87.02 psi)
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds +

protected

Auxiliary materials:
The following auxiliary materials must be provided when testing the seal tightness of the pressure-bearing body for threaded valves.

Auxiliary material	Material no.
Leak detection spray	0161.0000
Accessories for threaded valves	0151.0002

Operations:

a) The inlet side of the safety valve must be vertically attached to the clamping device.

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 46: Clamping the valve in the clamping device

protected

b) If the test is performed on the Manual Basic Test Bench, then the valve must be attached to the test bench with the help of the accessories for threaded valves (material no.: 0151.0002) as shown in Figure 47.

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 47: Clamping on the Manual Basic Test Bench

c) Apply test pressure of 6 bar (87.02) psi to the safety valve.

Fig. 48: Test pressure 6 bar

d) When the test pressure of 6 bar (87.02 psi) is reached, spray the body with test liquid on the inlet side between the markings (see Figure 49).

Fig. 49: Testing zone

Allow a settling time of 10 seconds before the test.

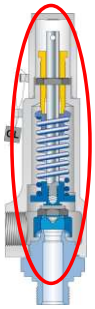
Test passed:
If there is no foam formation on the body, then the test has been passed.

Test not passed:
If there is foam formation on the body, then the test has not been passed.
If it is possible to repair the damage, then the test must be conducted again.

Fig. 51: Bubble formation

protected

4. Testing of the back seal:



Test data:
The following test data must be observed when testing the back seal.

	Test data
Test characteristic	Testing of the seal tightness of the valve on the outlet side
Testing standard	The valve must not have any visual signs of leaks
Testing depth	Every safety valve with a gas-tight design, 100% testing
Test medium	Air
Test pressure	6 bar (87.02 psi)
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds + 15 seconds up to DN 200 30 seconds above DN 200

protected

Auxiliary materials:
The following auxiliary materials must be provided when testing the back seal.

Auxiliary material	Material no.
Leak detection spray	0161.0000
Thread adapter (Only for the Manual Basic Test Bench)	0151.0002

a) The outlet side of the safety valve must be attached to the testing device with the help of the additional screw connections. To do this, the respective thread adapter must be screwed on first.

Fig. 52: Screw in the thread adapter

Clean sealing surfaces are a basic requirement for accurate measurement results.

b) In addition, the base unit must be attached to the test bench. The safety valve must be attached to the base unit with the adapter.

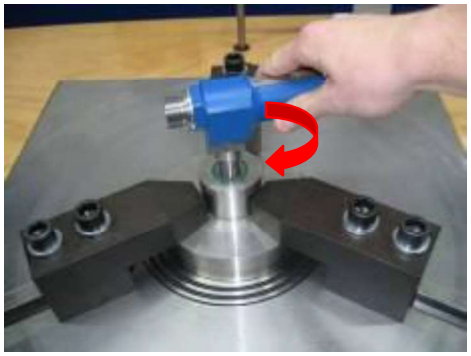


Fig. 53: Screw the valve into the adapter

c) The testing zone is marked in colour (see Figure 54)

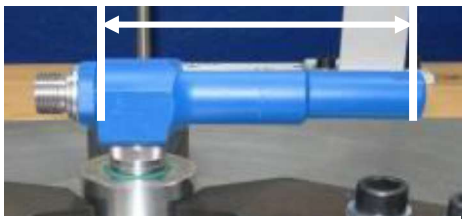


Fig. 54: marked testing zone

protected

d) Test the marked zone with leak detection spray.

Fig. 55: Applying the leak detection spray

protected

e) Count the bubbles per minute according to LWN 220.01.

Allow a settling time of 10 seconds before counting the bubbles.

Test passed:
If there is no foam formation on the body, then test has been passed.

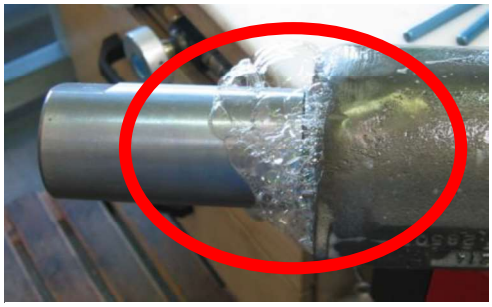


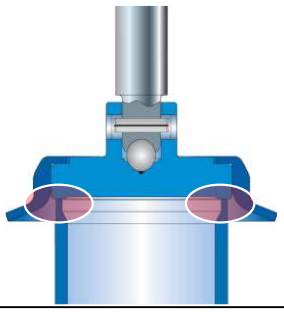
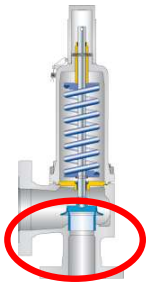
Fig. 56: Foam formation

Test not passed:
If there is foam formation on the body, then test has not been passed.
If it is possible to repair the damage, then the test must be conducted again.

protected

6.2 Safety valves in a non-gas-tight design:

6.2.1 Flanged valves

1.	**Valve assembly:** The safety valve is assembled and adjusted to the set pressure (see assembly documentation) • LWN 369.30 • LWN 369.32 • LWN 369.33	
2.	**Testing of the functional seal tightness:** Testing of the functional seal tightness with air and application of testing liquid	
3.	**Testing the body seal tightness:** Testing of the body seal tightness with air and application of testing liquid	

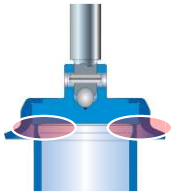
protected

1. Valve assembly:

The valve must be assembled according to the assembly documentation.

- LGS 4430
- LGS 4432
- LGS 4433

Fig. 58: API non-gas-tight



2. Testing of functional seal tightness:

Test data:
The following test data must be observed when testing functional seal tightness with non-gas-tight valves.

	Test data
Test characteristic	Seal tightness between the seat and disc
Testing standard	The blow-hole at the outlet must not extend more than 5mm
Testing depth	Every safety valve, 100% testing
Test medium	Air
Test pressure	90% of set pressure
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds + testing time of 5 seconds

Auxiliary materials:
The following auxiliary materials must be provided when testing the functional seal tightness of non-gas-tight valves.

Auxiliary material	Material no.
Valve-specific test plugs	0172.0001
Leak detection spray	0161.0000

protected

Operations:

a) The outlet side of the safety valve must be attached to the chuck.

Clean sealing surfaces are a basic requirement for accurate measurement results.

Fig. 59: Clamped on valve

b) Apply test pressure of 6 bar (87.02) psi to the safety valve.

Fig. 60: Test pressure 6 bar

c) When the test pressure of 6 bar (87.02 psi) is reached, put the rubber test plug in the outlet flange.

Fig. 61: Inserting the test plug

protected

d) The opening of the test plug must be sprayed with leak detection liquid.

Fig.62: Application of the leak detection liquid

protected

The extension of the blow-out must be observed for 10 seconds.

Test passed:
If the blow-out remains as it is and does not burst, then the test is considered to have passed.

Test not passed:
If the blow-out projects more than 5 mm or bursts, then the test is considered to have failed. If it possible to repair the damage, then the test must be conducted again.

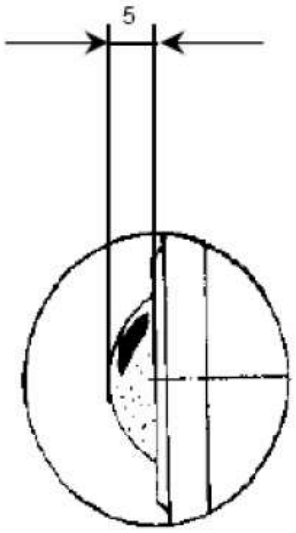


Fig. 63: Blow-out extension

3. Testing body seal tightness:

Test data:
The following test data must be observed when testing the body seal tightness.

	Test data
Test characteristic	Testing of the seal tightness of the pressure-bearing body
Testing standard	The body must not have any visual signs of leaks
Testing depth	Every safety valve with a cast body and a rolled-in seat, 100% testing
Test medium	Air
Test pressure	A test pressure must be chosen that is slightly lower than the set pressure.
Testing device	Application of test liquid
Length of test	Settling time of at least 10 seconds + 15 seconds up to DN 50 60 seconds up to DN 200 180 seconds above DN 200

protected

Auxiliary materials:
The following auxiliary materials must be provided when testing body seal tightness for non-gas-tight valves.

Auxiliary material	Material no.
Leak detection spray	0161.0000

Operations:

a) The inlet side of the safety valve must be vertically attached to the chuck.

Fig. 64: Clamped on valve

Clean sealing surfaces are the basic requirement for accurate measurement results.

b) Apply test pressure of 6 bar (87.02) psi to the safety valve.

Fig. 65: Test pressure 6 bar

c) When the test pressure of 6 bar (87.02 psi) is reached, spray the body with test liquid on the inlet side between the markings (see Figure 65).

Fig. 48 Body with market testing zone

Allow a settling time of 10 seconds before the test.

Test passed:
If there is no foam formation on the body, then the test has been passed.

Test not passed:
If there is foam formation on the body, then the test has not been passed. If it is possible to repair the damage, then the test must be conducted again.

protected

protected

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1 Purpose

This LESER Global (LGS) compiles the requirements of standards and describes the procedure of tightness testing of safety valves and pilot operated safety valves and also their Certification.

2 Scope

This LGS applies to all members of the LESER quality cluster, as well as at national and overseas representatives and approved LESER service repair shops, in case of service on LESER's account.

3 References

LID_DE 1704.41, LGS 0201, LGS 0222, LDeS_0201.02

DIN EN ISO 4126-1	Safety devices for protection against excessive pressure Part 1: Safety valves,
DIN EN ISO 4126-4	Safety devices for protection against excessive pressure Part 4: Pilot-operated safety valves
DIN EN ISO 12266-1	Industrial valves: Testing of valves, part 1: Pressure tests, test procedures and acceptance criteria

DIN EN ISO 12266-2	Industrial valves – Testing of valves, part 2: Tests, test procedures and acceptance criteria, supplementary requirements
DIN EN 1593	Tightness test, bubble test
DIN EN 14291	Foam producing solutions for leak detection on gas installations
DIN EN 10204	Metallic products- Types of inspection documents
ASME Code Section VIII	Rules for Construction of Pressure Vessels
API 527	American Petroleum Institute Seat Tightness of Pressure Relief Valves

4 Introduction

All LESER safety valves have to be test on tightness except SKD Kits Compact Performance-Valves (ref. to LID_DE 1704.41).

The tightness test is a production test and is set up to ensure that each safety valve fulfils the requirements for which they have been design without suffering from leakage of pressurized parts or seals.
The tightness test is standard practised at LESER (100 %) after the set pressure was be demonstrated.

The leakage rates shall be document. In case the observed leakage rate exceeds the defined specification limit, the valve must be subject to the LESER quality rework process.

The test requirements and acceptance criteria shall be according to Appendix.

4.1 Test media

The following test media are to be use at LESER: Air, helium, water and steam.

The test medium for determining the seat tightness, air, steam or water, shall be the same as that used for determining the set pressure of the valve.
For dual- service valves, the test medium, air, steam or water, shall be the same as the primary relieving medium. (API Standard 527).

Upon customer request, LESER can conduct the tightness test using Helium as test medium for higher accuracy.

4.2 Pressure range

The set pressure range by safety valve is regulate as follows:

- acc. to ASME Code pressure range starts with 15 psi (1,03 bar)
- acc. to DGRL 97/23 pressure range starts with 0,5 bar
- acc. to DIN EN ISO 4126-1 pressure range starts with 0,1 bar.

The test pressure for the leakage is applied according the set pressure range.

4.3 Test pressure

The test pressure is regulated according set pressure range and requirement by API527 for each test procedure and is fixed in Appendix 1 to 11.

4.4 Test duration

The test duration is regulated according standards requirement for each test procedure and is fixed in Appendix 1 to 11.

4.5 Temperature

As a standard technique, the minimum or maximum temperature shall not be bellow 5°C (40°F) nor above 50°C (125°F) during the test. (ASME Code Section V, Article 10).

4.6 Acceptance Criteria

Leakage rates, measured during the determined test period, shall not exceed the fixed leakage rates defined for the relevant types/designs. The leakages rates are fixed in Appendix.

5 Test Procedures at LESER

Following test procedures for tightness are to be applied for LESER safety valves and POSVs:

- Seat tightness test procedure, Test P12
- Shell tightness test procedure, Test P11
- Back seat Tightness test procedure, Test P21
- Tightness test procedure for pressure seals

Test medium is water, gas (air or helium) and steam.

6 Test Equipment at LESER

The LESER safety valves are assembled and tested on an assembly and test benches. The assembly and test benches consist of the following subunits:

- fixture system (incl. adaptors)
- pressure system (air)
- pressure measurement system
- bubble count device (Kellog test)
- valve submerge basin

LESER POSVs are assembled and tested on assembly and test benches for POSVs. The benches consist of the following sub units:

- pilot assembly and test bench where the pilots are assembled and set
- assembly and test bench for fully assembled POSV: in this place the full POSV is assembled, set and tested.

7 Seat tightness test procedure, Test P12

7.1 Definition

Seat tightness means tightness between seat and disc. A safety valve/POSV is considered to be tight between seat and disc, if all requirements of the relevant standard are performed.

Following measures for determination of seat tightness can be used:

- Leakage Rate in mbar l/s,
- Leakage Volume in cm³/min. and
- Number of bubbles/min.

Testing of seat tightness will be carried out at ambient temperature.

7.2 Requirements of LESER

Due to the fact that API 527 is the sole international approved standard which regulates tightness requirements for safety valves in special, LESER in its function as global company refers to this standard only. However, LESER considers also tightness requirements acc. to DIN EN 12266 and EN ISO 4126-4.

Appendix 1: Seat tightness API 527 Requirements
Test conditions and requirements for seat tightness acc. to API 527 are subject of this Appendix.

Appendix 2: Seat tightness, LESER standard requirements for SVs,
Test conditions and tightness requirements acc. to API 527 and DIN EN 12266 for seat tightness and general requirements are deviated in Appendix 2 to 4.

Appendix 3: Seat tightness, LESER improved tightness requirements for SVs,
Test conditions and requirements of tightness for increased tightness are summarized in this Appendix. The allowable leakage rate for metal-sealing safety valves with “increased tightness” equals half of allowable leakage rate for “general tightness”. It has to be considered that in case of tightness requirements which exceed the standard higher lapping effort and higher costs will arise.

Appendix 4: Seat tightness, LESER standard requirements for POSVs
Test conditions and requirements for seat tightness acc. to API 527, EN ISO 4126-4 and DIN EN 12266 of POSVs (standard requirements) are subject of this Appendix.

7.3 Scope

The testing procedure of seat tightness for each valve occurs after setting and checking of cold differential set pressure on test bench in accordance with operation chart, which is deposited in SAP System.

7.4 Test media

The following test media are to be used at LESER: Air, helium, water and steam.

7.5 Test pressure

The pressure range is regulated as follows:

- Acc. to ASME Code pressure range starts with 15 psi (1,03 bar)
- Acc. to DGRL 97/23 pressure range starts with 0,5 bar
- Acc. to DIN EN ISO 4126-1 pressure range starts with 0,1 bar.

At LESER the performance of pressure range and test pressure requirements acc. to API 527 is as follows (table 1):

Set pressure / cold differential set pressure, p_0 , bar	Test pressure, p_{test} bar
$0,1 < p_0 < 0,7$	$0,5 * p_0$
$0,7 \leq p_0 \leq 3,5$	$p_0 - 0,35$
$p_0 > 3,5$	$0,9 * p_0$

Table 1: Test pressures for seat tightness testing

7.6 Test duration

After a short damping time, the test pressure has to be retained over the entire determined test period (ref. to App. 2 and 4).

7.7 Test method for the seat tightness test

Considering a.m. requirements of LESER, following test procedures are utilized for seat leakage test:

- Seat tightness test procedure with air, procedure of bubble counting
- Seat tightness test procedure acc. to PAS 1085
- Seat tightness test procedure with air, application of test fluid
- Seat tightness test procedure with helium
- Seat tightness test procedure with water
- Seat tightness test procedure with steam

7.8 Testing of seat tightness with air, bubbles emission test procedure

7.8.1 Applicability

This procedure of seat leakage test with air, counting number of bubbles, is practised in case of safety valves with gastight design (lifting device H4, cap H2, closed bonnet).
For POSVs this test is first carried out on the pilot, afterwards the full system (POSV) is tested.

7.8.2 Test Equipment for SVs (Kellog-Test)

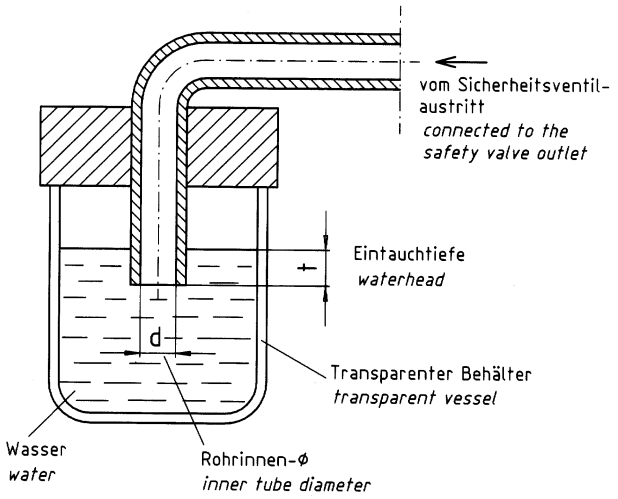
Testing of seat tightness with air, counting number of bubbles is practised at assembler working place. Following parts are components of the assembly work place:

- Clamp station (with adapter discs)
- Pressure system (air)
- Pressure gauge system
- Bubble counting instrument

Following features of bubble counting instrument, shown in fig. 1, correspond to API 527:

- Inner tube diameter Ø = 6,12 mm
- Water head t =12,7 mm
- Bubble volume = 0,295 cm³

Fig. 1



7.8.3 Test Equipment for POSVs

The test of seat tightness of the pilot is tested on the pilot assembly bench. For this purpose a bubble test device fulfilling the requirements of API 527 is installed.
The full POSV the test is carried out on the PSV assembly bench, which is also equipped with a bubble test device.
A sketch of the bubble test device is given by graph 1. This device is fulfilling the API527 requirements with the following parameters:

7.8.4 Test duration

After a short damping time, the test pressure has to be retained over the entire determined test period (ref. to App. 2 and 4).

7.8.5 Test pressure

After setting and checking of cold differential set pressure p0 a blow down up to test pressure ptest has to be carried out. The test pressure ptest is defined in table 1.

Attention:
For POSV with a set pressure greater than 30 bar, the seat tightness is additionally checked at 30% of the set pressure after the functional tightness test.

7.8.6 Test description

Spring Safety Valves

Angle typed flanged safety valves are mounted via clamping jaw vertically at the inlet 0flange on the test bench. For the sealing a rubber pad is laid down under the inlet flange of safety valve. For safety valves with screwed connection, a clamping device with screwed connection is needed. After valve setting the leakage test is carried out.

The pressure will be reduced by 10% resp. in case of set pressures ≤ 3,5 bar by 0,35 bar. After 10 seconds of slowdown the leakage rate will be determined (test time 10 s). The amount of air leakage escaping from the inlet via the seal between seat and disc causes a low excess pressure in the closed outlet chamber. This excess pressure will be decomposed in the water tank in form of escaping bubbles. The escaping bubbles are counted in determined test time (ref. to appendix 2 and 3). The volume of bubbles is defined by resp. depends on the water head and inner width of dipping tube.

The leakage rate shall not exceed the limited leakage rates depending on the flow area d_0 and valve design as mentioned in appendix 2 and 3.

POSV

The testing of POSVs corresponds to a two sets sequence:

1/

The pilot is fixed on the PILOT assembly bench, set and tested for tightness. Pilot bodies along with the manifold block are attached to the pilot assembly bench with four screws. Sealing is achieved using suitable o-rings.
After assembly and pressure setting of the pilot the seat tightness test is carried out. The inlet pressure is increased to meet the test pressure and after a defined damping period the leakage rate is determined. The bubble test device is hooked up to the outlet and the bubbles created within the test period are counted.
The testing procedures are implemented as part of the overall assembly and testing procedure of the control program.

2/

Every completed POSV is tested for its respective CDTP. Usually this is achieved by setting the PILOT and therefore no additional setting is required. Consequently tightness of the seat is tested.

For the fully assembled POSV the tightness of the seat is defined as the tightness between seat and disk of the main valve.
For the test the inlet of the POSV is clamped (perpendicular) to the test bench. The pressure in the inlet is increased to the respective test pressure and after a suitable damping period the leakage rate is determined. The observable bubbles within the testing period are then counted.

7.8.7 Acceptance criteria

Leakage rates, measured during the determined test period, shall not exceed the fixed leakage rates defined for the relevant types/designs. The leakages rates are fixed in Appendix 2 and 4.

The seat tightness standard - requirements of spring safety valve made in Works- Hohenwestedt are defined at LDeS 0201.02.

7.8.8 Certification

The testing of seat tightness with air (bubble emission procedure) is documented in the SAP system and confirmed by inspection test certificate 3.1 acc. to DIN EN 10204. (LESER CGA)
If test report for seat leakage test is required, it has to be accessed with option code M66.

7.9 Testing of seat tightness of safety valve with sealing plate disc

This requirements shall be applied to spring loaded safety valve with configuration sealing plate discs at PTFE, Kel - F or VESPEL materials only.

For all spring loaded safety valves with seal plate configuration, test pressure is defined as described in 15 Appendix 2:

p_{test} = p_0 x (formula, please find in column "Test pressure" under 15 Appendix 2)
p_{test} = test pressure
p_0 = cold differential test pressure

The test duration shall be applied according with the Appendix 2 and 3.

Leakage Test

1. Before starting the seat tightness test, the set pressure shall be demonstrated according at LGS0202.
2. The safety valve shall than waiting for 48 hours.
3. After 48 Hours the seat tightness test as described above shall be determinate again.
4. In case the valve has opened/lifted any time after the 48hour period, the procedure has to be repeated beginning with step 2.

7.10 Tightness Test acc. to PAS 1085:2008

7.10.1 Scope

The seat tightness test according to PAS 1085 is only applied to spring loaded safety valves. The seat tightness test is only applied to safety valves in gas tight configurations (lifting aid H4, cap H2 and closed bonnet).

7.10.2 Test Pressure, Stabilizing Time and Inspection Time

The test pressure and stabilizing time depend on the CDTP and the nominal size, respectively. The inspection time is 1 minute for all safety valves.
The defined stabilizing times and test pressures are listed in tables 2 and 3.

Set pressure, p_0 bar	Test pressure, $ptest_f$ bar
>= 1,0	0,97 x p_0
< 1,0	0,9 x p_0

Table 2: Test pressure for seat tightness test, acc. to PAS 1085

Nominal size	Stabilizing time	Inspection Time	Allowed leakage (Bubbles/Minute)
Up to DN 200	1 min.	1 min.	3
Over DN 250	3 min.	1 min.	3

Table 3: Stabilizing Time, Inspection Time and leakage rates acc. to PAS 1085

7.10.3 Test Procedure

- Fix safety valve on test bench in upright position
- Adjust set pressure of safety valves acc. to LGS 0202
- Release pressure and attach inspection tube to outlet, then increase pressure to test pressure according to table 2.
- Determination of leakage rate starts after the stabilizing time defined in table 3 or latest after the release of the first bubble from the tube opening.
- The determination of the leakage rate is done over a period of one minute. Relevant are only those bubbles, which were released from the tube during this inspection time.
- The observed number of relevant bubbles is recorded. If this number exceeds the allowed number of bubbles as defined in table 3, the valve must be subject to the LESER quality rework process.

7.10.4 Acceptance Criteria

The test parameters and the acceptance criteria are listed in the table of appendix 14.12 (seat tightness acc. PAS 1085 for safety valves).

7.11 Seat tightness test procedure with air, another method

7.11.1 Applicability

In case of non-gas tight safety valve design (lifting device H3, open bonnet), the seat leakage test is carried out with procedure of applying test fluid (acc. to DIN EN 1593). The application of test fluid is a qualitative test procedure, because the quantitative procedure of bubble counting (leakage rate) is not possible.

7.11.2 Test equipment

The seat leakage test by using air, procedure of test fluid application, can be carried out at the assembly working place. Following parts are components of the assembly working place:

- Clamp station (with adapter discs)
- Pressure system (air)
- Pressure gauge system
- Bubble counting instrument

As test fluid a foamy lotion acc. to DIN EN 14291, leakage finder, is used. The test fluid shall be non-volatile (it shall not dry at test temperature during test period) and viscous.

7.11.3 Test description

Angle typed flanged safety valves are mounted via clamping jaw vertically at the inlet flange on the test bench. For the sealing a rubber pad is laid down under the inlet flange of safety valve (fig. 2).

After setting of safety valve the seat leakage test is carried out. A foamy lotion is drawn over the outlet orifice. The extension under pressure impact and the accumulate leakage volume can be observed at the outlet.

Test time amounts 5 seconds. The sealing between seat and disc fulfils the tightness requirements of this standard, if arises bubble extends not more than 5 mm during test time.

In case of nominal sizes $DN_A \geq$ DN100 an opening reducing rubber plug is adopted, because only for nominal sizes up to ≤ DN 80 bubbles can be drawn reliable.

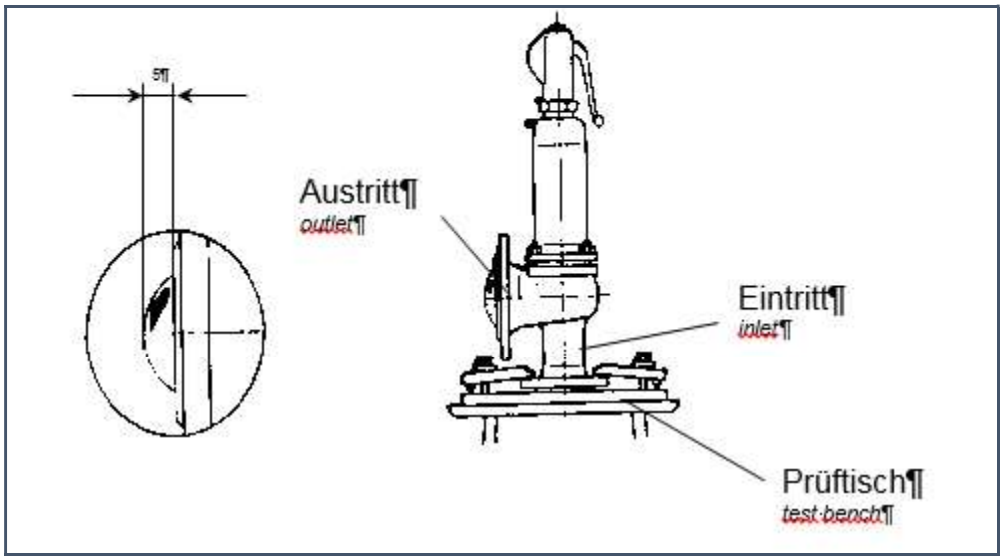


Fig. 2

7.11.4 Certification, Option Code

The testing of seat tightness with air, applying of test liquid procedure, is documented in the SAP system and confirmed by an inspection certificate according to DIN EN 10204.

If inspection certificate for seat tightness test is required, it has to be accessed with option code M22.

7.12 Seat tightness test procedure with helium

7.12.1 Applicability

The testing of seat tightness with helium is a special case of testing and is practised on customer demand only. This test can be carried out for all safety valve types, even though the helium test is very extensive for open valves.

7.12.2 Test equipment

LESER uses a helium leak detector for the helium test procedure:
Technical Characteristic:

Max. Pressure	15 mbar
Minimum detectable Helium. Leakage rate:	
- Vacuum method	≤ $5 * 10^{-12}$ mbar l/sec
- sniffing method	< $1 * 10^{-7}$ mbar l/sec
Maximum indicated Helium- Leakage rate	0,1 mbar l/sec
Measuring range	12 decade

7.12.3 Test method

With this helium leak detector different test procedures for seat tightness can be practised. LESER uses following test methods:

- Procedure of overpressure (sniffing method)
- Procedure of leakage detector in vacuum.(spraying method)

7.12.4 Test pressure

The test pressure has to correspond to the pressure values at ambient temperature mentioned in App. 2 and 3.

7.12.5 Test duration

The test pressure has to hold up at least 5 min.

7.12.6 Test description

Overpressure procedure (sniffing method):

After setting the relevant safety valve with air on cold-differential set pressure, it will be carried to the helium test lab. After safety valve is mounted via clamping jaw at the inlet flange on the test bench, it will be pressurized with helium. After reaching the test pressure leakage rate is determined via probe at the outlet.

Procedure of leakage detection in vacuum:

After setting the relevant safety valve with air on cold- differential set pressure, it will be carried to the helium test lab.

Via adapter the valve is connected airproof with the helium leakage detector at the inlet. After evacuation (vacuum occurs in the fitting) an airgun is injection helium between disc and sealing in the outlet. The test result is metered after 5 min.

7.12.7 Acceptance criteria

Leakage rates, measured during the determined test period, shall not exceed the fixed leakage rates defined for the relevant types/designs.
In case of metal-to-metal sealed safety valves leakage rates up to 10^{-3} mbar l/s are possible. Dependent on the test procedure leakage rates up to 10^{-9} mbar l/s can be reached in case of soft-sealed safety valves.
The standard test value for seat tightness of LESER safety valves with soft seal amounts < $1x10^{-5}$ mbar l/s.
Following option codes shall be used for seat leakage test with helium:

- Option Code N62, for sniffing method
- Option Code M86, for vacuum method

7.12.8 Certification

The testing of seat tightness with helium is documented in the SAP system and confirmed by inspection test certificate acc. to DIN EN 10204 / test report.
Following information are to be considered:

- Test subject
- Requirements of Standard
- Reference terms / Main technical characteristics
  Test medium, Helium
  Test equipment: helium leakage detector
- Test results
- Test method for each test result
- Relevant Units, mbar l/s, for each test result.

If inspection certificate for seat tightness test with helium is required, it has to be accessed with following option code:

- M 77 for seat tightness, overpressure procedure (sniffing method)
- M 81 for seat tightness, procedure of leakage detection in vacuum

7.13 Seat tightness test procedure with water

7.13.1 Scope

All valves, which are set with medium water, must be seat tightness tested. The seat tightness test is carried out with the medium water after setting up the set pressure.

The test conditions, test pressure, test time and allowed leakage are defined in Appendix 2 resp. 3.

7.13.2 Test description

The valve shall be mounting vertically on the water test stand. Before the leakage test, the set pressure must be determined.
After a successful set pressure test with water, the seat tightness test follows.

The pressure shall be lowered to zero.

Wait until no more water drains/flows off the outlet area. It is not allowed to wipe dry the moistened outlet area (or the used testing device (stream detector)) of the valve.

Steadily the inlet pressure shall than be increased to the test pressure.
When reach the test pressure the valve outlet area shall be observed for 1 minute.

The leakage of the seat is determined by counting of draining off water drops in outlet area of the valve or in the testing device.

7.13.1 Acceptance criteria

The leakage rate shall not exceed the acceptance criteria defined in Appendix 2.1.

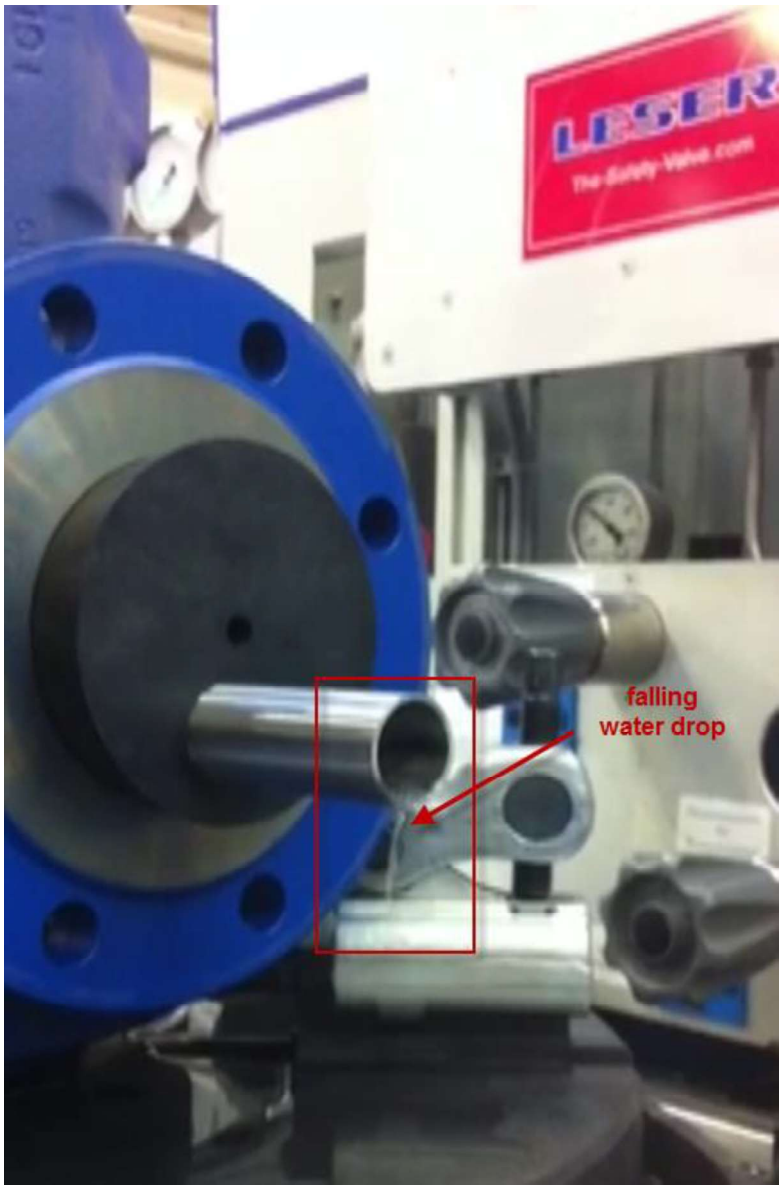


Photo 4: Falling water drop at the edge of stream detector

7.14 Seat tightness test procedure with steam

7.14.1 Applicability

Testing of seat tightness with steam is practised for safety valves, which are set on cold-differential set pressure with steam.

7.14.2 Test equipment

The test is carried out at the steam test lab in Hohenwestedt site.

7.14.3 Test pressure

The test pressure has to be in accordance with test values determined in Appendices 2 and 3.

7.14.4 Test duration

The test pressure has to be retained acc. to the determined test period in Appendices 2 and 3.

7.14.5 Test description

After setting the relevant valve on cold-differential test pressure and testing, the seat leakage test is carried out with steam. The pressure is to be dropped to test pressure and after a short damping time the qualitative statement can be determined.

7.14.6 Acceptance criteria, Option Code

The valve obtains to be tight, if the qualitative estimation criteria acc. to App. 2 resp. 3 are fulfilled: no noticeable or visible leakage, no pressure drop at the pressure gauge is recognized.

7.14.7 Certification

The seat leakage test with steam is documented in the SAP system and confirmed by inspection test certificate acc. to DIN EN 10204.

8 Shell Tightness test procedure P11

8.1 Applicability

The shell tightness test procedure, at LESER called body tightness, is carried out for all LESER safety valves, Pilot Operated Safety Valves and Change Over Valves. For Safety Valves with a heating jacket the shell tightness test procedure is carried out at the heating jacket itself including all connections.

8.2 General, Definition

The shell tightness test procedure is a collateral production pressure test to prove the tightness of pressure retaining body and is carried out at LESER as a standard test.

Designation acc. to DIN EN 12266-1:
Shell Tightness, test procedure P11-EN 12266-1

8.3 Test procedure at LESER

For shell tightness test procedure the test fluid is coated onto body surface at the inlet area.
During the shell tightness test the test object is subjected to the test medium air up to a certain test pressure. The surface of the test object including all connections is than wetted with a test liquid and subjected to a visual inspection.

8.4 Depth of inspection

The shell tightness test is conducted for each valve in gas tight design.

8.5 Test equipment

The shell tightness test procedure is carried out on assembly test benches.

As test fluid a foamy lotion acc. to DIN EN 14291, leakage finder, is used.
The test fluid shall be non-volatile and viscous.

8.6 Test medium

In General this test is carried out with air at ambient temperature.

8.7 Test pressure

The shell tightness test procedure is carried out with a test pressure of 6 bar (±1).

8.8 Test duration

The test pressure has to be retained acc. to the determined test period in table 4.

Table 4: Minimum test time for testing of pressure retaining body

Nominal size	Minimum test time [s]
Up to DN 50	15
From DN 65 up to DN 150	60
From DN 200 up to DN 300	120
DN 350 and higher	300

8.9 Test description

The valve is clamped on the inlet side on the test bench and then pressurized to a test pressure of 6 bar (±1). The valve is then wetted on the surface with the test liquid and subjected to a visual inspection.

For valves with a heating jacket design, the heating jacket including connections must be also pressurized to a test pressure of 6 bar (±1) and the surfaces must be wetted with the test liquid. Subsequently, a visual inspection of the surfaces and connections is carried out.

8.10 Acceptance criteria

There shall be no continuous bubble formation which could indicate a leak in the wall or at the connections.

8.11 Certification, Option Code

The shell tightness test with air is confirmed by inspection test certificate acc. to DIN EN 10204. As standard testing the leakage test of pressure retaining body effects without access of option code. The certification of the test is controlled by option code M18

9 Back seat tightness, test P21 (tightness outwards)

9.1 Scope

The tightness test of the back sealing, LESER named it tightness outwards, is carried out at all LESER's safety valves in gastight design and at all POSV.

9.2 Definition

The test is a pre-expediting pressure test for certification that the determined leakage rate of the back sealing is kept to the moment of the manufacture.

The tightness outwards has reference to the test of the tightness at the connections body/bonnet, bonnet/lifting device H4 (cap H2) as well as the outlet of the body.

POSV at the connections:
Top plat and body with spray, manifold block and top plate with spray and at backflow preventer with the Kellog –test method.

Marking in accordance with DIN EN 12266-2,
Tightness of back seal, test P21-EN 12266.2

9.3 Applicability

The tightness of the back seal, test P21, is in accordance with the task schedule which is deposited in the data base of the SAP-system for every safety valve in gastight design. At LESERs', this test is standard which is integrated in the production process.

9.4 Test equipment

At LESER's the test of the tightness of the back seal takes place at the test benches.

9.5 Test medium

At LESERS's, this test is carried out standard with air in room temperature. The back seat tightness can be realized with helium test procedure if the customer requests.

9.6 Test pressure

The test pressure for tightness of back seal, test P21, tightness outwards, shall be a minimum of 1,1 times the allowable pressure or (6±1) bar whereby the lower value counts (in accordance with DIN EN 12266-2).
Standard LESER carries out this test with a test pressure of 6 bar with the exception of:

- Safety valves beginning with a nominal size DN 200 will be tested with a test pressure of 2,5 bar/air 36 psig .
- For safety valves with PTFE - or elastomer components the pressure must be limited as follows:
  - for initial pressures / set pressures p_0 < 3 bar to 0,15 x p_0 bar and
  - for initial pressures / set pressures p_0 ≥ 3 bar to 2 bar (28 PSIG) to avoid damages

Test pressures outside of the scope of the standard must be coordinated between the customer and LESER (VK/TB).

9.7 Test duration

The test pressure must be maintained at least for the test period determined in table 5 (in accordance with DIN E 12266-2).

Table 5: Minimum test period for testing of the tightness of the back seal

Nominal size	Minimum test period s
> DN 50	15
from DN 65 to DN 200	15
DN 250 to DN 450	30

9.8 Test requirements for POSV

Appendix 5: Back Seat tightness, LESER standard requirements for POSVs
Test conditions and requirements for back seat tightness acc. DIN EN 12266 of POSVs (standard requirements) are subject of this Appendix.

9.9 Test description

Operation with application of the test fluids (DIN EN 1593)
This test procedure will be used for safety valves when the dipping is impractical.
The testing of the tightness of back seal, tightness outwards, will be controlled in standard cases. After testing of the seat leakage and the test pressure the safety valve will be tightened (outlet) on the test bench and admitted with pressure.
Reaching the test pressure, the safety valves will be sprayed at the connections and the outlet area with a non- volatile and viscous test fluid. If there is no frothing formation recognizable the tested areas are all right.

Dipping procedure (DIN EN 1593)
This test procedure is applicable for compact performance safety valves.
The safety valve will be sealed (inlet) with an unscrewed sealing cap. After that the safety valve will be clamped (outlet) in the test bench and dipped into the diving basin (water)

The specified test pressure 6 bar / air will start. If there are no bubbles on the outside surface of the safety valve the tested safety valve is all right.
The test pressure will blow off and the safety valve will be detached from the test control unit.

Remark! During the test period the test pressure has to be kept constantly.
The safety vale should be blistered dry with compressed air.

9.10 Helium test

This testing method, tightness of the back seal with helium, will be realized if customer requires. Apart from testing with air the test can also be realized with Helium. The determined leakage rate will be $>10^{-5}$ mbar l / s in standard cases

With the leak detector used by LESER, the tightness test with the vacuum-method is realized.

The safety valve will be sealed (at the inlet) with a sealing cap. Afterwards the safety valve will be clamped (at the outlet) on the leak detector. When the evacuation process is finished (in the safety valve is now a vacuum) helium will be sprayed with an air gun on every connection for 3 – 4 sec. The test result will be read if the LED display is stabled.

9.11 Certification, Option Code

The back seat tightness test tightness outwards, will be mentioned in the SAP system and confirmed with the inspection certificate in accordance with DIN EN 10204

As a standard test with air, the tightness test of the back sealing, tightness outwards, will follow without option code.
The tightness test of the back sealing, tightness outwards, with Helium will be regulated with option code N64.
If inspection certificate for back seat test tightness outwards is required, it has to be accessed with following Option Codes:

- M 28 Back seat tightness test outwards, application of test fluids
- M 78 Back seat tightness test outwards, dipping procedure
- M 82 Back seat tightness test outwards with helium, overpressure method (sniffing method)

10 Tightness of Pressure Seals of POSVs

10.1 Scope

The tightness test of pressure seals is carried out on all LESER POSV.

10.2 Definition

The tightness of pressure seals refers to the tightness verification of the valve, the loading and unloading tubes (pilot, manifold block, main valve), pilot and tubing (pilot, tubing, pilot tube).

10.3 Test Procedure

The tightness test of the pressure sealing is carried out using the bubble count procedure and/or with the application of a leakage detection agent (foaming test).

10.4 Applicability

The tightness test of pressure seals is performed according to the work plan defined in the SAP system for every POSV. At LESER this test is a standard test integrated into the assembly procedures,

10.5 Test Equipment

The tightness test of pressure seals is carried out on the assembly benches for POSV: The pilot is tested at the pilot assembly bench and the completed POSV is then testes on the POSV assembly bench.
For the Kellogg test the bubble count device at the assembly bench is used.
For the foaming test an foaming fluid according to DIN 14291 is used. This fluid must be non-volatile (it may not dry within the testing period at the test temperature) and viscous.

10.6 Test Media

At LESER these tests are performed using air at ambient temperatures.

10.7 Test Pressure

The test is carried out at 10% or 0.35bar whichever is greater below set pressure.

10.8 Test Duration

The test pressure must be applied for one minute.

10.9 Test Procedure

The tightness test of pressure seals is carried out during and after assembly of the complete POSV. A detailed description of the testing procedure is documented within the assembly instructions for POSVs.
The following seals/connections are tested for tightness:
Pilot:
- The connection between adjusting screw and body is tested during assembly - bubble count method.
- After setting of CDTP and test of the seat tightness:
  - Connection between manifold block and body – leakage finder
- Tightness at BFP (set to position „forward“) – bubble count method.

POSV:
After testing of the set pressure the tightness test of the pressurized seals is carried out on the seals.

10.10 Acceptance Criteria

No leakage of the pressure seals may occur.

10.11 Certification

The tightness testing of pressure seals is always documented within the SAP system and is certified by a 3.1 inspection certificate according to DIN EN 10204.

11 Qualifications of the staff

The test staffs are in the situation, because of their professional knowledge as well as physical qualifications to carry out the a. m. test procedures correctly.

12 Certification

Test results are reported standardly in the SAP system and are proved by an inspection certificate according to 3.1 of DIN EN 10204.
Following information has to be included in the inspection certificate 3.1:

- Test subject
- Requirements of Standard
- Used procedures
- Reference terms / technical characteristics
  Test medium, test liquid, test device
- Test results
- Test method for each test result
- Relevant units, mbar l/s, for each test result.

13 Demands of standards

Following standards are considered for the tightness tests at LESER's:

DIN EN ISO 4126-1, Safety devices for protection against excessive pressure Part 1: Safety valves, chapter. 6 Production testing, 6.6 Seat leakage test:
„The seat leakage test of a safety valve shall be carried out. The test procedure and leakage rate shall be agreed between the manufacturer and the purchaser"

DIN EN ISO 4126-4, Safety devices for protection against excessive pressure Part 4: Pilot-operated safety valves, Chapter 6 Production Testing,

6.6 Seat leakage test:

„The seat leakage test of the pilot operated safety valve shall be carried out after the adjustment of the set or the cold differential test pressure. The test procedure and the leakage rate shall be agreed between the manufacturer and the purchaser. When it is not the case, the values in 6.6.3 and 6.6.4 shall be used."

6.7 Pressure Seals

„All pressure seals between valve, loading/unloading line and sensing line shall be leak tested. If appropriate, hold for 1 min at 10% or 0.35 bar whichever is the greater below set pressure, using air or nitrogen. Leakage is not acceptable.

ASME Code Section VIII Rules for Construction of Pressure Vessels,
Part UG-136(d) Production Testing by Manufacturers and Assemblers
UG- 136 (d) (3) The secondary pressure zone of each closed bonnet pressure relief valve exceeding NPS 1 (DN 25) inlet size when such pressure relief valves are designed for discharge to a closed system shall be tested with air or other gas at a pressure of at least 30 psi (200kPa). There shall not be visible sign of leakage."

UG- 136(d) (5) After completion of the tests required by (d) (4) above, a seat tightness test shall be conducted. Unless otherwise designated by a Manufacturer's published pressure relief valve specification or another specification agreed to by the user, the seat tightness test and acceptance criteria shall be in accordance with API 527."

DIN EN 12266-1 Industrial valves: Testing of valves, part 1: Pressure tests, test procedures and acceptance criteria- Mandatory requirements, edition 2003, chapter.4 Test requirements:

4.2 „Every valve shall be subjected to the shell tightness test, reference P11, listed in Table 1. "

DIN EN 12266-2 Industrial valves – Testing of valves, part 2: Tests, test procedures and acceptance criteria, edition 2003, A.3 Back seat tightness, test P21

14 Appendix 1: Seat tightness requirements acc. to API 527

	Test conditions												**Tightness requirements**				
						Test Time BZ = damping time PZ = Test Time Min						$d_0 \leq 18$mm			$d_0 > 18$mm		
	Test medium		**Set pressure p_o** (relating to 16°C)		After testing of set pressure p_o / Blow down up o **Test pressure**	DN ≤50 ≤2“		DN 65...100 21/2...4“		DN >100 >4“		**Leakage rate** (related to 16°C; bubble volume V_B= 0,295 cm³, tube ∅ = 6,12mm)			**Leakage rate** (related to 16°C; bubble volume V_B= 0,295 cm³, tube ∅ = 6,12mm)		
			bar	MPa		BZ	PZ	BZ	PZ	BZ	PZ	Number of bubbles bubble/ min	Leakage volume cm³/ min	Leakage rate Mbar l/s	Number of bubbles Bubble/ min	Leakage volume cm³/ min	Leakage rate Mbar l/s
API 527	Air (Gases)	Metal-to-metal sealing	1,03-68,9 103 130 172 207 276 385 414	0,103-6,896 10,3 13,0 17,2 20,7 27,6 38,5 41,4	if $p_o \leq 3{,}45$ bar (0,345 MPa) then $p_{Prüf\ test} = p_o - 0{,}345$ bar (0,0345 MPa)	1	1	2	1	5	1	40 60 80 100 100	11,80 17,70 23,60 29,50 29,50	$1{,}9\times10^{-1}$ $2{,}8\times10^{-1}$ $3{,}8\times10^{-1}$ $4{,}7\times10^{-1}$ $4{,}7\times10^{-1}$	20 30 40 50 60 80 100 100	5,90 8,85 11,80 14,75 17,70 23,60 29,50 29,50	$9{,}4\times10^{-2}$ $1{,}4\times10^{-1}$ $1{,}8\times10^{-1}$ $2{,}3\times10^{-1}$ $2{,}8\times10^{-1}$ $3{,}8\times10^{-1}$ $4{,}7\times10^{-1}$ $4{,}7\times10^{-1}$
		Soft sealing	-	-		1	1	2	1	5	1	0	0	$<4{,}7\times10^{-3}$	0	0	$<4{,}7\times10^{-3}$
	Steam	Metal-to-metal sealing Soft sealing	-	-	if $p_o > 3{,}45$ bar (0,345 MPa) then $p_{Prüf.\ test} = 0{,}9 * p_o$	BZ= damping time = 3 min TZ= test time = 1 min						No recognized or visible leakage					
	Water	Metal-to-metal sealing	-	-		TZ- test time = 1 min						***NW≥1“ (DN25)*** Leakage volume ≤10cm³/h x Inlet nominal size / inch (Leakage volume ≤0,166cm³/min x Inlet nominal size /inch) ***NW<1“ (DN25)*** *leakage volume* ≤10cm³/h*					
		Soft sealing	-	-		TZ- test time = 1 min						No leakage					

2) Note: see Appendix 6

15 Appendix 2: Seat tightness LESER Standard tightness requirement for spring safety valve

	Test conditions						Tightness requirements							
	Test medium		Set pressure p_o (related to 16°C)		Test pressure p_{test} After testing of set pressure p_o Blow down up to... Test pressure	Test time BZ-damping time TZ-Test time	$d_0 \leq$ 18mm Leakage rate (related to 16°C; bubble volume V_B= 0,295 cm³ tube ∅ = 6,12mm)				$d_0 >$ 18mm Leakage rate (related to 16°C; bubble volume V_B= 0,295 cm³ tube ∅ = 6,12mm)			
			Pressure stages acc. to LGS 0222 bar	MPa	Blow-down of... Test pressure	s / min	Number of bubbles bubble/min	Leakage volume cm³/min	Leakage volume mm³/sec	Leakage rate mbarl/s	Number of bubbles bubble/min	Leakage volume cm³/min	Leakage volume mm³/sec	Leakage rate mbarl/s
LESER-Standard	Air (Gases)	Metal-to-metal sealing	0,1- 66	0,01- 6,6	if $0,1 < p_o < 0,7$ (bar) $0,01 < p_o < 0,07$ (MPa) then $P_{test} = 0,5*p_0$	BZ = 10s TZ = 10s	40	11,80	196,66	$1,9x10^{-1}$	20	5,90	98,33	$9,4x10^{-2}$
			>66-165	>6,6-16,5			60	17,70	295,00	$2,8x10^{-1}$	30	8,85	147,50	$1,4x10^{-1}$
			>165- 700	>16,5- 70,0			80	23,60	393,33	$3,8x10^{-1}$	40	11,80	196,66	$1,8x10^{-1}$
		Soft sealing plate	-	-		BZ= 10s TZ = 10s	20	5,90	98,33	$9,4x10^{-2}$	10	2,95	49,16	$4,7x10^{-2}$
		Soft sealing O-Ring or disc With vulcanized soft sealing	-	-	if $0,7 \leq p_o \leq 3,5$ (bar) $0,07 \leq p_o \leq 0,35$ (MPa) then $p_{test} = p_0 - 0,35$bar	BZ =10s TZ = 10s	0	0	0	$\leq 9x10^{-5}$	0	0	0	$\leq 9x10^{-5}$
	Steam	Metal-to-metal sealing Soft sealing	-	-	if $p_0 > 3,5$ bar po >0,35 (MPa) then $p_{test} = 0,9*p_o$	BZ = 3 min PZ = 1 min	No recognized or visible leakage No indication of pressure drop at the pressure gauge							
	Water	Metal-to-metal sealing Soft sealing	-	-		TZ = 1 min	See Appendix 2.1							

Appendix 2.1: Seat tightness LESER Standard tightness requirement, testing with water

Test Medium	Seat	Nominal size		Tightness requirements				
				Leakage				
				Leakage volume			Water Drops (related to 16°C; Drop volume V_T = 0,1 cm³) [3]	
		DN	inch	cm³/h	cm³/h	cm³/min	drop / min exakt	drop / min Abgerundet
Water	Metal-seated	**Nominal size** >= 1“ (DN25) Leakage volume ≤10cm³/h x nominal size in inch) (Leakage ≤0,166 cm³/min x nominal size in inch)						
		25	1	10 x 1	10	0,166666667	1,666666667	1
		40	1 1/2	10 x 1 1/2	15	0,25	2,5	2
		50	2	10 x 2	20	0,333333333	3,333333333	3
		80	3	10 x 3	30	0,5	5	5
		100	4	10 x 4	40	0,666666667	6,666666667	6
		125	5	10 x 5	50	0,833333333	8,333333333	8
		150	6	10 x 6	60	1	10	10
		200	8	10 x 8	80	1,333333333	13,33333333	13
		250	10	10 x 10	100	1,666666667	16,66666667	16
		300	12	10x12	120	2	20	20
		400	16	10x16	160	2,666666667	26,66666667	26
		Nominal size < 1“ (DN25) Leakage volume ≤ 10cm³/h (≤ 0,166cm³ min)						
					10	0,166666667	1,666666667	1
	Soft - seated			No visible leakage				

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16 Appendix 3: Seat tightness LESER increased tightness requirements

	Test conditions						Test requirements							
	Test medium		Set pressure p_o (related to 16°C)		Test pressure $p_{prüf}$ After testing of set pressure p_o Blow down up to ... Test pressure	Test time BZ=damping time TZ = test time	$d_0 \leq 18$mm Leakage rate (related to 16°C; Bubble volume V_B= 0,295 cm³ tube ∅ = 6,12mm)				$d_0 > 18$mm Leakage rate (related to 16°C; Bubble volume V_B= 0,295 cm³ tube ∅ = 6,12mm)			
			Pressure stage acc. to LGS 0222 bar	MPa	Blow-down of... Test pressure		Number of bubbles bubble/min	Leakage volume cm³/min	Leakage volume mm³/sec	Leakage rate mbarl/s	Number of bubbles bubble/min	Lekage volume cm³/min	Lekage volume mm³/sec	Leakage rate (mbarl/s)
LESER - increased tightness	Air (Gases)	Metal-to-metal sealing	0,1-66 >66-165 >165-700	0,01-6,6 >6,6-16,5 >16,5-70,0	if $0,1 < p_o < 0,7$ (bar) $0,01 < p_o < 0,07$ (MPa) then $P_{test} = 0,5*p_0$	BZ- =10s TZ = 10s	20 30 40	5,90 8,85 11,80	98,33 147,5 196,66	$9,4x10^{-2}$ $1,4x10^{-1}$ $1,8x10^{-1}$	10 15 20	2,95 4,42 5,90	49,16 73,66 98,33	$4,7x10^{-2}$ $7,0x10^{-2}$ $9,4x10^{-2}$
		Soft sealing	-	-		-	Increased tightness not possible, ref. to App. 2: Standard tightness requirements							
	Steam	Metal-to-metal sealing	-	-	If $0,7 \leq p_o \leq 3,5$ (bar) $0,07 \leq po \leq 0,35$ (MPa) Then $p_{test} = p_0 - 0,35$bar (0,035 Mpa)	BZ =3 min TZ- = 1 min	No recognized or visible leakage No indication of pressure drop at the pressure gauge							
		Soft sealing	-	-		-	Increased tightness not possible, ref. to App. 2: Standard tightness requirements							
	Water	Metal-to-metal sealing	-	-	if $p_0 > 3,5$ bar po >0,35 (MPa) then $p_{test} = 0,9*p_o$	TZ = 1 min	No recognized or visible leakage							
		Soft sealing	-	-		-	Increased tightness not possible, ref. to App. 2: Standard tightness requirements							

17 Appendix 4: Seat tightness LESER increased tightness requirements POSV, Type 810, Pop Action pilot

	Seat Type	Set pressure po			Test pressure, p_{test_f}		Test time		Leakage rate (Maximum)		
		Pounds per Square Inch Gauge (psig)	bar	Mega -Pascals, MPa	bar		BZ=damping time Pz = test time		Number of bubbles bubble/min	Leakage volume cm^3/ min	Leakage rate mbar* l/s
Type 811- Pop Action Pilot	Metal-to-metal sealing (Main Valve) and Metallic or soft sealing Or soft sealing (Pilot)	15 - 1000	1,03 - 68,9	0,103 - 6,896	if: $p_o \leq 3,45$ than: $p_{test} = p_o - 0,345$ If : $p_o > 3,45$ Than: $P_{test.} = 0,9*po$	Additional testing for POSV with $p_o > 30$ bar than $p_{test.} = 0,3 *po$	DN < =50 (<= 2“)	BZ = 1 PZ = 1	20	5,9	9,4x10-2
		>1000 - 1500	> 68,9 - 130	> 6,896 - 10,3					30	8,85	1,4x10-1
		>1500 - 2000	> 130 - 172	> 10,3 - 13					40	11,8	1,8x10-1
		> 2000 - 2500	> 172 - 207	> 13 - 17,2					50	14,75	2,3x10-1
		> 2500 - 3000	> 207 - 276	> 17,2 - 20,7			DN 65-100 (21/2...4“)	BZ = 2 PZ = 1	60	17,7	2,8x10-1
		> 3000 - 4000	> 276 - 385	> 20,7 - 27,6					80	23,6	3,8x10-1
		> 4000 - 6170	> 385 - 425	> 27,6 - 42,5					100	29,5	4,7x10-1
	Soft sealing (O-ring or sealing plate at main valve) And Metalic or soft sealing (Pilot)	15 - 6170	1,03 - 425	0,103 - 42,5			DN > 100 (> 4“)	BZ = 5 PZ = 1	No recognized or visible leakage	-	<4,7x10-3

18 Appendix 4: Seat tightness LESER increased tightness requirements POSV, Type 810, Modulate Action Pilot

Baugruppe	Seat Type	Set pressure po			Test pressure, p_{test_f}		Test time		Leakage rate (Maximum)		
		Pounds per Square Inch Gauge (psig)	bar	Mega -Pascals, MPa	bar		BZ=damping time Pz = test time		Number of bubbles bubble/min	Leakage volume cm^3/ min	Leakage rate mbar* l/s
Type 821- Modulate Action Pilot	Metal-to-metal sealing (Main Valve and pilot)	15 - 1000	1,03 - 68,9	0,103 - 6,896	if: $p_o \leq 3,45$ than: $p_{test} = p_0 - 0,345$ If : $p_o > 3,45$ Than: $P_{test.} = 0,9*po$	Additional testing for POSV with $p_0 > 30$ bar than $p_{test.} = 0,3 *po$	DN < =50 (<= 2“)	BZ = 1 PZ = 1	40	11,8	1,9x10-1
		>1000 - 1500	> 68,9 - 130	> 6,896 - 10,3					60	17,7	2,8x10-1
		>1500 - 2000	> 130 - 172	> 10,3 - 13					80	23,6	3,8x10-1
		> 2000 - 6170	> 172 - 425	> 13 - 42,5					100	29,5	4,7x10-1
	Metal-to-metal sealing (Main Valve) and soft sealing (Pilot)	15 - 1000	1,03 - 68,9	0,103 - 6,896			DN 65-100 (21/2...4“)	BZ = 2 PZ = 1	20	5,9	9,4x10-2
		>1000 - 1500	> 68,9 - 130	> 6,896 - 10,3					30	8,85	1,4x10-1
		>1500 - 2000	> 130 - 172	> 10,3 - 13					40	11,8	1,8x10-1
		> 2000 - 2500	> 172 - 207	> 13 - 17,2					50	14,75	2,3x10-1
	Soft sealing (main valve) and Metal-to-metal sealing (Pilot)	> 2500 - 3000	> 207 - 276	> 17,2 - 20,7					60	17,7	2,8x10-1
		> 3000 - 4000	> 276 - 385	> 20,7 - 27,6			DN > 100 (> 4“)	BZ = 5 PZ = 1	80	23,6	3,8x10-1
		> 4000 - 6170	> 385 - 425	> 27,6 - 42,5					100	29,5	4,7x10-1
	Soft sealing (O-Ring or sealing plate at main valve) and soft sealing (Pilot)	15- 6170	1,03 - 425	0,103 - 42,5					No recognized or visible leakage	-	<4,7x10-3

19 Back Seat tightness, LESER standard requirements for POSVs

Set pressure po	Test pressure, p test, bar/ psig			Test Duration Sec.		Leakage rate Bubble / Min			Test procedure at LESER
	Pilot	POSV +				Pilot	Main Valve	POSV	
		Pop Pilot	Modulate Action						
po	if: $p_o \leq 6$ then: ptest = 1,1x p_0 if $p_o > 6$ then: p_{test} = 6 bar	if: $p_o \leq 6$ then: p_{test} = 1,1x p_0 if: $p_o > 6$ then: p_{test} = 6 bar	if: $p_o \leq 2,5$ then: p_{test} = 1,1x p_0 if: $p_o > 2,5$ then: p_{test} = 2,5 bar	DN < = 200 (<= 8") DN > 250 to 450 (10" to 18")	15 30	No recognized or visible leakage	No recognized or visible leakage	No recognized or visible leakage	Babble emission and / or Application with tests fluid

20 Seat tightness acc. to PAS 1085 -SV

	Seat Type	Set pressure, po			Test pressure, p test,	Nennweite	Test Time		Leakage rate	
		Pounds per Square Inch Gauge (psig)	bar	Mega -Pascals, MPa	bar		BZ=damping time [Min.]	Pz = test time [Min.]	Number of bubbles bubble/min	Leakage volume cm^3/ min
Seat tightness acc. to PAS 1085	Metal-to-metal sealing and soft sealing	≥ 15	≥ 1,0	≥ 0,1	97% x p0	DN ≤ 200 (DN ≤ 8“)	1	1	3	0,89
		< 15	< 1,0	< 0,1	90% x p0					
	Metal-to-metal sealing and soft sealing	≥ 15	≥ 1,0	≥ 0,1	97% x p0	DN > 200 (DN >8“)	3	1	3	0,89
		< 15	< 1,0	< 0,1	90% x p0					

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1 Purpose

This LESER Global Standard (LGS) provides instruction on the visual final inspection of LESER safety valves. The required work steps and materials are described.

2 Scope

This document must be observed in the visual final inspection of safety valves in agencies and subsidiaries of LESER GmbH & Co. KG.

3 Disclaimer

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4 Qualified fitting personnel

The visual final inspection of LESER safety valves may only be performed by trained or qualified fitters. The qualifications must be obtained through the appropriate training measures.

5 General Information

- Gloves must be worn during the final inspection of oil and grease-free safety valves.

6 Flow chart for the visual inspection (final inspection)

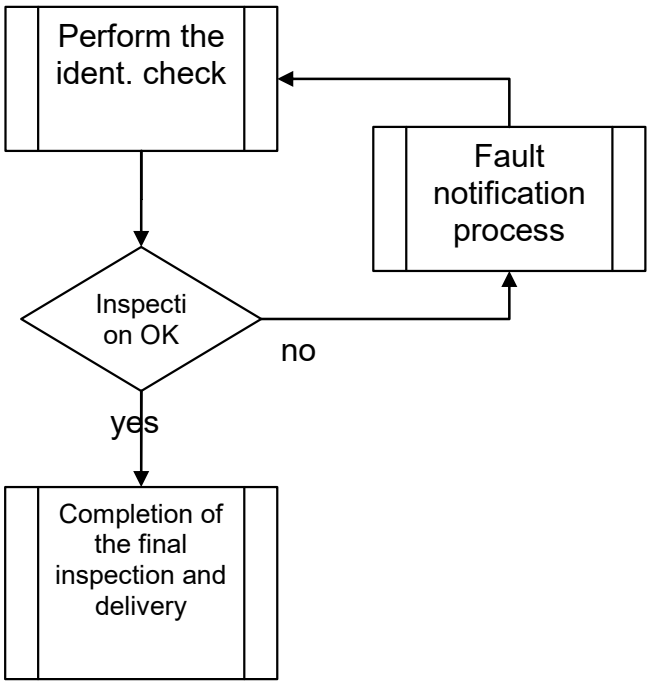

Figure 6-1

protected

7 Performing the final inspection

7.1 General inspections

a) Compare the content of the valve inspection plan or repair order to the valve model.

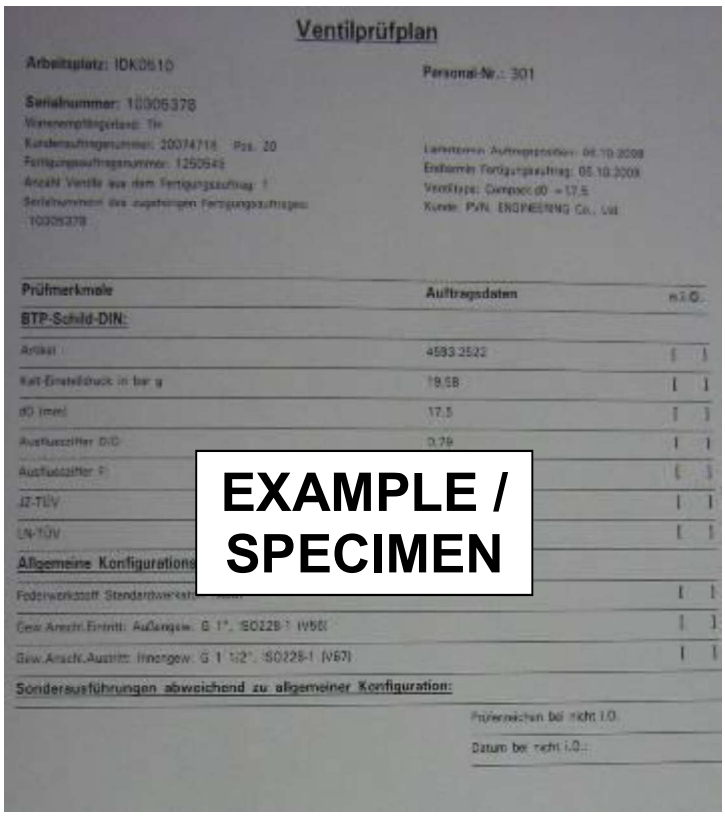

Figure 7.1-1

Figure 7.1-2: Check the type number against the valve inspection plan / repair order

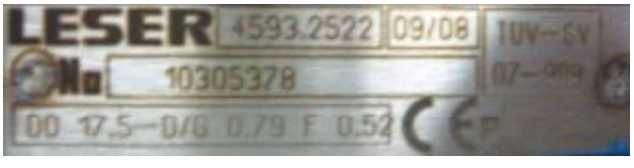

Figure 7.1-3: Check the BT plate / customer ID plate data against the valve inspection plan / repair order

protected

7.2 Visual inspection of other items

7.2.1 Inspection of the paintwork

a) Valve is not completely painted

OK specimen:	**Rejected specimen:**
Figure 7.2.1-1	**Figure 7.2.1-2**

b) Paint coat is cracked (too much paint)

OK specimen:	**Rejected specimen:**
Figure 7.2.1-3	**Figure 7.2.1-4**

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c) Paint coat is not complete due to oil / grease

OK specimen:	**Rejected specimen:**
Figure 7.2.1-5	**Figure 7.2.1-6**

OK specimen:	**Rejected specimen:**

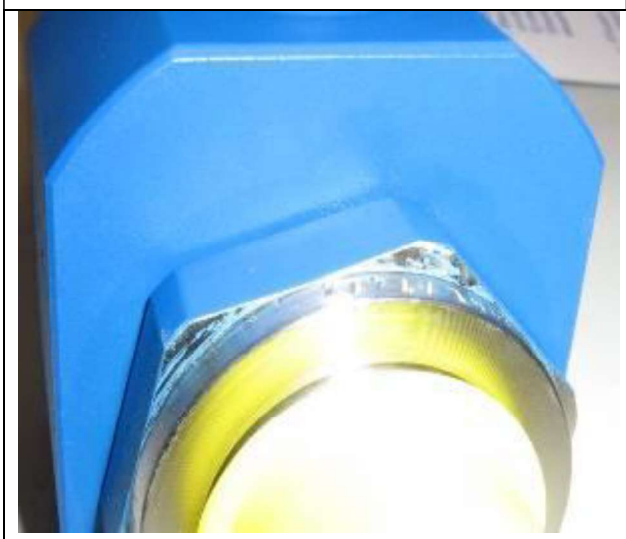
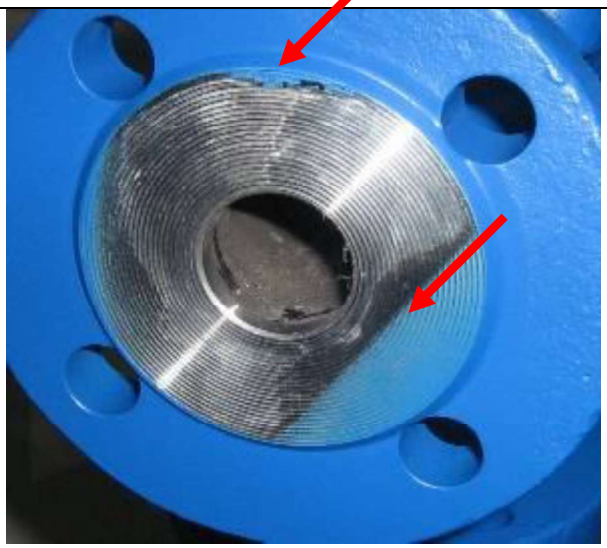



Figure 7.2.1-7	

protected

	Figure 7.2.1-8

d) Paint on masked off areas

OK specimen:	**Rejected specimen:**
	
Figure 7.2.1-9	**Figure 7.2.1-10**

OK specimen:	**Rejected specimen:**
Figure 7.2.1-11	**Figure 7.2.1-12**

Reason: The legibility of the plate is not guaranteed.

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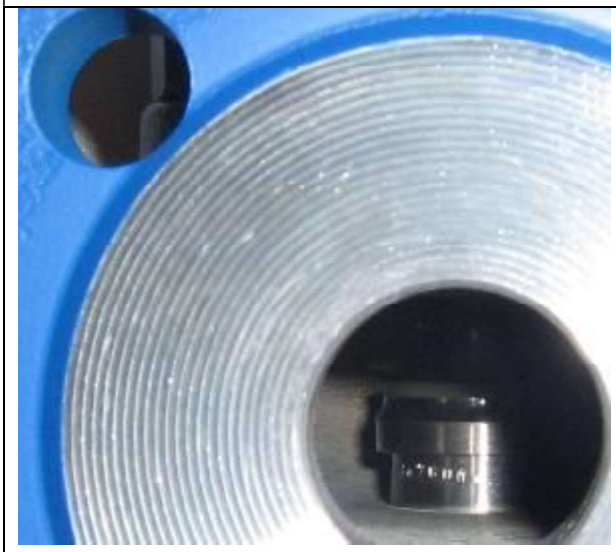
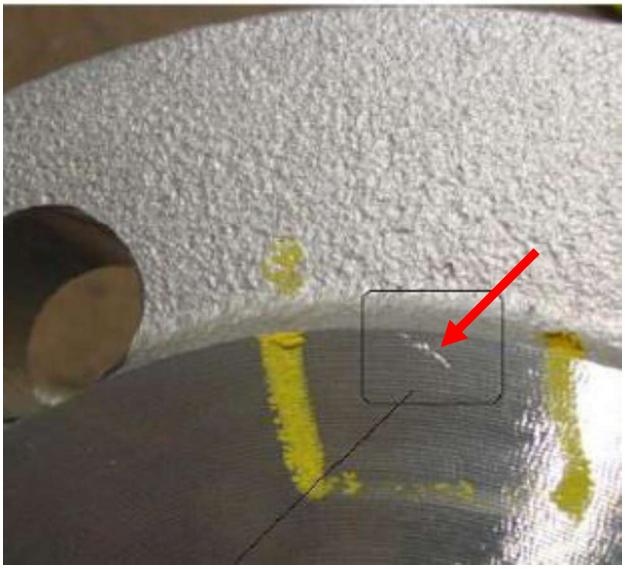
7.2.2 Inspection of the sealing surfaces

OK specimen:	**Rejected specimen:**
 **Figure 7.2.2-1**	 **Figure 7.2.2-2**

protected

7.2.3 Inspection of the seal

OK specimen:	**Rejected specimen:**
Figure 7.2.3-1	Seal is missing for sealed valves, or it is not crimped.

If the result of the inspection is okay, then the safety valve is sent for packaging and shipment.

7.3 Fault notification process

- If the result of the inspection is not okay, then the fitting is sent to the fault notification process that is to be determined.
- The final inspection is performed again after completion of the fault notification process.

protected

Type 526
Spare parts kits

The spare parts kit provides all spare parts which are recommended by LESER to be replaced during rework of a safety valve.

Content

Item	Component	Material	Quantity
7.5	Securing ring (Disc)	1.4571 316Ti	1
14	Split ring	1.4404 316L	2
57	Ball	1.4401 316	15
59	Securing ring[1)]	1.4571 316Ti	1
60	Gasket[2)]	Graphite / 1.4401 Graphite / 316	3
61	Ball	1.4401 316	1
66	Screw	1.4401 316	1
73.2	Gasket (Lock screw)	1.4401 316	1

[1)] Kits 5012.1118 and 5012.1119: Kits don't contain securing ring due to re-usable ring bush in the safety valve.
[2)] Kit 5012.1109: Three additional gaskets are enclosed for use in type 5267 (WC6).

Article numbers

Orifice	Inlet flange rating class of the safety valve						
	CL150	CL300L	CL300	CL600	CL900	CL1500	CL2500
D	5012.1101				5012.1102		
E							
F	5012.1103						
G	5012.1104					5012.1121	
H	5012.1105		5012.1106				
J	5012.1107		5012.1108				
K	5012.1109				5012.1110		
L	5012.1111		5012.1112				
M	5012.1113						
N	5012.1114						
P	5012.1115		5012.1116				
Q	5012.1117						
R	5012.1118		5012.1119				
T	5012.1120						

6.2.11 Testing and Inspection of Safety Valves before Installation

“The condition of all safety valves should be visually inspected before installation. Before installation all protective materials on the valve flanges have to be completely removed. Bonnet shipping plugs must be removed from balanced safety valves.”[6)]
API 520 Part II recommends that the inlet surface must be cleaned, since foreign materials clinging to the inside of the nozzle will be blown across the seats when the safety valve is operated. Some of these materials may damage the seats or get trapped between the seats in such a way that they cause leakage. Valves should be tested before installation to confirm their set pressure.

LESER Note:
Due to the LESER types of packing, LESER safety valves are delivered ready-to-install. As long as safety valves remain in the packing during storage, the safety valves do not need to be inspected, cleaned or tested before initial installation. For more details see the LESER operating instructions.

[6)] API RP 520 Part II, 5th Edition 2003, Sect. 12.3

6.2.11.1 Pressure Test before Operation

Before a plant can be started up a hydraulic pressure test has to be performed. For this test all safety valves in the system must be prevented from opening.
Three different possibilities are feasible:

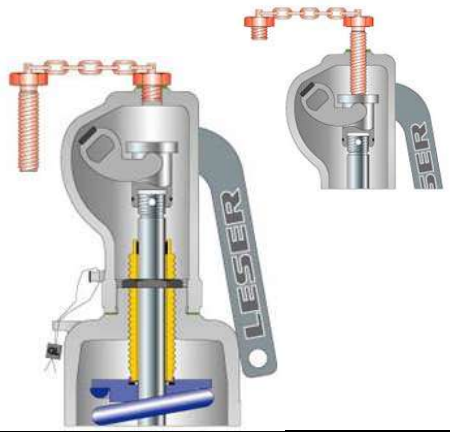
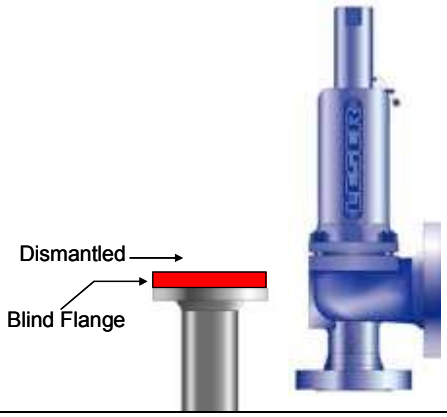
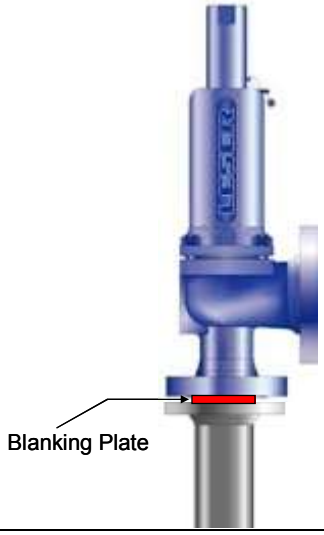
Possibility	Figure	Description
Test gag		The test gag blocks the spindle and keeps the safety valve tight while the system pressure exceeds the set pressure. Advantage: It is possible to perform pressure tests in a system without dismantling the safety valve. After testing, the test gag must be removed! Otherwise the safety valve cannot protect the system against unallowable overpressure.
Blind flange		The safety valve is replaced by a blind flange for the duration of the pressure test. After testing the safety valve has to be reinstalled.
Blanking plate/ Isolation plate		To block the safety valve during a pressure test a blanking plate is placed between inlet pipe and safety valve. After testing, the blanking plate must be removed! Otherwise the safety valve cannot protect the system against unallowable overpressure.

Table 6.2.11.1-1:Options for the hydraulic pressure test

6.2.12 Recommendation for Testing and Inspection during Operation

When and how often safety valves should be inspected is a frequently asked question. This question cannot be answered in general but has to be regarded for each application individually.

6.2.12.1 Inspection Intervals for LESER Safety Valves

Due to the individual operating conditions and in consideration of the different mediums, LESER gives no general reference for an inspection time interval.

In coordination between LESER, different operators, and the notified body, the following procedure has proven itself:

1. Determination of an ininitial inspection time interval:
In accordance with the operating conditions an initial interval of 24 month has proven itself. If the safety valve opens frequently or the medium is corrosive the inspection time interval should be 12 months.

2. Inspection of safety valves after this period of time:
- ► Set pressure repeat accuracy (this requirement is fulfilled if the set pressure corresponds to the test pressure with a tolerance of ± 3 %)
- ► Tightness test of the safety valve (this requirement is fulfilled if the tightness is tested according to API standard 527 or LWN 220.01)
- ► Testing of the mobility (this requirement is fulfilled if the safety valve can be opened with the lifting device at an operating pressure >75 % without the use of any additional tools).

3. Adapting the inspection time interval
The inspection time interval can be increased if the safety valve fulfills the requirements of the above mentioned tests. If not, the interval should be reduced to 12 months or less. In case the following inspection fulfills the requirements again the inspection interval can be lengthened by two month.

If the safety valve is leaking the inspection has to be done immediately.

6.2.12.2 Statements in Codes and Standards

Within the below stated codes and standards the following guidelines for inspection intervals for LESER safety valves are important:

API Recommended Practice 576, Inspection of Pressure-Relieving Devices
Chapter 6.4:
“The inspection of pressure-relieving devices provides data that can be evaluated to determine a safe and economical frequency of scheduled inspections. This frequency varies widely with the various operating conditions and environments to which relief devices are subjected. Inspections may usually be less frequent when operation is satisfactory and more frequent when corrosion, fouling, and leakage problems occur. Historical records reflecting periodic test results and service experiences for each relief device are valuable guides for establishing safe and economical inspection frequencies.
A definite time interval between inspections or tests should be established for every pressure-relieving device on operating equipment. Depending on operating experiences, this interval may vary from one installation to another. The time interval should be sufficiently firm to ensure that the inspection or test is made, but it should also be flexible enough to permit revision as justified by past test records.”

In API 510, the subsection on pressure-relieving devices establishes a maximum interval between device inspections or tests of 10 years. It also indicates that the intervals between pressure relief device testing or inspection should be determined by the performance of the devices in the particular service concerned.

AD2000-Merkblatt A2: Safety Devices against excess pressure – Safety Valves
Chapter 4.7:
“Tests on the response pressure and checks on the smooth running of moving parts within the guides shall be carried out at regular intervals. The intervals for regular tests shall be stipulated by the user in accordance with the operating conditions, using as a basis the recommendations of the manufacturer and the relevant third party. These tests and checks shall be carried out at the latest on the occasion of the external or internal tests on the relevant pressure vessel.”

Ordinance on Industrial Safety and Health – BetrSichV (Betriebssicherheitsverordnung).
Section 15 – Recurrent inspection
“ (1) An installation subject to monitoring and its components shall be subjected to recurrent inspections in certain intervals by an approved body to ensure their proper condition with respect to its operation. The operator shall determine the inspection intervals of the entire installation and its components on the basis of a technical safety assessment...“

The following testing periods for category IV pressure equipment (including safety valves) are defined in section 15:

- External inspection: 2 Years
- Internal inspection: 5 Years
- Strength inspection: 10 Years

6.2.13 Storage and Handling of Safety Valves

“Because cleanliness is essential to the satisfactory operation and tightness of a safety valve, precautions should be taken to keep out all foreign materials during storage or transportation. Safety valves should be closed off properly at both inlet and outlet flanges. Specific care should be taken to keep the valve inlet absolutely clean.
If possible, safety valves should be stored indoors, on pallets, and away from dirt and other forms of contamination.
Safety valves should be handled with care and should not be subjected to shock. Otherwise, considerable internal damage or misalignment can occur and seat tightness may be adversely affected.”[7)]
Depending on the size and weight of the safety valve, the quantity of safety valves in one shipment, and the shipping method, LESER offers different types of packing (see LWN 617.08), e.g.:

Individual safety valve in a cardboard box (Figure 6.2.13-1)
Tied-down on a pallet (Figure 6.2.13-2)
Cardboard or wooden crate (Figure 6.2.13-3)

Figure 6.2.13-1: Individual cardboard box

Figure 6.2.13-2: Tied-down on a pallet

Figure 6.2.13-3 Wooden crate

During storage until installation, safety valves should be kept in their own packaging. The advantages of the LESER types of packing are:

- Due to secure packaging, no damage during transport.
- Unpacking of safety valves before stocking is not necessary.
- Safety valves are protected against dust and dirt during storage.
- Easy and space-saving storage of safety valves on shelves or racking.
- Easy identification of the content from the outside via labels (Figure 6.2.13-4).

Figure 6.2.13-4: Outside label on a cardboard box

It is also possible to transport LESER Safety valves horizontally. The advantages of this kind of transportation are:

- ► requires little space
- ► less freight charge
- ► lower risk of damages in horizontal transport due to lower center of gravity

[7)] API RP 520 Part II, 5th Edition 2003, Sect. 12.2

4 Typical Mistakes as a Result of Unauthorized Repair

Figure 17.4-1: Twisted stainless steel bellows

Safety valves are safety devices and improper repair may cause damage to equipment and serious injury or death! The following table lists typical mistakes that are made when repair is performed by unauthorized or untrained personnel or when maintenance instructions are not followed.

No.	Mistake	Effect
1	Assembly of incorrect spring	1. Spring is too soft: Safety valve closes too late 2. Spring is too strong: Safety valve opens too late
2	Spring is compressed to solid after assembly	Safety valve does not open or does not achieve the required lift
3	Wrong disc is mounted	The safety valve may have the wrong operating characteristic for the application
4	Due to excessive machining of seat/ disc the tolerances of the critical dimensions (chamfer) may be exceeded	The safety valve will have the wrong operating characteristic
5	After repair lifting aid was not reinstalled	The safety valve will have the wrong operating characteristic
6	After repair lift restriction was not reinstalled	The safety valve will blow off with a higher capacity. Pressure drop in the inlet and outlet line may occur as well as chattering
7	During assembly the spindle was not secured against rotation: → the stainless steel bellows is twisted	Safety valve does not open
8	Unsuitable or insufficient grease is used for the lubrication of the actuator of the pneumatic lifting device H8	The Lifting device H8 fails; the safety valve continues to function
9	Lifting lever left in open position - lever with knob - H4 for Clean Service	The safety valves stays open