GB

DUNGS®
Combustion Controls

Instruction manual

FRM 100025 - 100050

1. Target group

The target group of this manual is qualified personnel of the gas safety and regulating technology, skilled personnel or the persons instructed by them.
Due to their specialist training, knowledge and experience and knowledge of standard regulations, they are capable of evaluating the work assigned to them and recognising possible dangers. Only they are permitted to carry out assembly, commissioning, settings and maintenance on the devices in compliance with the recognised rules for occupational safety.

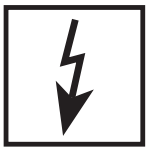
Hang this instruction manual in a readily visible place inside the installation room! Do not carry out any work until you have read the safety instructions of this instruction manual.

2. Warnings

2.1 General warnings

The recognised occupational safety rules and accident prevention regulations must be observed and, if necessary, personal protective measures must be taken.

All adjustments and settings should only be performed in accordance with the instruction manuals of the connected machines.



Never carry out work as long as gas pressure or voltage is applied. Avoid open fire. Please observe public regulations.

Prior to assembly, the device must be inspected for transport damage.

The device must not be exposed to open fire. Protection against lightning strikes must be guaranteed.

Connected line systems must be free from dirt and contamination.

Protection from environmental impacts and weather conditions (corrosion, rain, snow, icing, humidity (e.g. by condensation), mould, UV radiation, harmful insects, poisonous, corrosive solutions/ liquids (e.g. cutting and cooling fluids), must be guaranteed. Depending on the installation site, it may be necessary to take protective measures.

The device may only be operated in compliance with the operating conditions stated on the type plate.

The device must be protected from vibrations and mechanical impacts.

The device must not be used in areas with increased seismic risk.

Explanation of the symbols		
1, 2, 3,...	=	Order of action
•	=	Instruction

2.2 Designated use

The device is used in accordance with its designated use if the following instructions are observed:

- Use of the device in gas transport and gas distribution networks, commercial and industrial plants.
- Use in pressure regulator stations according to EN 12186 and EN 12279.
- Use with gases of the 1st and 2nd gas families according to EN 437 only.
- Use with dry and clean gases only, no aggressive media.
- Use only in compliance with the operating conditions stated on the type plate.
- Use in perfect condition only.
- Malfunctions and faults must be eliminated immediately.
- Use only in observance of the instructions given in this instruction manual and of national regulations.

2.3 Risks in case of misuse

- If used in accordance with their designated use, the devices are safe to operate.
- Non-observance of the regulations may result in personal injury or material damage, financial damage or environmental damage.
- Operator errors or misuse present risks to life and limb of the operators and also to the device and other material property.

3. Approval / declaration of conformity

CE 0085

DVGW CERT

EG-Baumusterprüfbescheinigung

EC type examination certificate

CE-0085CP0256
Produkt-Identnummer
product identification no.

Anwendungsbereich *field of application*	EG-Druckgeräterichtlinie (97/23/EG) *EC Pressure Equipment Directive (97/23/EC)*
Zertifikatinhaber *owner of certificate*	Karl Dungs GmbH & Co. KG Siemensstr. 6-10, D-73660 Urbach
Vertreiber *distributor*	Karl Dungs GmbH & Co. KG Siemensstr. 6-10, D-73660 Urbach
Produktart *product category*	Gasarmaturen: Druckregelgerät für Erd-/Allgas (4301)
Produktbezeichnung *product description*	direkt wirkender Druckregler
Modell *model*	FRM 1000 ...
Prüfberichte *test reports*	Baumusterprüfung: 13/204/4308/130 vom 12.09.2014 (EBI)
Prüfgrundlagen *basis of type examination*	EU/97/23/EG A III B (29.05.1997) DIN EN 334 (01.07.2009)
Ablaufdatum / AZ *date of expiry / file no.*	12.09.2024 / 14-0504-GDE

18.11.2014 Kö A-1/2
Datum, Bearbeiter, Stelle, Leiter der Zertifizierungsstelle
date, issued by, sheet, head of certification body

DVGW CERT GmbH ist von der DAkkS nach DIN EN 45011:1998 akkreditierte und von der Deutschen Bundesregierung benannte Stelle für die Zertifizierung von Druckgeräten und Baugruppen gemäß Richtlinie 97/23/EG.

DVGW CERT GmbH is an accredited body by DAkkS according to EN 45011:1998 and notified by the government of the Federal Republic of Germany for certification of pressure equipment under EC Directive 97/23/EC.

DAkkS Deutsche Akkreditierungsstelle D-ZE-16028-01-02

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Typ *type*	Technische Daten *technical data*	Bemerkungen *remarks*
FRM 100025 ...	Eingangsdruckbereich: 0,5 bis 10 bar Nennweite: DN 25 max. zulässiger Druck PS: 10 bar	
FRM 100040 ...	Eingangsdruckbereich: 0,5 bis 10 bar Nennweite: DN 40 max. zulässiger Druck PS: 10 bar	
FRM 100050 ...	Eingangsdruckbereich: 0,5 bis 10 bar Nennweite: DN 50 max. zulässiger Druck PS: 10 bar	

Ausführungsvariante *type variation*	Erläuterungen *explanations*
FRM 1000... ND	Ausgangsdruckbereich: 0,02 bis 0,1 bar
FRM 1000... MD	Ausgangsdruckbereich: 0,08 bis 0,35 bar
FRM 1000... HD	Ausgangsdruckbereich: 0,3 bis 1,5 bar

Verwendungshinweise / Bemerkungen
hints of utilization / remarks

Medium: Brenngase der 1., 2. und 3. Familie sowie alle nicht aggressive Gase
Genauigkeitsklasse AC 5: Ausgangsdruck: 0,18 bar ... 1,5 bar
Genauigkeitsklasse AC 10: Ausgangsdruck: 0,02 bar ... 0,18 bar
Schließdruckgruppe SG 10: Ausgangsdruck: 0,18 bar ... 1,5 bar
Schließdruckgruppe SG 20: Ausgangsdruck: 0,02 bar ... 0,18 bar
Anschlüsse: Flansch
Umgebungstemperaturbereich: -20 °C ... +60 °C
Gehäusematerial:Gusseisen EN GJS 400-18

4. Table of contents

5. List of abbreviations

Abbreviation	Description
AG_o	Response pressure group of the upper response pressure
AG_u	Response pressure group of the lower response pressure
AC	Accuracy class
ASE	Safety shutoff valve (without housing)
C_v	Flow volume coefficient
DN	Nominal diameter
Fail-open	The firing valve moves automatically to the open position, if the main diaphragm or the auxiliary power required for the actuation of the firing valve fails
IS	Type: integral strength range
Class A	Functional class: the SAV closes if the comparison diaphragm is damaged or the auxiliary power supply has failed
MOP	Maximum admissible operating pressure
p_d	Outlet pressure
p_u	Inlet pressure
p_{do}	Upper response pressure
p_{du}	Lower response pressure
p_{max}	Maximum operating pressure
$p_{zul.}$	System-specific operating pressure according to the regulator
PN	Nominal pressure of the flange
PS	Maximum admissible pressure
SAV	Safety shutoff valve
SBV	Safety relief valve
SG	Lock-up pressure class
SN	Serial number
SZ	Closing pressure zone group
Tp.	Operating temperature -20 °C ... +60 °C
W_{ds}	Specific guide range
W_{do}	Adjustment range for the upper response pressure through regulation of the available adjusting springs
W_{du}	Adjustment range for the lower response pressure through regulation of the available adjusting springs
W_{dso}	Specific adjustment range of the adjusting spring installed for the upper response pressure
W_{dsu}	Specific adjustment range of the adjusting spring installed for the lower response pressure

6. Features

6.1. Technical data

Technical data	FRM …
Device	Spring-loaded medium pressure regulator according to EN 334
Type	IS (integral strength range)
Type of gas	Family 1+2+3
Nominal diameters Flange	Connecting flanges PN 25 according to EN 1092-1 DN 25 40 50
Admissible pressure load	10 bar (1000 kPa)
Max. inlet pressure	10 bar (1000 kPa)
Outlet pressure range	30 - 1500 mbar (3-150 kPa)
Minimum differential pressure (ND)	270 mbar (27 kPa)
Minimum differential pressure (MD)	350 mbar (35 kPa)
Minimum differential pressure (HD)	500 mbar (50 kPa)
Materials	Firing valve housing: cast iron GGG 50 Diaphragm housing: steel sheet Diaphragms: NBR
Ambient temperature	-20 °C to + 60 °C

Technical data	SAV …
Device	Safety shutoff valve in compliance with EN14382, class A
Type	IS
Response time	≤ 2s
Adjustment range below W_{du}	10 - 2500 mbar (1-250 kPa)
Adjustment range above W_{du}	40 - 4000 mbar (4-400 kPa)
Materials	Firing valve housing: cast iron GGG 50 Diaphragm housing: Aluminium Diaphragms: NBR

6.2 Nomenclature

Example FRM 100025 ND / SAV ND	FRM		100	025	ND	SAV	ND
Type	**Spring-loaded medium pressure regulator**						
MOP	100 …	10,000 mbar					
Nominal diameter	DN 25	025					
	DN 40	040					
	DN 50	050					
Pressure range, outlet pressure	ND	Low pressure					
	MD	Medium pressure					
	HD	High pressure					
Safety device	SAV	Integrated safety shutoff valve					
Pressure range, triggering pressure	ND	Low pressure					
	MD	Medium pressure					
	HD	High pressure					

6.3 Adjustment range

Type	Connection	Version	Accuracy class* [AC]	Lock-up pressure class* [SG]	Outlet pressure range W_d	Lower switching point SAV		Upper switching point SAV	
						W_{du}	AG	W_{do}	AG
FRM 100025 ND	DN 25	ND	AC 10	SG 20	30-100 mbar				
FRM 100025 MD	DN 25	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100025 HD	DN 25	HD	AC 5	SG 10	400-1500 mbar				
FRM 100025 ND / SAV ND	DN 25	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100025 MD / SAV MD	DN 25	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100025 HD / SAV HD	DN 25	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5
FRM 100040 ND	DN 40	ND	AC 10	SG 20	30-100 mbar				
FRM 100040 MD	DN 40	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100040 HD	DN 40	HD	AC 5	SG 10	400-1500 mbar				
FRM 100040 ND / SAV ND	DN 40	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100040 MD / SAV MD	DN 40	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100040 HD / SAV HD	DN 40	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5
FRM 100050 ND	DN 50	ND	AC 10	SG 20	30-100 mbar				
FRM 100050 MD	DN 50	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100050 HD	DN 50	HD	AC 5	SG 10	400-1500 mbar				
FRM 100050 ND / SAV ND	DN 50	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100050 MD / SAV MD	DN 50	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100050 HD / SAV HD	DN 50	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5

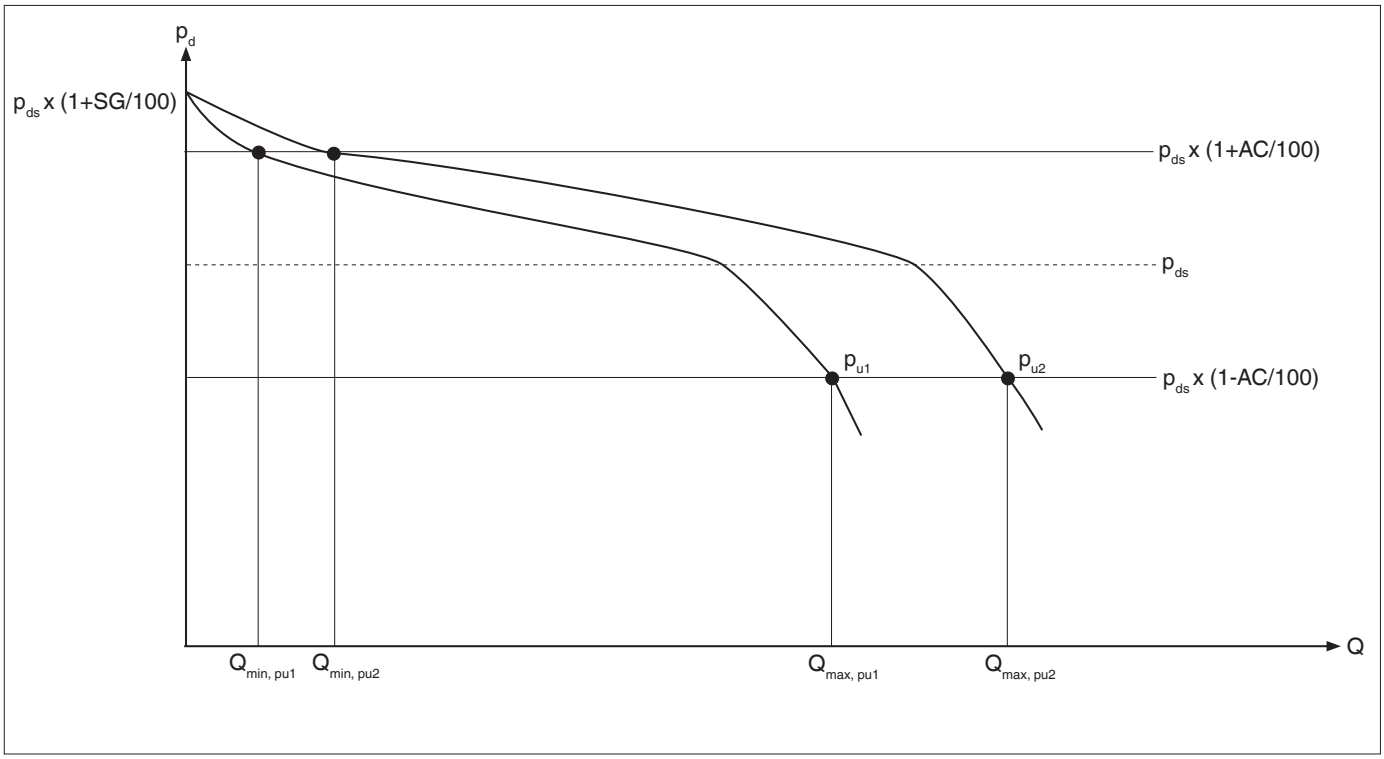
*Accuracy class / lock-up pressure class according to EN 334
**p_d = 90-180 mbar: AC 10
p_d= 180-420 mbar: AC 5

6.4 Accuracy class / lock-up pressure class

Version	Outlet pressure range	Accuracy class [AC]	Closing pressure
FRM...ND	30-50 mbar	AC 15	p_d + 15 mbar
	50-80 mbar	AC 10	
	90-100 mbar	AC 5	
FRM...MD	90-120 mbar	AC 15	p_d + 25 mbar
	120-180 mbar	AC 10	
	180-420 mbar	AC 5	
FRM...HD	400-450 mbar	AC 10	p_d + 50 mbar
	450-500 mbar	AC 5	
	500-1500 mbar	AC 2.5	

The AC and SG data, in compliance with EN 334, do not make any statement about the modulation range. Knowledge of the minimum and maximum volume flow is essential for the application in the field. Therefore, the accuracy values 'control quality' and 'lock-up pressure class' that can be guaranteed at a volume flow of 1:10 were determined.

The AC values of the table mentioned above refer to the maximum admissible percentage deviation of the outlet pressure from the set nominal value, at which Q_{max} / Q_{min} ≥ 10 is observed.



Abbreviation	Description
AC	Accuracy class
p_d	Outlet pressure
$p_{u1/2}$	Inlet pressure
p_{ds}	Set nominal value of the outlet pressure
SG	Lock-up pressure class
$Q_{min\ /\ pu1/2}$	AC minimum flow volume at a specific inlet pressure p_u (lower limit of the volume flow after which the stable operating conditions for a given nominal value within the given operating temperature range are given).
$Q_{max\ /\ pu1/2}$	AC maximum flow volume at a specific inlet pressure p_u (upper limit of the volume flow until which a given accuracy class for a given nominal value within the given operating temperature range is adhered to).

6.5 Selection of regulator springs

Adjustment range, outlet pressure W_{du}							
Spring colour	Order number	Wire diameter [mm]	Length [mm]	Diameter [mm]	Setpoint range [mbar]		
					ND	MD	HD
Silver	270341	5.5	220	60	30-40	90-110	
Green	270345	6.5	220	62	40-55	110-170	
Yellow	270346	7.0	220	63	55-80	170-240	
Blue	270347	8.0	220	65	80-100	240-330	
Black	270348	9.0	220	68		330-420	400-580
Purple	270349	10.0	220	69			560-850
Orange	270350	11.0	220	71			800-1200
Pink	270352	12.0	220	73			1100-1500

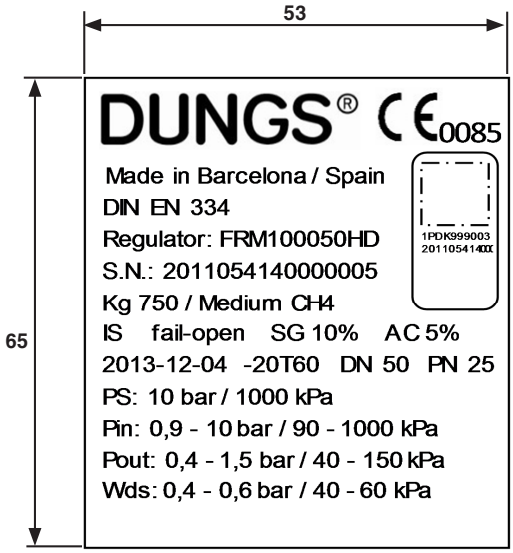
6.6 Selection of SAV springs

Specific adjustment range, underpressure W_{dsu}							
Spring colour	Order number	Wire diameter [mm]	Length [mm]	Diameter [mm]	Setpoint range [mbar]		
					ND	MD	HD
White	270353	1.2	60	10.0	10-32		
Yellow	270355	1.5	55	12.3	24-40		
Blue	270356	2.0	55	12.3	30-115	35-110	
Black	270357	2.3	55	12.3		50-250	
Purple	270358	2.5	55	12.3		80-400	150-500
Orange	270359	2.8	55	12.3			300-1000
Pink	270360	3.0	55	12.5			800-2500

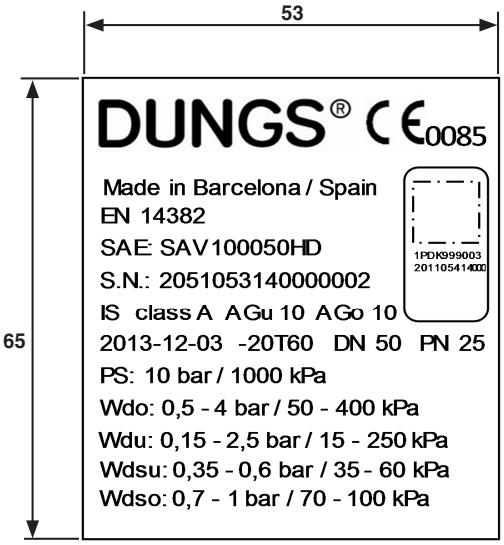
Specific adjustment range, overpressure W_{dso}							
Spring colour	Order number	Wire diameter [mm]	Length [mm]	Diameter [mm]	Setpoint range [mbar]		
					ND	MD	HD
Silver	270361	2.2	60	30.0	40-130		
Green	270366	2.5	60	30.0	60-190	180-290	
Red	270367	2.7	60	30.0	90-240	230-370	
Yellow	270368	3.2	60	30.0		300-500	
Blue	270369	3.5	60	30.0		400-800	500-1000
Black	270370	3.7	60	30.0			700-1300
Purple	270371	4.0	60	30.0			1000-1800
Orange	270372	4.5	60	30.0			1300-2500
Pink	270373	4.8	60	30.0			1800-4000

6.7 Type plate

Regulator



SAV



Abbreviation	Description
AG_o	Response pressure group of the upper response pressure
AG_u	Response pressure group of the lower response pressure
AC	Accuracy class
C_V	Flow volume coefficient for natural gas
DN	Nominal diameter
Fail-open	The firing valve moves automatically to the open position, if the main diaphragm or the auxiliary power required for the actuation of the firing valve fails
IS	SAV type: integral strength range
Class A	Functional class: in case the comparison membrane is damaged or in the event of a breakdown of the auxiliary power supply the SAV closes
p_d	Outlet pressure
p_u	Inlet pressure
PN	Nominal pressure of the flange
PS	Maximum admissible pressure
SAV	Safety shutoff valve
SG	Lock-up pressure class
-20T60	Operating temperature -20 °C ... +60 °C
SN	Serial number
W_{ds}	Specific guide range
W_{do}	Adjustment range for the upper response pressure through regulation of the available adjusting springs
W_{du}	Adjustment range for the lower response pressure through regulation of the available adjusting springs
W_{dso}	Specific adjustment range of the adjusting spring installed for the upper response pressure
W_{dsu}	Specific adjustment range of the adjusting spring installed for the lower response pressure

7. Function

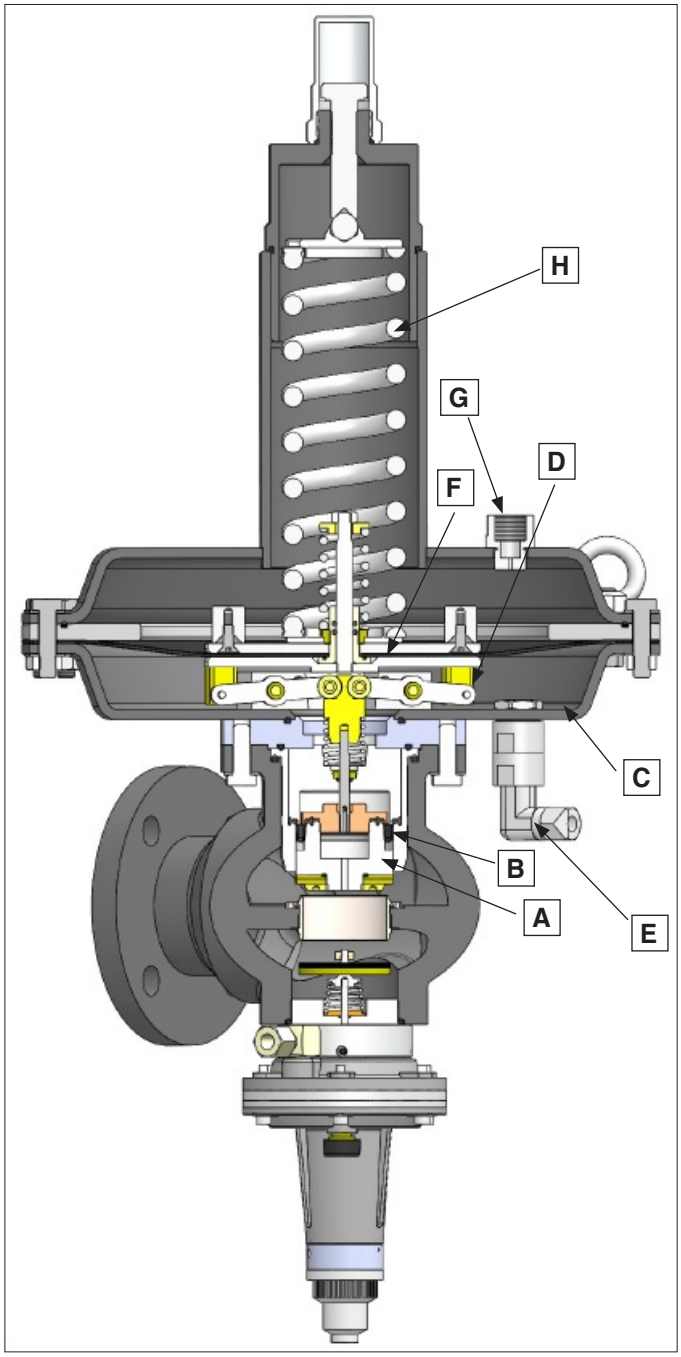
The pressure regulator's function is to keep the outlet pressure largely constant, independent of changes in the inlet pressure and/or in the flow volume. In the depressurised state the regulator is open. The pressure regulator complies with the requirements of EN 334 as gas pressure regulator with standard strength range (IS) and zero flow.

Main components
A Control plate
B Inlet pressure compensation diaphragm
C Lower diaphragm shell
D Lever system
E Impulse connection for the outlet pressure
F Working diaphragm
G Vent connection
H Setpoint spring

Depressurised state
The force of the setpoint spring **H** acts on the working diaphragm **F**. In depressurised state there is no counterforce acting in the lower diaphragm shell **C**, since no overpressure is applied in the outlet range. The resulting upward movement of the working diaphragm causes the lever system **D** to be pushed downwards. In this way, the control plate **A** is then pulled upwards and lifted from the seat. The regulator is open.

Steady state
In case of increasing outlet pressure, the force on the working diaphragm **F** in the diaphragm shell **C** increases also. The working diaphragm **F** is thus pushed upwards until the force of the setpoint spring **H** is equal to that of the outlet pressure. The upward movement of the working diaphragm **F** causes the lever system **D** to be pulled upwards. In this way, the control plate **A** is then pushed downwards and the valve gap is reduced. The flow volume decreased in this way reduces the outlet pressure until the set nominal value (outlet pressure) is reached again and a balance of forces at the working diaphragm **F** is established.

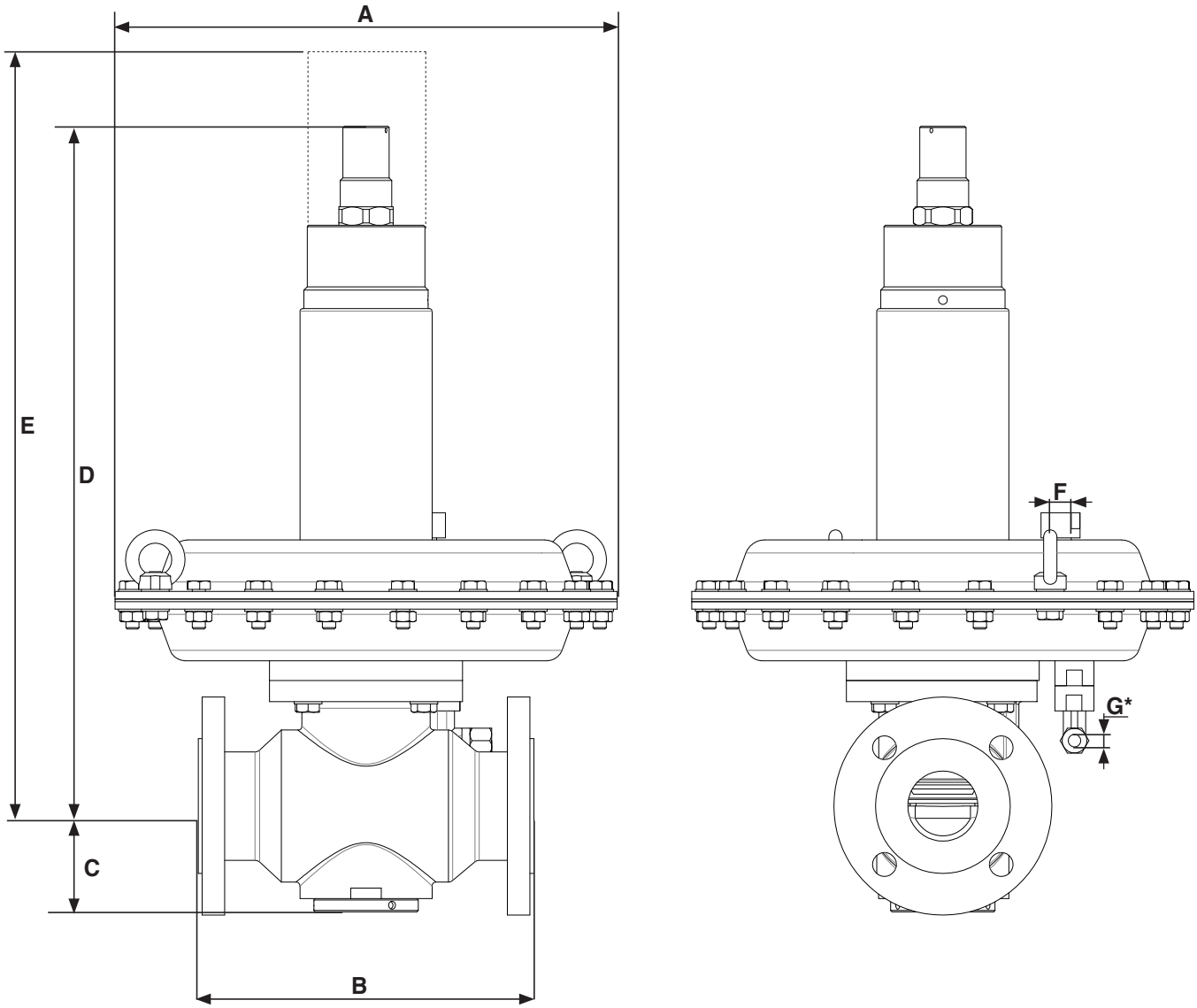
If the outlet pressure drops, the force on the working diaphragm **F** in the lower diaphragm shell **C** decreases as well. The working diaphragm **F** is, thus, pushed downwards until the force of the setpoint spring **H** is equal to that of the outlet pressure. The upward movement of the working diaphragm **F** causes the lever system **D** to be pushed downwards. In this way, the control plate **A** is then pulled upwards and the valve gap is reduced. The increased flow volume increases the outlet pressure until the set nominal value (outlet pressure) is reached again and a balance of forces at the working diaphragm **F** is established.



Inlet pressure compensation
Changes in the inlet pressure have no influence on the balance of forces. The inlet pressure is compensated by the inlet pressure compensation diaphragm **B**. The inlet pressure is then conducted in the chamber above the inlet pressure compensation diaphragm **B** through an opening at the control plate **A**. At the control plate **A**, the inlet pressure acts in the opening direction. At the inlet pressure compensation diaphragm **B**, opposite to the control plate, the inlet pressure acts in the closing direction. The surface of the control plate, on which the inlet pressure acts from below, has the same size as the admission pressure compensation diaphragm **B**, on which the inlet pressure acts from above. Therefore, both forces cancel each other. The inlet pressure balance at the regulator is ensured.

8. Dimensions

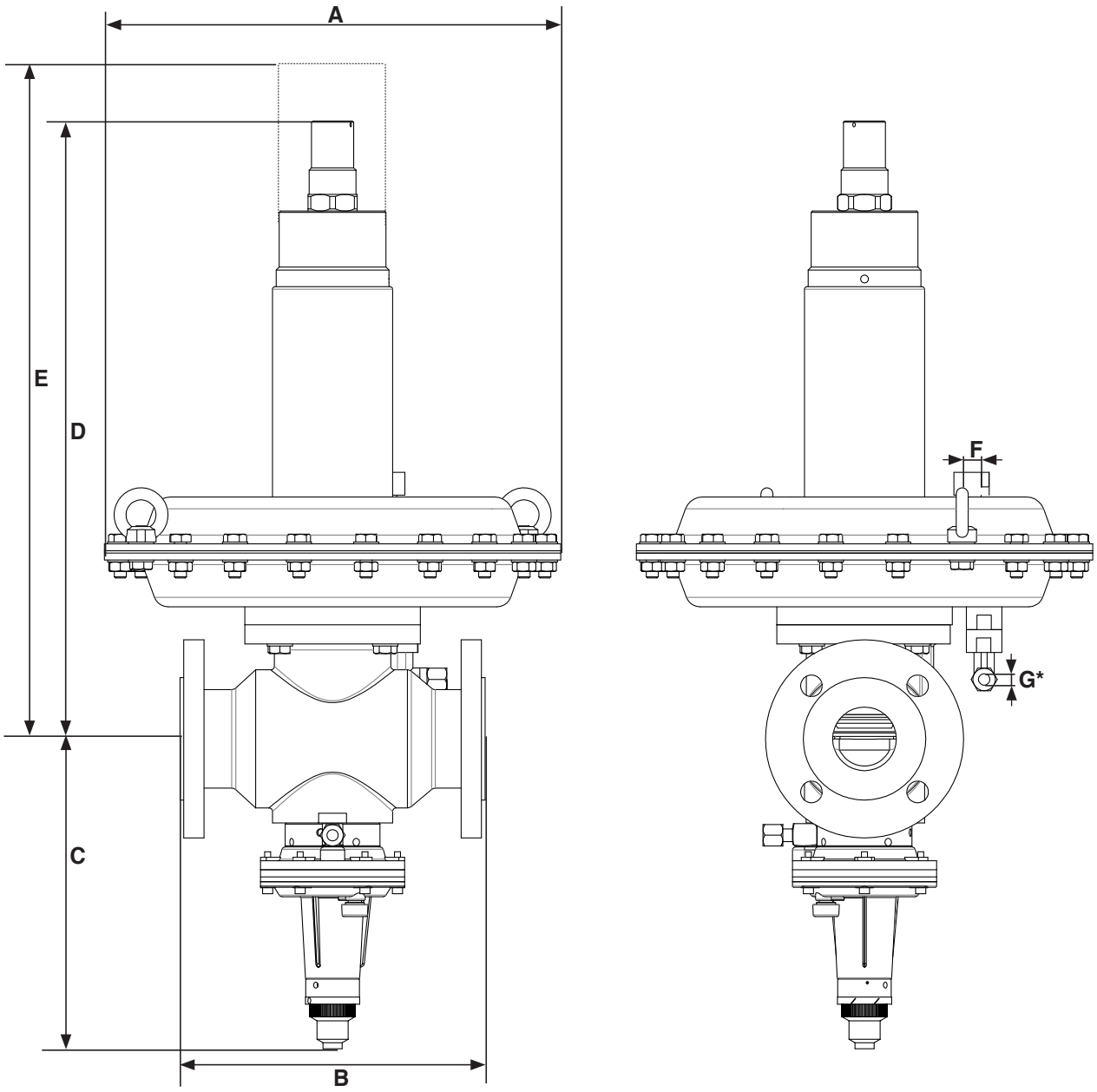
FRM...



*Ermeto screw connection 12L: GE 12 - 1/4
with screw connection M16 for pipes 12 x 1.5

Type	Order number	$p_{max.}$ [bar/kPa]	DN	Dimensions							Weight [kg]
				A	B	C	D	E	F	G	
FRM 100025 ND	270272	10 / 1000	25	500	184	57	492	820	⊘ 29.5-1/2“G	⌀12	38
FRM 100025 MD	270273	10 / 1000	25	380	184	57	492	820	⊘ 29.5-1/2“G	⌀12	32
FRM 100025 HD	270274	10 / 1000	25	380	184	57	502	830	⊘ 29.5-1/2“G	⌀12	36
FRM 100040 ND	270278	10 / 1000	40	500	223	69	505	830	⊘ 29.5-1/2“G	⌀12	42
FRM 100040 MD	270279	10 / 1000	40	380	223	69	505	830	⊘ 29.5-1/2“G	⌀12	36
FRM 100040 HD	270280	10 / 1000	40	380	223	69	515	840	⊘ 29.5-1/2“G	⌀12	40
FRM 100050 ND	270284	10 / 1000	50	500	254	80	515	840	⊘ 29.5-1/2“G	⌀12	49
FRM 100050 MD	270285	10 / 1000	50	380	254	80	515	840	⊘ 29.5-1/2“G	⌀12	43
FRM 100050 HD	270286	10 / 1000	50	380	254	80	525	850	⊘ 29.5-1/2“G	⌀12	47

FRM... / SAV



*Ermeto screw connection 12L: GE 12 - 1/4
with screw connection M16 for pipes 12 x 1.5

Type	Order number	p max. [bar/kPa]	DN	Dimensions							Weight [kg]
				A	B	C	D	E	F	G	
FRM 100025 ND/SAV ND	270275	10 / 1000	25	500	184	232	492	1070	⌀ 29.5-1/2“G	⌀12	40
FRM 100025 MD/SAV MD	270276	10 / 1000	25	380	184	229	492	1070	⌀ 29.5-1/2“G	⌀12	34
FRM 100025 HD/SAV HD	270277	10 / 1000	25	380	184	236	502	1080	⌀ 29.5-1/2“G	⌀12	38
FRM 100040 ND/SAV ND	270281	10 / 1000	40	500	223	243	505	1080	⌀ 29.5-1/2“G	⌀12	44
FRM 100040 MD/SAV MD	270282	10 / 1000	40	380	223	239	505	1080	⌀ 29.5-1/2“G	⌀12	38
FRM 100040 HD/SAV HD	270283	10 / 1000	40	380	223	247	515	1090	⌀ 29.5-1/2“G	⌀12	42
FRM 100050 HD/SAV ND	270287	10 / 1000	50	500	254	252	515	1090	⌀ 29.5-1/2“G	⌀12	51
FRM 100050 HD/SAV MD	270288	10 / 1000	50	380	254	248	515	1090	⌀ 29.5-1/2“G	⌀12	45
FRM 100050 HD/SAV HD	270289	10 / 1000	50	380	254	256	525	1100	⌀ 29.5-1/2“G	⌀12	49

9. Installation

9.1 General information

- **This device can only be installed in compliance with the rules and stand ards applicable and in accordance with the local regulations and authorisa - tions that may be necessary.**
- **Install the device in a building or housing, do not install it outdoors without suitable protective measures!**
- **The work area must be provided with general safety devices.**
- **The lifting devices used must be suitable for the load to be lifted.**
- **Enough installation space for operation and maintenance has to be provided.**
- **It is recommended to install a filter with a pore size ≤ 50 µm upstream of the regulator.**
- **The installation must not impair the functioning of other components.**

Check prior to installation!

- Shut-off valves both on the inlet and outlet side are closed.
- Lines are free from combustible gas.
- Prevent explosive gas-air mixture: the room atmosphere must constantly be monitored through gas concentration measuring devices for the detection of gas leakages.

- Ensure electrically conductive bridging. Prevent contact voltage and ignitable flashover.
- The performance data on the type plate correspond to the ordering data.
- Flanges on the inlet side and outlet side of the connecting line are parallel.
- The sealing surfaces of the flange are undamaged and clean.
- The maximum inlet pressure of the system is lower than the maximum admissible pressure of the regulator.
- Protective caps at the connection flange, if any, must be removed.
- The minimum distances for the setting must be observed.
- The pipeline on the inlet side must be free of water and dirt.

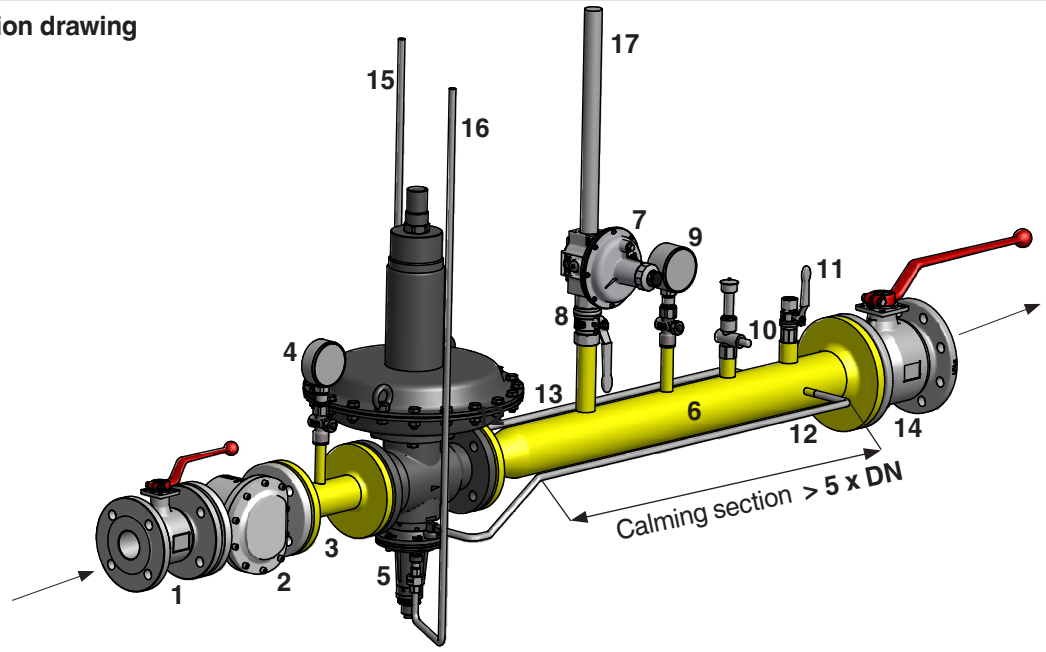
Note during installation!

- Mounting must be carried out in a tension-free state.
- Tighten the screws crosswise.
- Tightening torques must be observed.
- Vent lines and blow-off lines have to be positioned individually.
- Vent lines and blow-off lines must lead outdoors: gases must be able to escape to a non-hazardous environment.
- The pulse lines may not be shut off.
- The specified distance between the measuring points of the pulse lines must be observed.
- The flow direction (arrow) on the housing must be followed.

9.2 Installation instructions

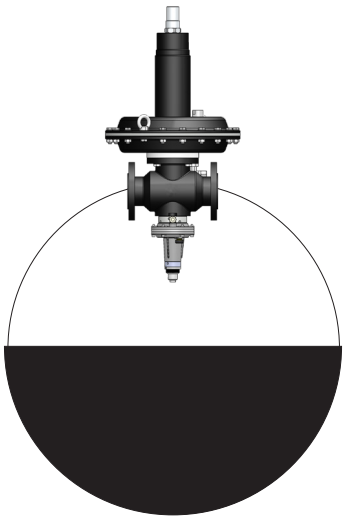
- The installation must be carried according to the installation scheme specified below.
- Install the safety shutoff valve in the flow direction (arrow/ housing).
- Design a straight calming section with the equal diameter.
- Make sure that the pulse tap at the calming section is clean and free from burrs. Distance > 5 x DN
- Maximum flow velocity in the calming section: ≤ 30 m/s.
- Version of the pulse lines: steel pipe D= 12 x 1.5
- Avoid accumulation of condensate: install the pulse lines with a gradient

Installation drawing



Pos.	Designation
1	Shutoff valve, inlet side (e.g. ball valve or butterfly valve)
2	Filter
3	Welded part
4	Pressure gauge, inlet side
5	Regulator with integrated SAV
6	Calming section
7	SBV
8	Ball valve
9	Pressure gauge, outlet side
10	Test burner
11	Venting ball valve
12	Pulse line, SAV
13	Pulse line, regulator
14	Shutoff valve, outlet side (e.g. ball valve or butterfly valve)
15	Vent line regulator
16	Vent line SAV
17	Relief line SBV

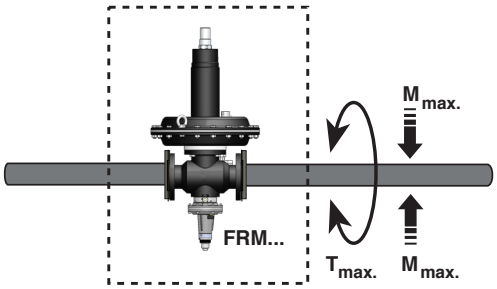
Mounting position



9.3 Torque

Use adequate tools!
Tighten the screws crosswise!

The device must not be used as lever.



DN	--	--	--	25	40	50	65	80	100	125	150
Rp	⅜	½	¾	1	1 ½	2	2 ½	--	--	--	--
$M_{max.}$ [Nm] t 10 s	70	105	225	340	610	110	1600	2400	5000	6000	7600
$T_{max.}$ [Nm] t 10 s	35	50	85	125	200	250	325	400	--	--	--

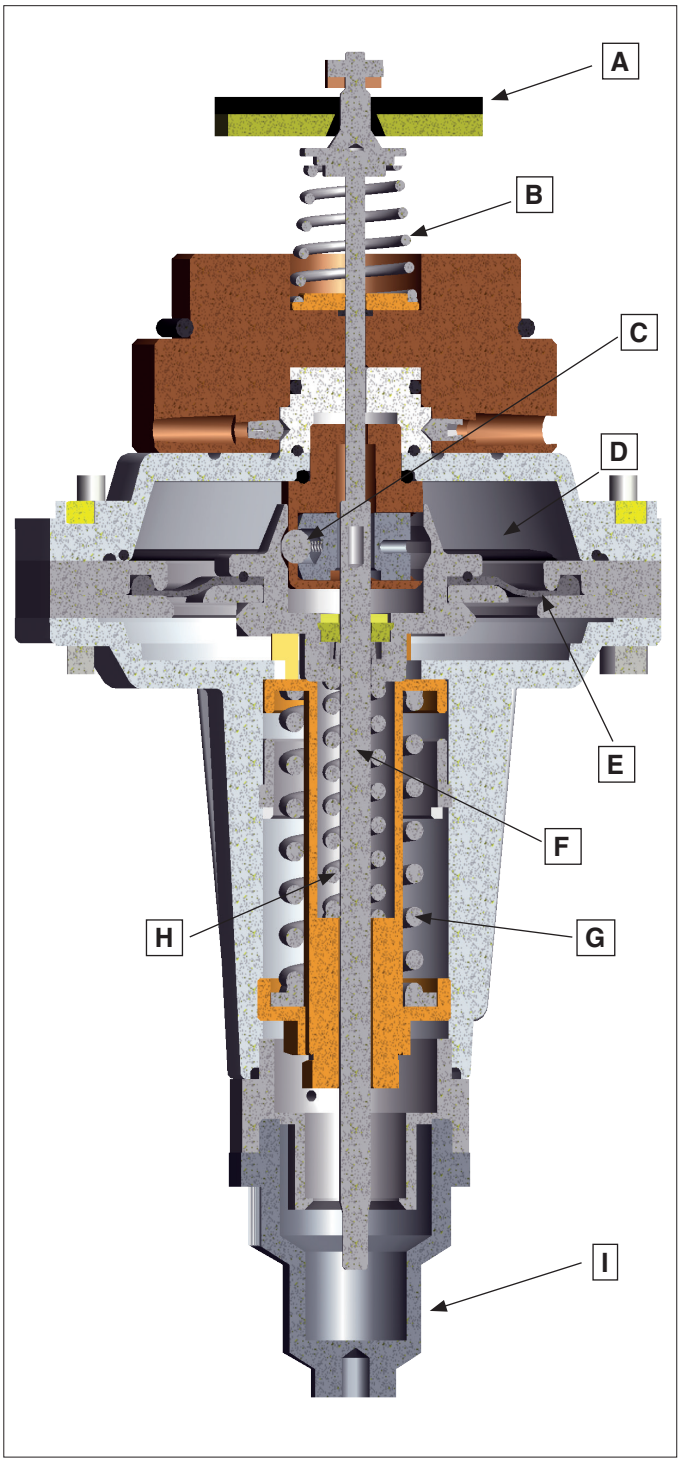
Max. torque system accessories								
M … / G …	M 4	M 5	M 6	M8	G ⅛	G ¼	G ½	G ¾
$M_{max.}$ [Nm] t 10 s	2.5 Nm	5 Nm	7 Nm	15 Nm	5 Nm	7 Nm	10 Nm	15 Nm

Max. torque flanged joint		
Stud	M 12 x 55 (EN 13611)	M 16 x 65 (DIN 939)
$M_{max.}$ [Nm] t 10 s	30 Nm	60 Nm

10. Integrated SAV

10.1 Function

SAV protects downstream fittings or lines against pressures that are too high or too low. As soon as the pre-set triggering pressure falls below or exceeds a limit due to a fault, the SAV interrupts automatically the gas flow. Under normal operating condition the SAV is open.
If the outlet side of the gas pressure regulator and/or the fittings and devices of the succeeding gas line section, inclusive its equipment until the gas-consuming device, are not designed for the highest supply pressure (inlet pressure to the gas pressure regulator in case of an error), a SAV must be installed to shut down the gas supply before the gas pressure becomes too high:
The SAV complies with the requirements of EN 14382 as safety shutoff valve with standard strength range (IS).

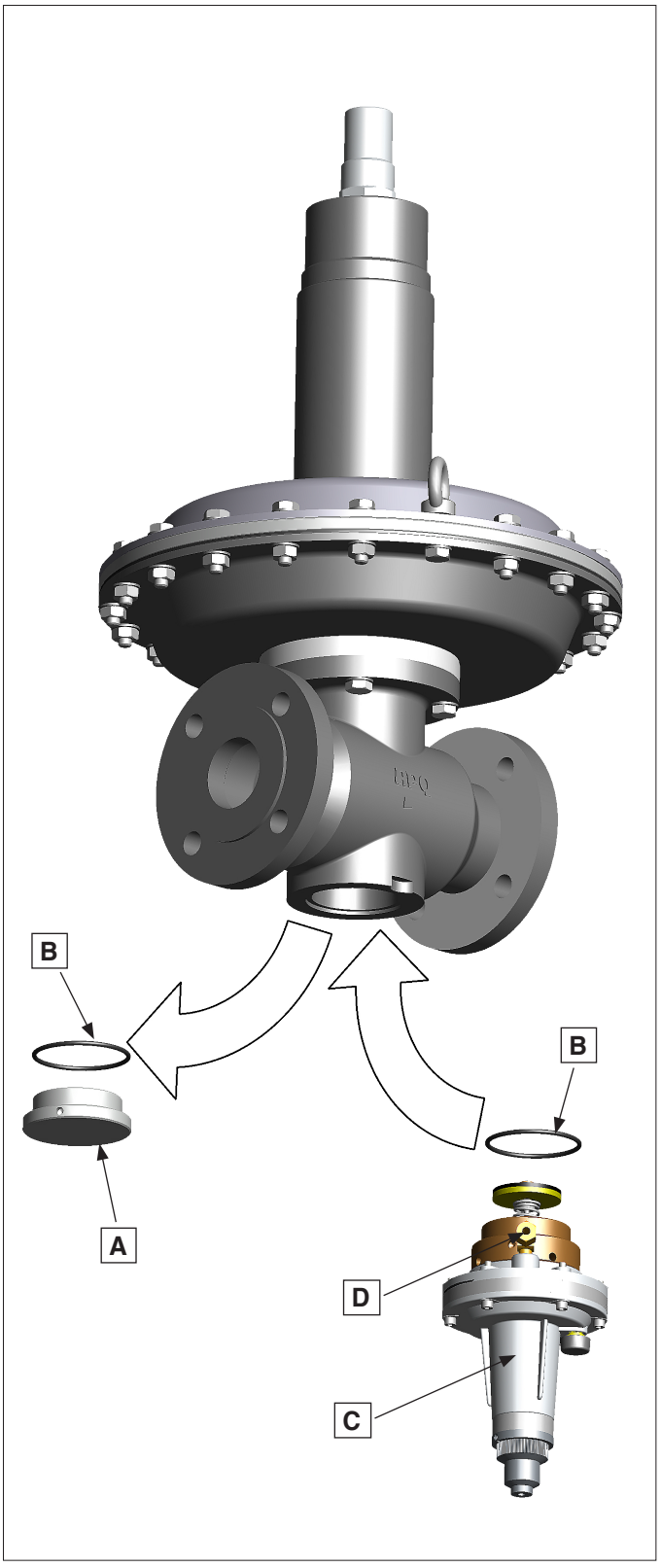


Main components
A Valve disc
B Closing spring
C Ball catch / trigger mechanism
D Chamber with the pressure to be monitored
E Working diaphragm
F Push rod
G Setpoint spring for p_{do}
H Setpoint spring for p_{du}
I Protective cap

Function
Chamber **D** is connected to the outlet pressure via a pulse line.
The pressure to be checked acts on the working diaphragm **E**. The force of the setpoint springs **G** and **H** acts as counterforce.
In case of an unbalance of forces (overpressure or underpressure), the SAV is actuated and the gas supply is blocked.

10.2 Mounting on the regulator

1. Loosen four hexagonal socket grub screws (M 5x8) of the ASE **C** using an internal hex key **SW 2.5.**
2. Remove the base plate **A** from the housing using a hook wrench **60-90**.
3. Remove the O-ring **B**.
4. Place the new O-ring **B** of the maintenance kit 6 on the ASE **C**.
5. Screw the ASE **C** in the housing using a hook wrench **60-90**.
6. Align the Ermeto screw connection **D** of the pulse connection to the connection of the external pulse line.
7. Tighten four hexagonal socket grub screws (M5x8) in the ASE **C** using an internal hex key **SW 2.5.**



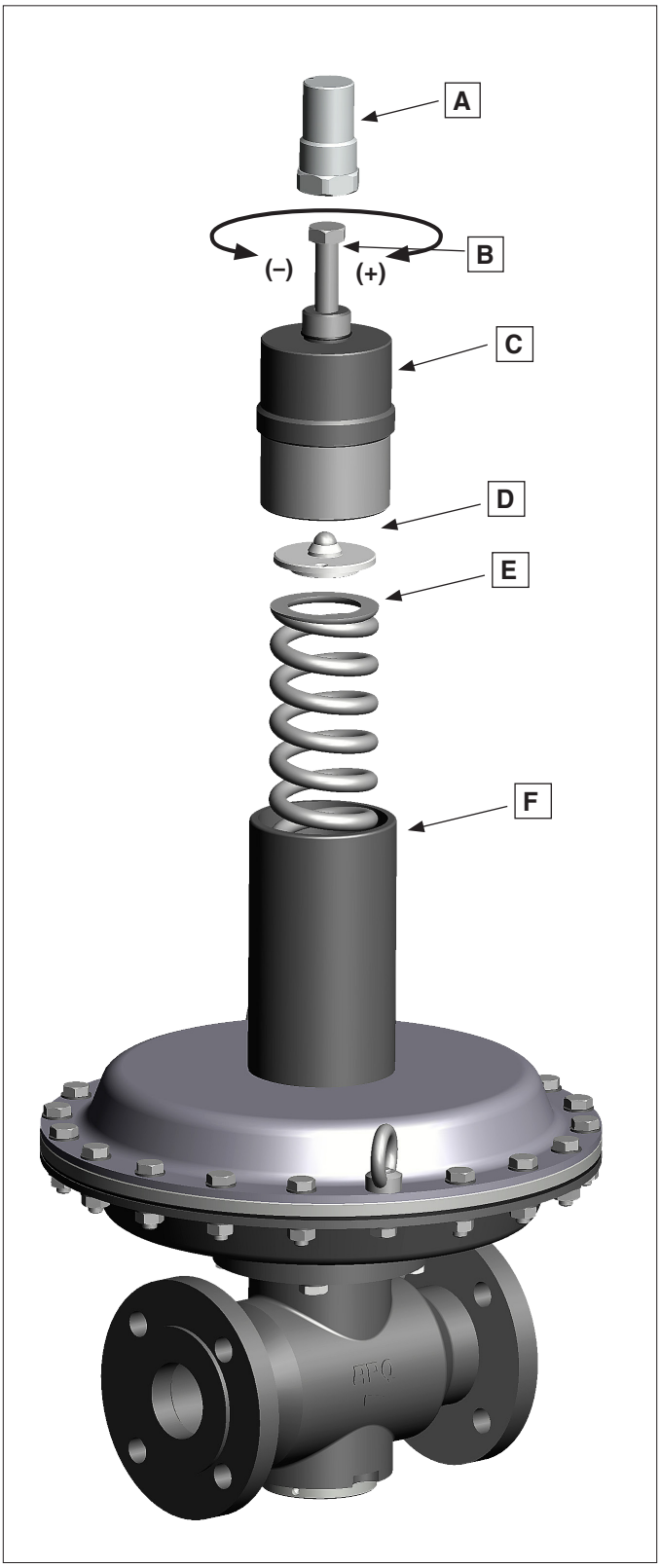
11. Setting

11.1 Regulator setting

Setting of the outlet pressure

The regulator is set using the adjusting screw **B**.

1. Remove the protective cap **A**.
2. Turn the adjusting screw **B** using an open-ended wrench **SW 24**.
3. Turning clockwise: the preload of the setpoint spring is increased and the outlet pressure p_{ds} is increased (+).
4. Turning counter-clockwise: the setpoint spring is released and the outlet pressure p_{ds} reduced (–).
5. After the setting: screw on the protective cap **A** again.



11.2 SAV setting

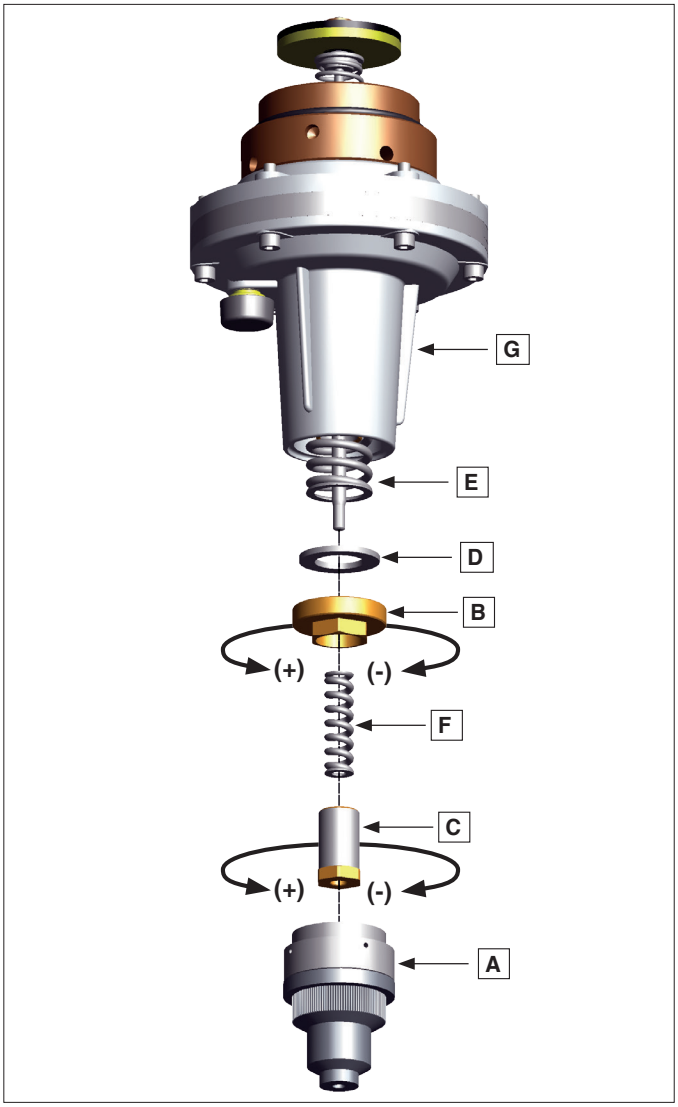
Switch-off setting in case of overpressure p_{do}

1. Remove the protective cap **A**.
2. Turn the external adjusting screw **B** using a socket wrench **SW 22**.
3. Turning clockwise: increase (+) in the upper shut down pressure p_{do}.
4. Turning counter-clockwise: reduction (+) in the upper shut down pressure p_{do}.
5. After the setting: screw on the protective cap **A** again.

Triggering setting in case of underpressure p_{du}

1. Remove the protective cap **A**.
2. Turn the internal adjusting screw **C** using a socket wrench **SW 17**.
3. Turning clockwise: increase (+) in the lower shut down pressure p_{do}.
4. Turning counter-clockwise: reduction (+) in the lower shut down pressure p_{do}.
5. After the setting: screw on the protective cap **A** again.

Attention: The setting for lower triggering affects the set value for upper triggering. Please set the vacuum triggering, first.



A mutual influence of the pressure regulator and the safety shutoff valve must be excluded.	
Calculation of the recommended set values according to the outlet pressure p_d of the regulator	• The SAV must lock as soon as it reaches the 1.1 times max. operating pressure according to the system specifications. • The set values of the SAV must be defined taking into account the set values and tolerances of the pressure regulator. • The tolerances and set values of additional safety devices must also be considered when setting of the SAV. • In case of a fault or regular shut-down of the downstream shutoff valve the SAV may not be actuated. The upper shut-down pressure must be determined accordingly.
$p_d \leq 100$ mbar $p_{do} = p_d + 50$ mbar	
100 mbar < $p_d \leq 200$ mbar $p_{do} > p_d + 100$ mbar	
$p_d > 200$ mbar $p_{do} > p_d$ **x** 1.5	

11.3 Calculation example of set values

Determination of the set values by means of a pressure graduation chart	
Selected regulator	**FRM 100025 MD / SAV MD**
Outlet pressure of the regulator p_d	**200 mbar**
System-specific operating pressure downstream of the regulator $p_{zul.}$	**500 mbar**
Limiting pressure in case of fault	**550 mbar**
Accuracy class	**AC 5**
Response pressure group of the upper shut down pressure SAV	**AG_o 10**
Response pressure group of the lower shut down pressure SAV	**AG_u 10**
Response group of the SBV	**AG 5**

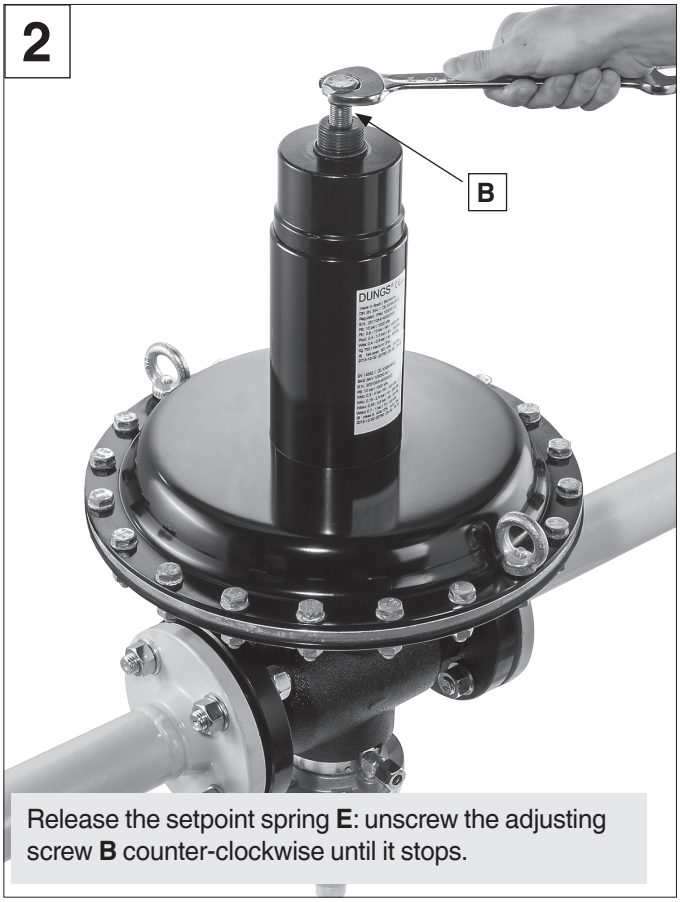
Result			
Device group	**Device data**	**Pressure graduation**	
Safety devices against excessive pressure	Limiting pressure in case of fault: 1.1 * $p_{perm.}$	550 mbar	
	AG_o 10		440 mbar
	SAV	p_{do} =	400 mbar
	AG_o 10		360 mbar
	AG 5		315 mbar
	SBV	p_d =	300 mbar
	AG 5		285 mbar
Gas pressure regulator	SG 20		240 mbar
	AC 5		210 mbar
	FRM	p_d =	200 mbar
	AC 5		190 mbar
Safety device against insufficient pressure	AG_u 20		60 mbar
	SAV	p_{du} =	50 mbar
	AG_u 20		40 mbar

11.4 Replacement of regulator springs

1

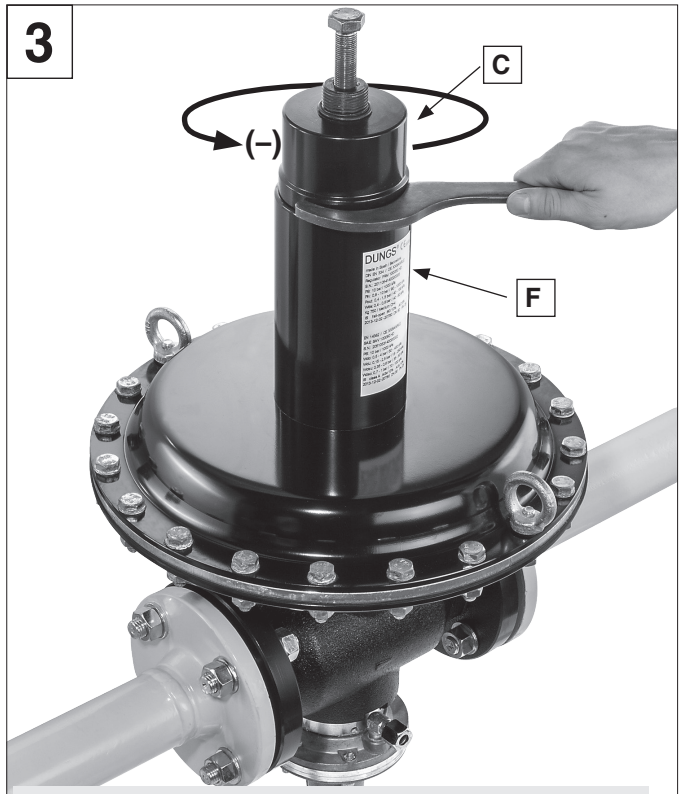
Remove the protective cap **A.**

2



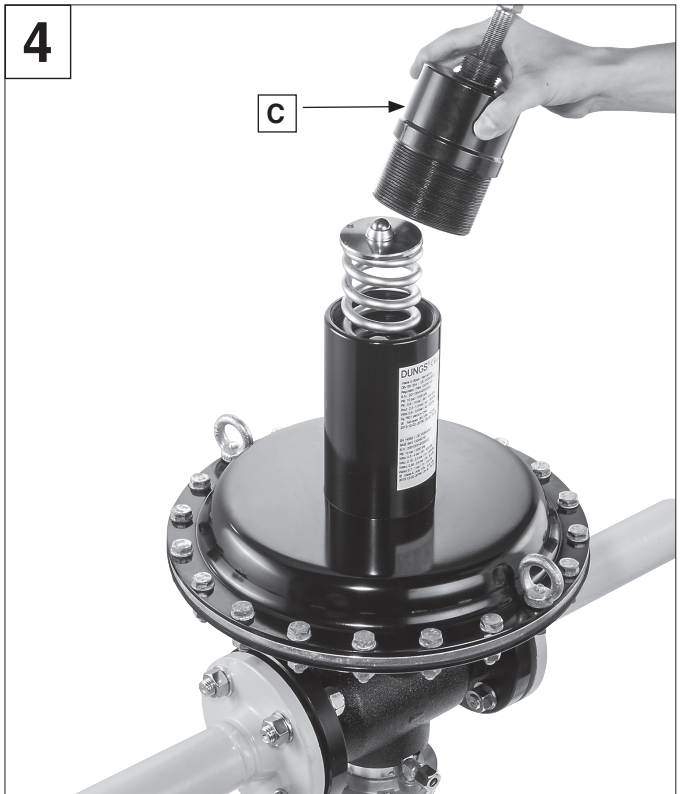
Release the setpoint spring **E**: unscrew the adjusting screw **B** counter-clockwise until it stops.

3



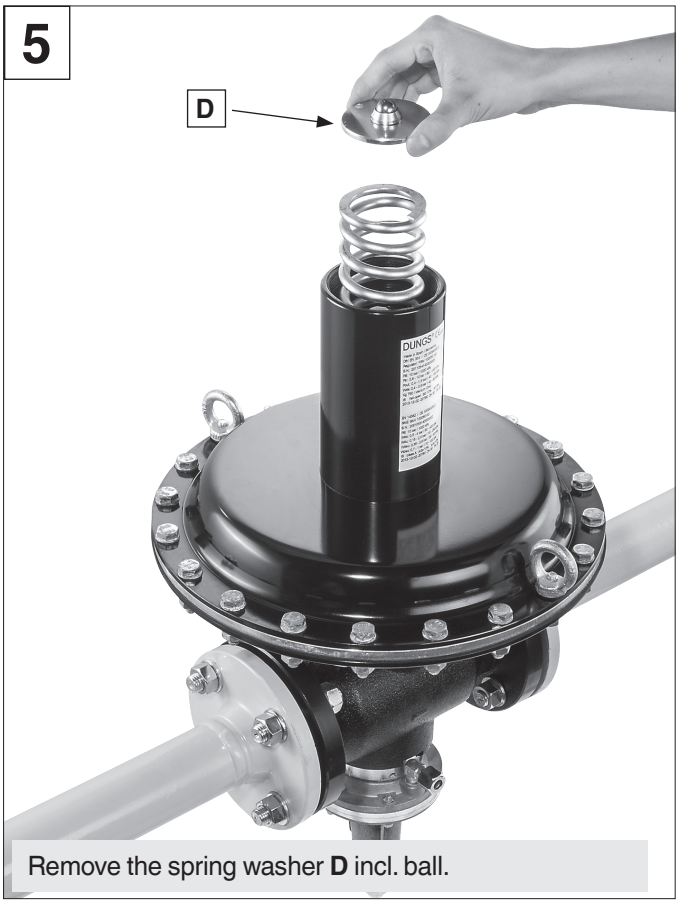
Unscrew the sealing cap **C** from the spring dome using a hinged hook wrench **90-155.**

4



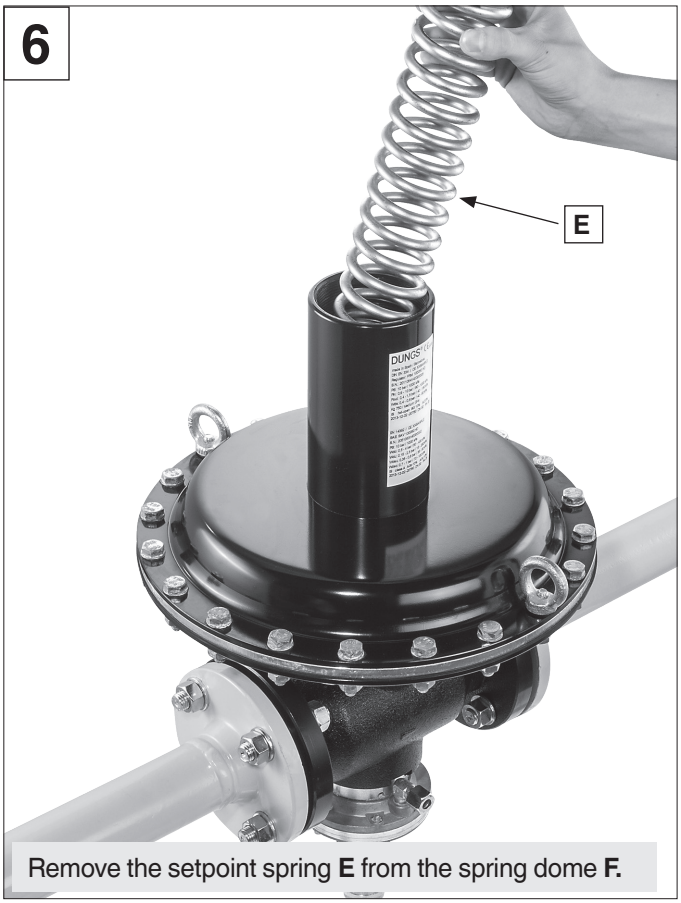
Remove the sealing cap **C**.

5



Remove the spring washer **D** incl. ball.

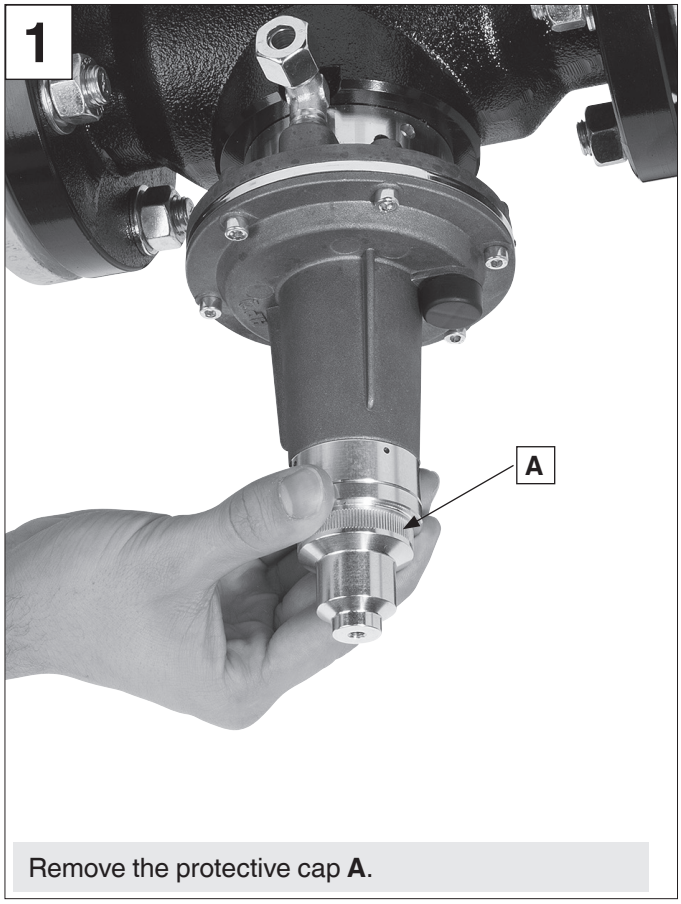
6



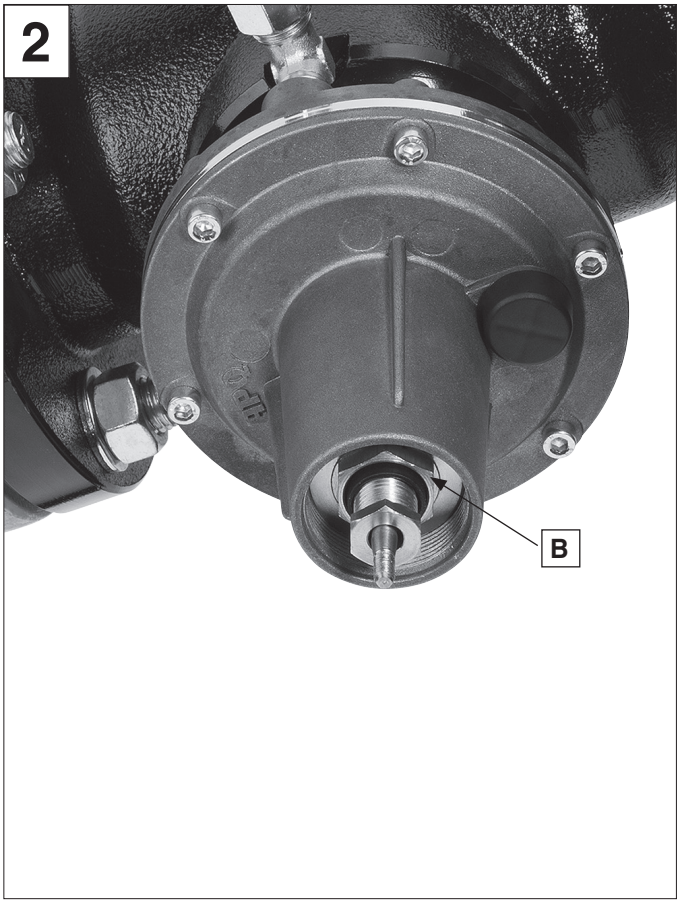
Remove the setpoint spring **E** from the spring dome **F.**

7. Insert a new spring with a suitable adjustment range
8. Reattach the spring washer **D** incl. ball on the spring.
9. Reinsert the sealing cap **C** in the spring dome **F**. Tighten the adjusting screw **B** until the required spring preload is reached. Reinsert the protective cap **A**.

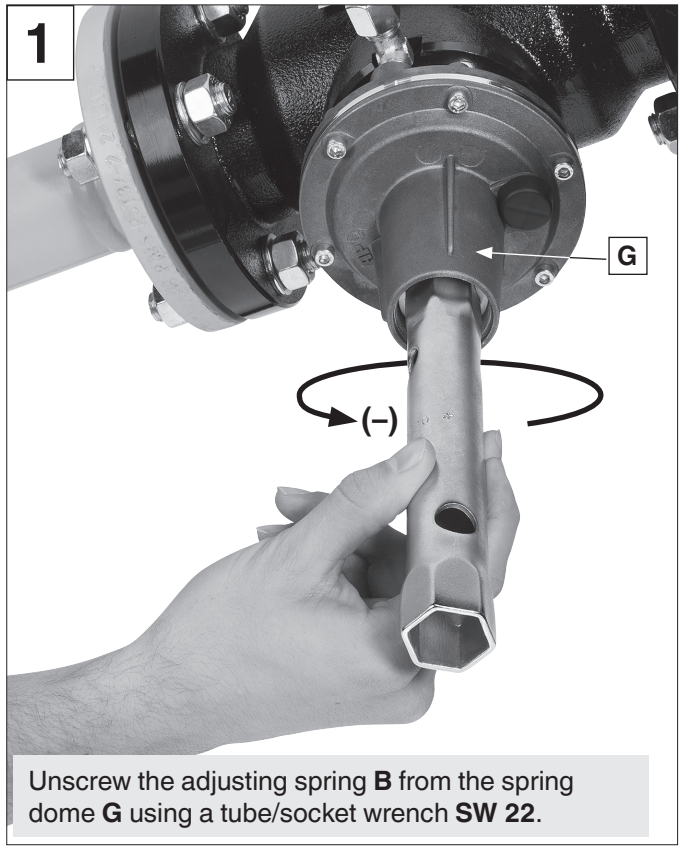
11.5 Replacement of SAV springs



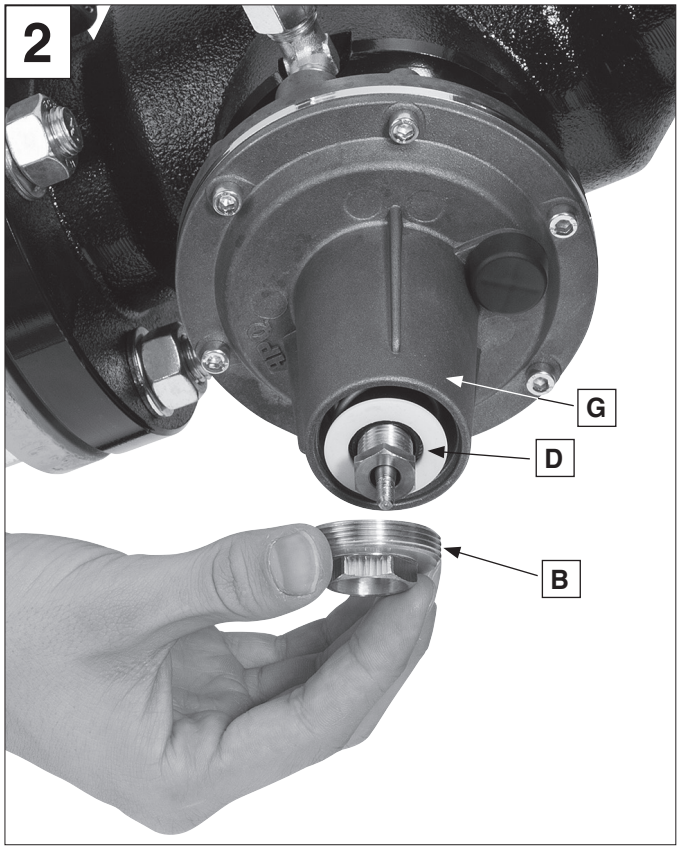
Remove the protective cap **A**.



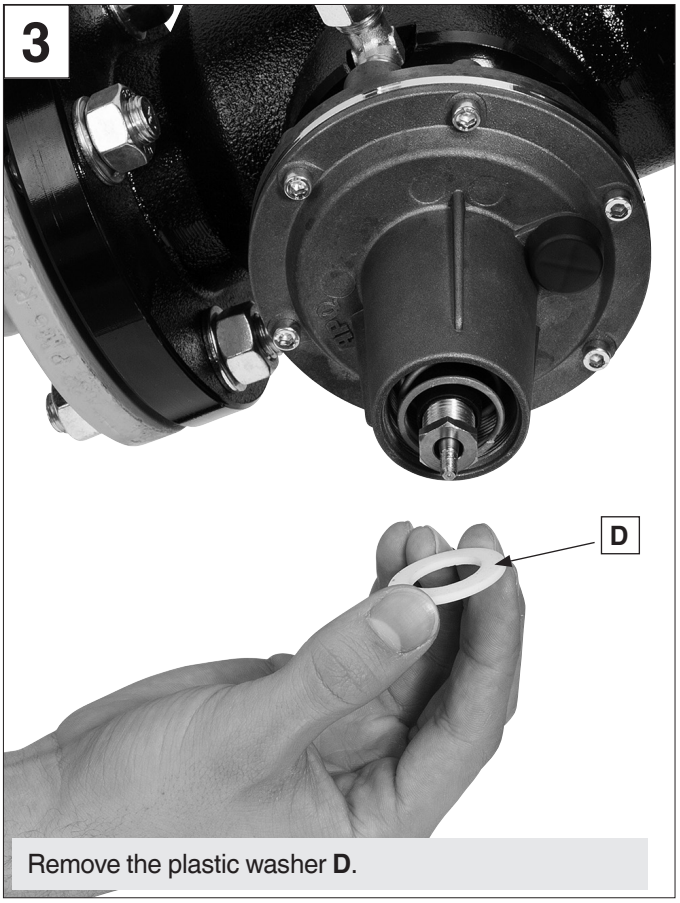
11.5.1 Spring replacement W_{dso}



Unscrew the adjusting spring **B** from the spring dome **G** using a tube/socket wrench **SW 22**.

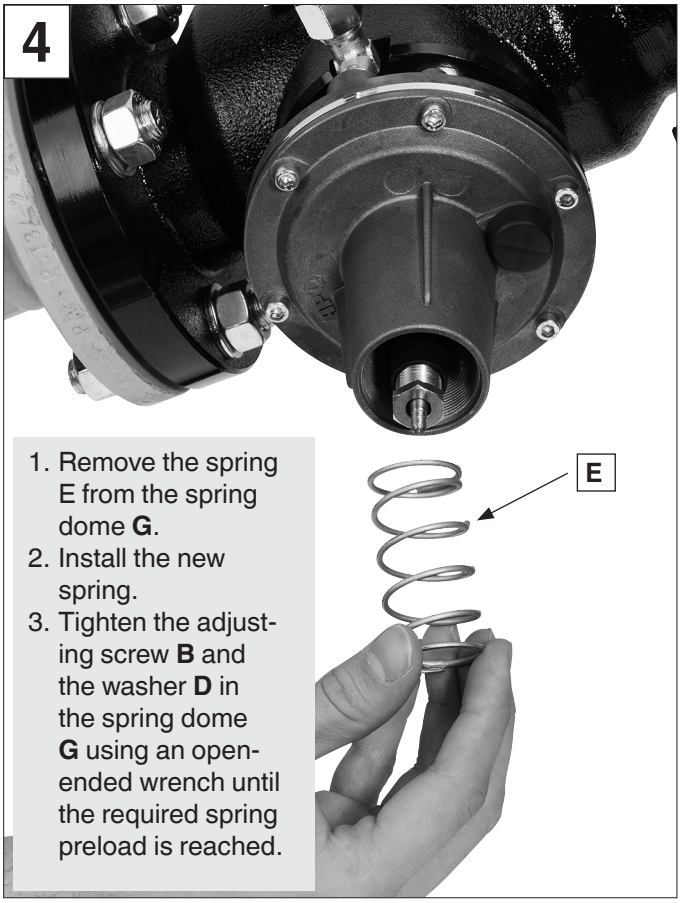


3



Remove the plastic washer **D**.

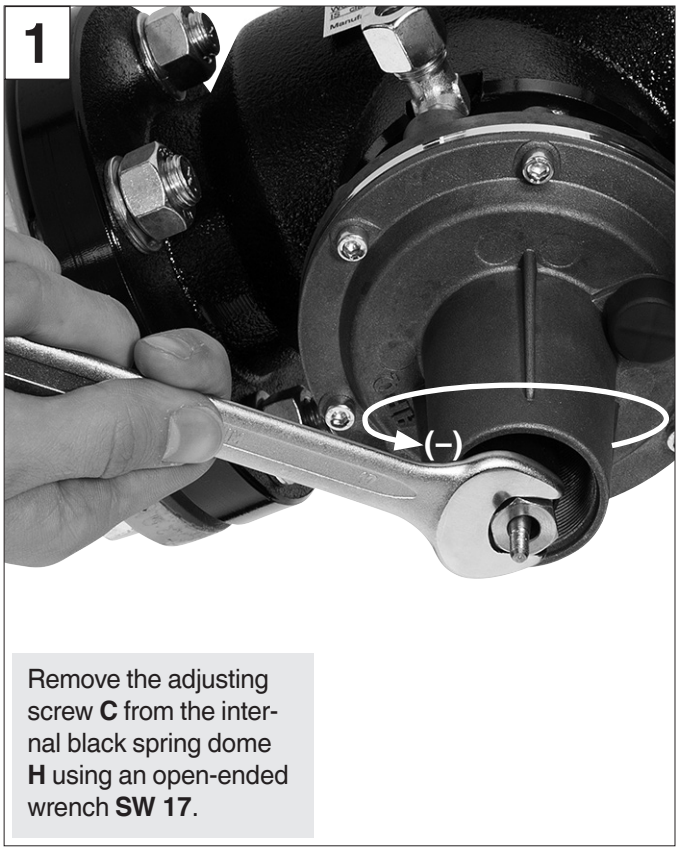
4



1. Remove the spring E from the spring dome **G**.
2. Install the new spring.
3. Tighten the adjusting screw **B** and the washer **D** in the spring dome **G** using an open-ended wrench until the required spring preload is reached.

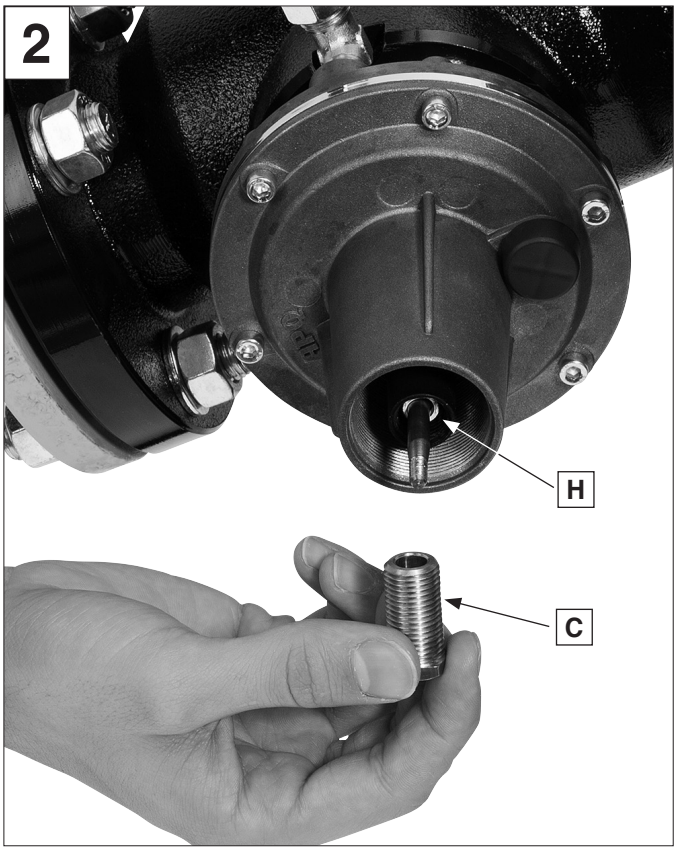
11.5.2 Spring replacement W_{dsu}

1

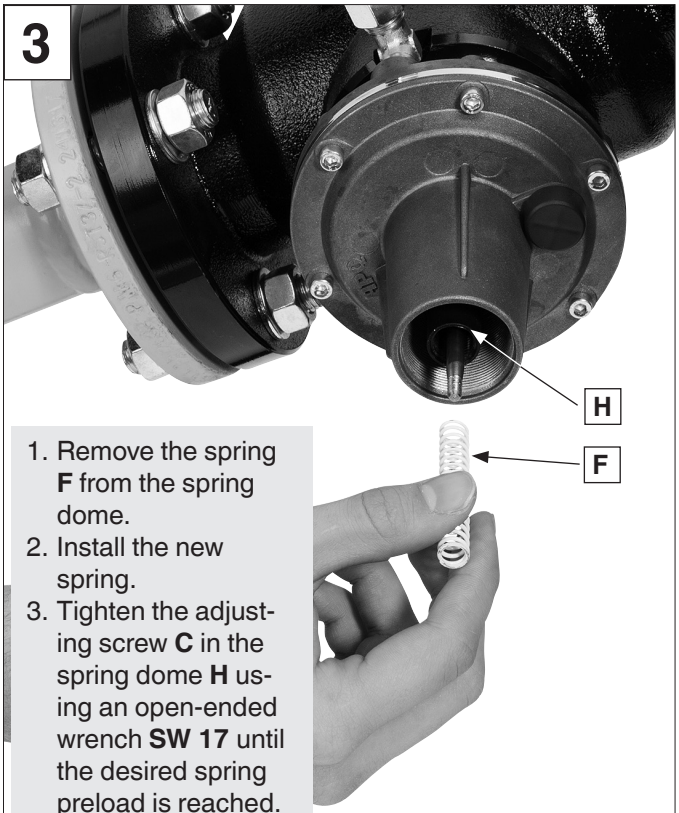


Remove the adjusting screw **C** from the internal black spring dome **H** using an open-ended wrench **SW 17**.

2

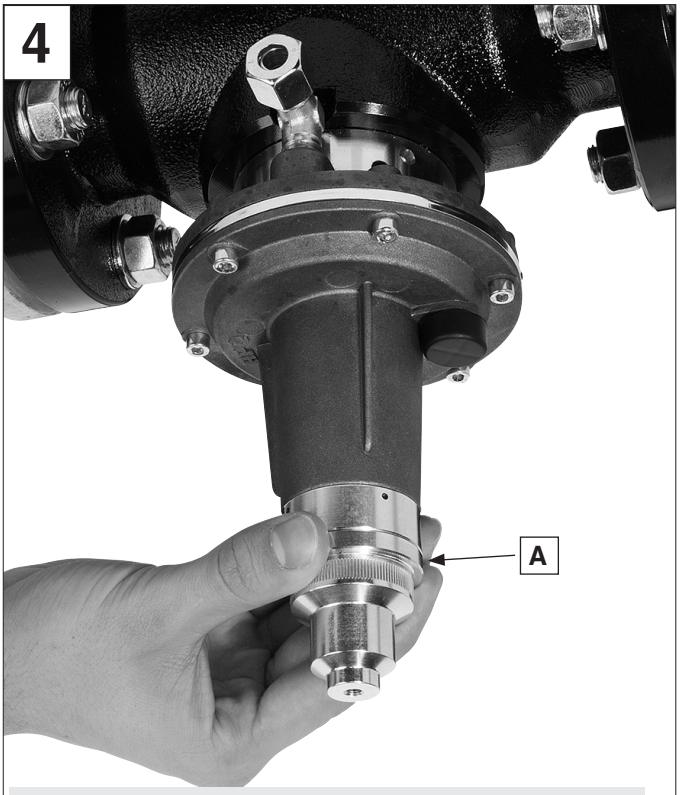


3



1. Remove the spring **F** from the spring dome.
2. Install the new spring.
3. Tighten the adjusting screw **C** in the spring dome **H** using an open-ended wrench **SW 17** until the desired spring preload is reached.

4



Screw on the protective cap **A** again.

12. Commissioning and decommissioning

12.1 General information

Prior to commissioning

- **The performance data on the type plate correspond to the ordering data.**
- **Prevent explosive gas-air mixture: the room atmosphere must constantly be monitored through gas concentration measuring devices for the detection of gas leakages.**
- **Only operate the device if all safety devices are fully functional.**
- **Only qualified personnel is allowed to carry out the commissioning.**

12.2 Leakage test

Before commissioning the device, a test for internal and external leakages must be carried out.

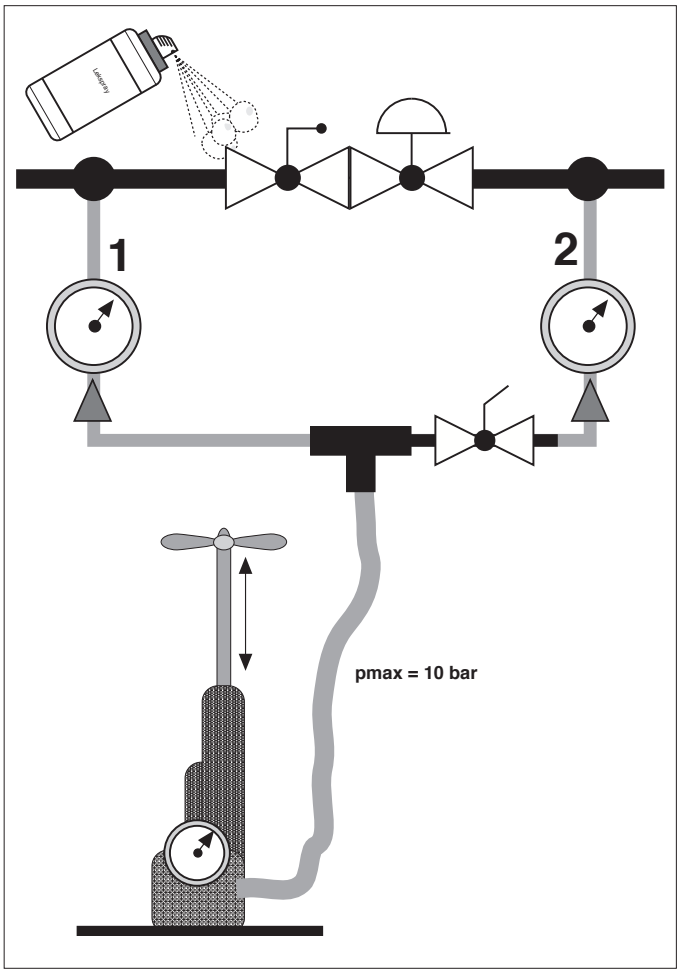
1. Test gases of the leakage test: air or inert gases.
2. Upstream and downstream shutoff valves must be closed.
3. Release the test section. Check the presence of gas and safely release it in the atmosphere.
4. Test pressure > blow-off pressure SBV: block the line upstream of the SBV.
5. Connect the test section to the test device and apply pressure.
6. Test pressure: 1.1 x system-specific operating pressure Maximum PS of the device. Different pressure ratings of the system must be taken into account.
7. Observe the waiting time necessary for the pressure compensation according to the system-specific volumes.

External leakage

8. Use a suitable leak detection spray on the device.
9. Monitor the foam formation.

Internal tightness

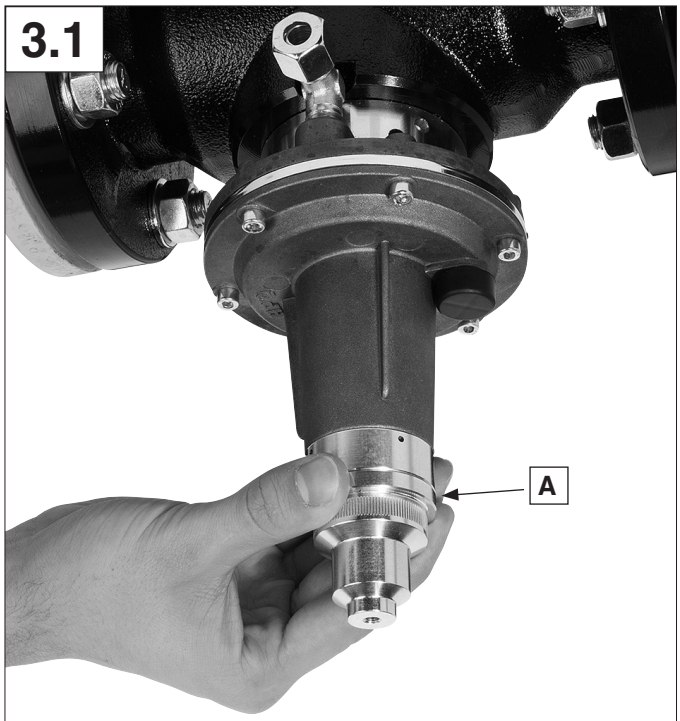
10. Release the pressure in the test section downstream of the device.
11. Monitor the increase in pressure on the outlet side: pressure gauge accuracy 0.1 mbar
12. Once the leakage test has been carried out, open the shutoff valve upstream of the SBV.
13. Release pressure in the test section.



12.3 Commissioning / unlocking/ control of the set values

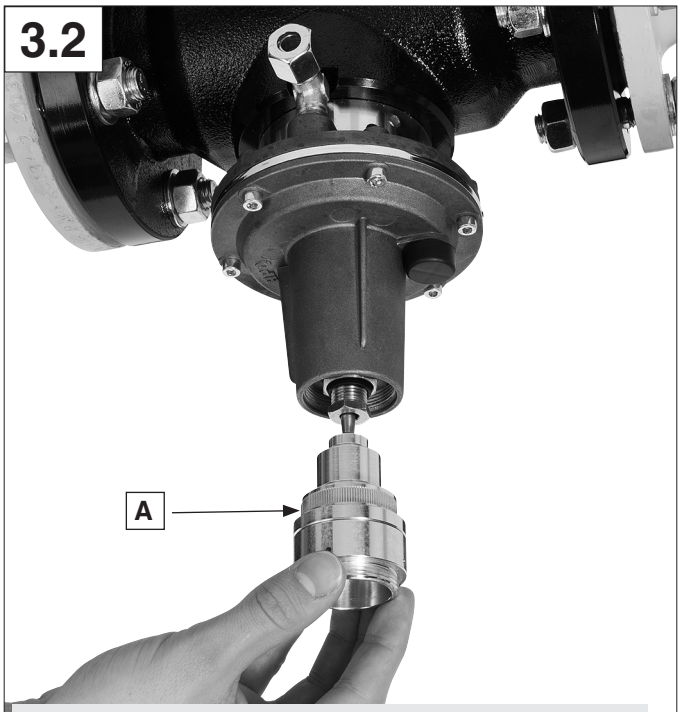
1. Slowly open the shutoff valve on the inlet side. The ball valve on the outlet side remains closed.
2. Monitor the pressure rise on the pressure gauge on the inlet side upstream of the device.
3. SAV unlocking:

3.1



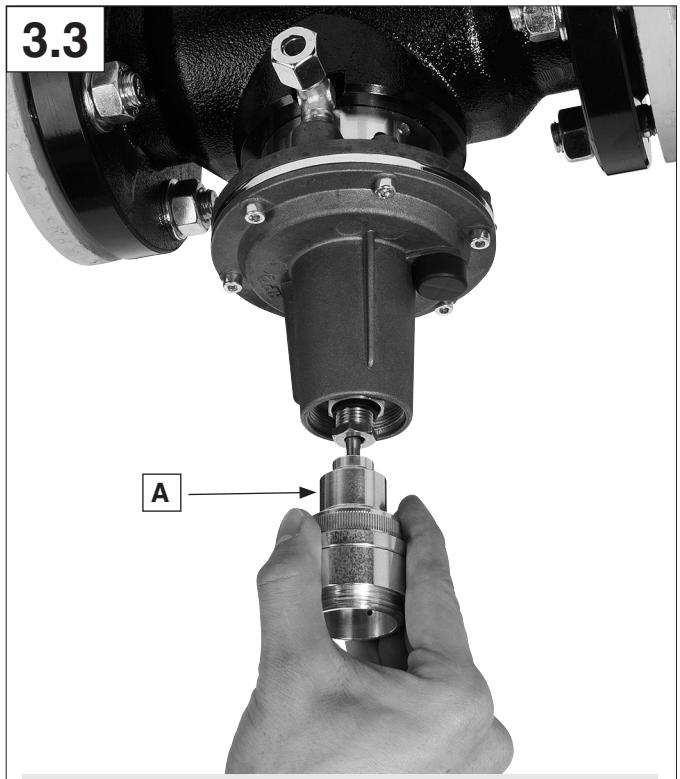
Unscrew the protective cap **A**.

3.2



Reverse the protective cap **A** and screw it again at the push rod of the SAV.

3.3



Use the protective cap **A** as a handle.

3.4 Compensate pressure by opening the compensation valve on the valve disc: Pull the protective cap **A** downwards by approx. 2 mm.
3.5 Monitor the pressure rise on the outlet side of the pressure gauge.
3.6 The operating pressure (closing pressure regulator) on the outlet side reached: pull the protective cap **A** to the stop and lock it.
3.7 SAV is open.
3.8 Unscrew the protective cap **A** from the push rod and screw it again on the spring dome **G.**

4.0 Venting

4.1 Vent the test section in the atmosphere by using a suitable hose. Do not use a test burner for venting.
4.2 The test section must be completely filled with gas: make sure that the test section is free from air by using a test burner. Close the stop-cock on the venting hose.

5.0 Check of the outlet pressure

5.1 Check the closing pressure of the regulator.
5.2 Open the vent valve and check the set value (outlet pressure) on the pressure gauge and, if necessary, correct it according to section 11.1
5.3 Close the vent valve, remove the hose, insert the sealing cap **A**.

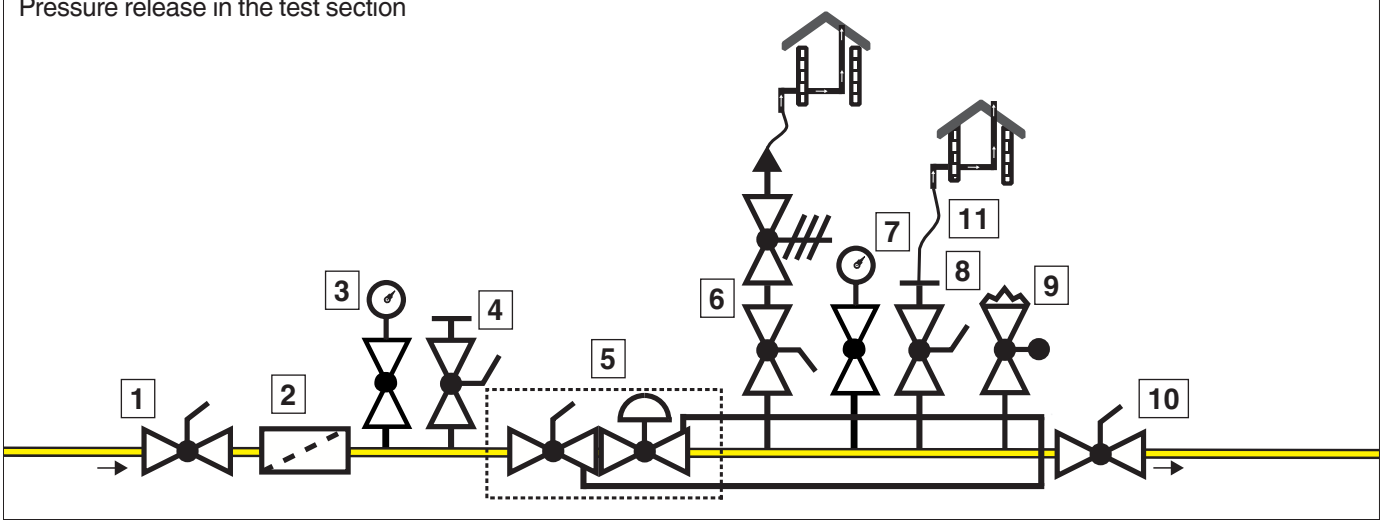
6.0 Check of the upper shut-down pressure p_{do}

6.1 SBV installation on the outlet side: block the line upstream of the SBV.
6.2 Check the upper trip pressure of the SAV: create wind load on the outlet side (reduction in pressure pulse)
6.3 Create a lockable connection between the inlet and outlet side.
6.4 Conduct the inlet pressure in the bypass on the outlet side through the long opening of the stop-cock.
6.5 Monitor the increase in pressure on the outlet side on the pressure gauge.
6.6 Avoid inadmissible high pressure on the outlet side stop applying pressure immediately after the SAV has tripped.
6.7 Read the upper response pressure on the pressure gauge on the outlet side and compare it with the nominal value.
6.8 The determined triggering pressure must be within the response tolerance (AG_o) of the nominal value.
6.9 If necessary, correct the response pressure according to the specifications in section 11.2 and check it again.

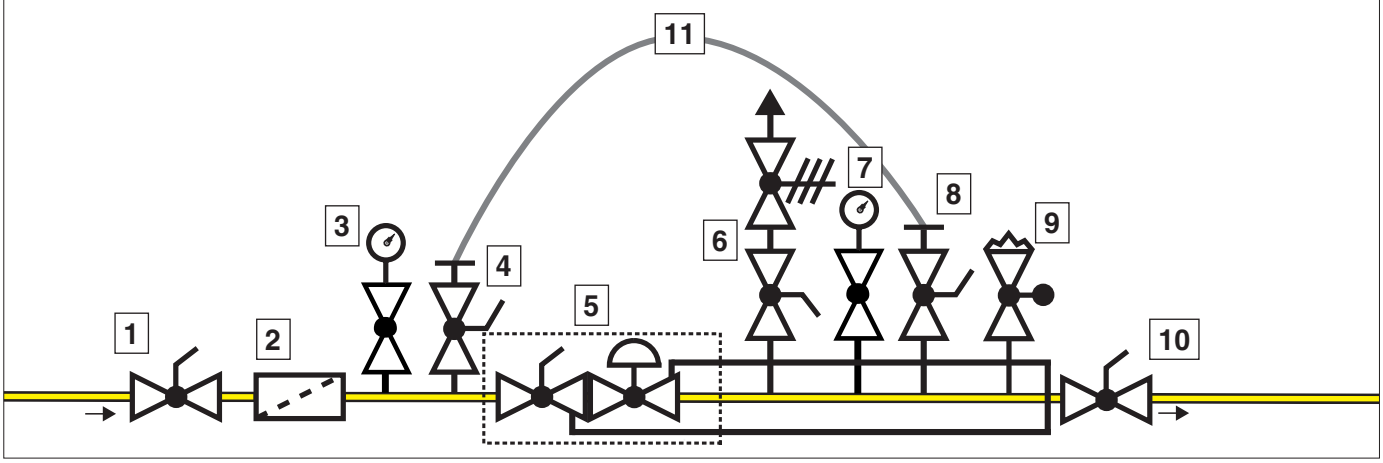
7.0 Check of the lower shut down pressure p_{du}

7.1 Release the pressure in the test section on the outlet side until the operating pressure is reached.
7.2 Check if gas is available and release it safely in the atmosphere.
7.3 Monitor pressure drop on the pressure gauge.
7.4 Unlock SAV.
7.5 Close the shut-off fitting on the input side.
7.6 Create the wind load: continue to safely release the gas in the line on the outlet side into the atmosphere.
7.7 After trip the SAV: 6.7 Read the lower response pressure on the pressure gauge on the outlet side and compare it with the nominal value.
7.8 The determined trip pressure must be within the response tolerance (AG_u) of the nominal value.
7.9 Close the vent valve, remove the hose, insert the sealing cap.
7.10 Slowly open the shut-off valve on the inlet side.

Pressure release in the test section



Creation of wind load



Pos.	Designation
1	Shut-off valve, inlet side
2	Filter
3	Pressure gauge with pushbutton
4	Venting ball valve
5	Regulator with integrated SAV
6	SBV with shutoff valve

Pos.	Designation
7	Pressure gauge with pushbutton
8	Venting ball valve
9	Test burner
10	Shut-off valve, outlet side
11	Hose

12.4 Recommissioning

1. Close the shutoff valve upstream of the bypass.
2. Remove the hose.
3. Open the ball valve upstream of SBV.
4. Slowly open SAV, see section 11.3.
5. Once SAV has been opened completely, open the shutoff valve on the outlet side.

12.5 Decommissioning

1. Slowly close the shutoff valve on the outlet side.
2. Slowly close the shutoff valve on the inlet side.
3. Check if gas is available in the test section and release it safely into the atmosphere.

13. Faults and related causes

- **Repair work must only be performed by authorized and skilled personnel.**
- **Only use original spare parts.**

Fault on SAV	Possible causes	Troubleshooting
It is not possible to open/ activate the SAV.	The pulse line is not installed.	Install the pulse line.
	The pulse line is clogged.	Clean the pulse line.
	The pulse line is leaky.	Seal the pulse line.
	The pulse line is broken.	Replace the pulse line.
	The pulse pressure is outside the adjustment range.	Set the shut-down pressure of the SAV or the outlet pressure.
	The adjusting springs are not suitable for the application.	Replace the adjusting springs.
	The adjustment range of the SAV is outside the outlet pressure.	Replace the SAV or the ASE.
The SAV cannot be activated.	The pulse line is not installed.	Connect/install the pulse line.
	The pulse line is clogged.	Clean the pulse line.
	The pulse line is leaky.	Seal the pulse line.
	The pulse line is broken.	Replace the pulse line.
	The pulse pressure is outside the adjustment range.	Set the shut-down pressure of the SAV.
	The adjusting springs are not suitable for the application.	Replace the adjusting springs.
The SAV can be activated, but not sealed.	The valve disc is damaged or worn out.	Replace the ASE or have it repaired by DUNGS.
	The valve seat is damaged.	Replace the valve seat.
	The movable parts are contaminated with foreign particles.	Clean the movable parts or replace the ASE.
	The drive is damaged.	Replace the ASE.
	The O-ring is damaged.	Replace the O-ring or the ASE.
The SAV is leaking towards the atmosphere.	The working diaphragm is damaged.	Change the working diaphragm or replace the ASE.
	The sealing ring between the ASE and the housing of the SAV is damaged.	Replace the sealing ring or the ASE.
	The O-ring in the ASE is damaged.	Replace the O-ring or the ASE.

Fault on the regulator	Possible causes	Troubleshooting
There is no gas.	The regulator contains no gas.	Check the gas installation upstream of the regulator.
	The SAV is closed.	Unlock the SAV.
The regulator provides a wrong outlet pressure.	The false setpoint spring is installed in the regulator.	Replace the setpoint spring.
	The required outlet pressure is outside the possible range.	Change the model of the regulator.
	The inlet pressure is not sufficient.	Check the gas installation or dismount the regulator again.
With no flow volume the outlet pressure corresponds to the inlet pressure.	The pulse line is not installed.	Close the pulse line.
	The pulse line is blocked.	Check the pulse line.
	The pulse line is leaky.	Seal the pulse line.
	The control plate is damaged.	Replace the control plate.
	The control plate seat is damaged.	Replace the control plate seat.
	The working diaphragm is damaged.	Replace the working diaphragm.
	The admission pressure compensation diaphragm is damaged.	Replace the admission pressure compensation diaphragm.
	The lever system is damaged.	Replace the lever system.
	The O-rings in the regulator are damaged.	Replace the O-rings of the regulator.
	The O-rings of the SAV are damaged.	Replace the O-rings of the SAV.
During operation the outlet pressure corresponds to the inlet pressure.	The pulse line is not installed.	Close the pulse line.
	The pulse line is blocked.	Check the pulse line.
	The pulse line is leaky.	Seal the pulse line.
	The working diaphragm is damaged.	Replace the working diaphragm.
	The admission pressure compensation diaphragm is damaged.	Replace the admission pressure compensation diaphragm.
	The lever system is damaged.	Replace the lever system.
The outlet pressure drops if the flow rate of the outlet pressure is increased.	The desired volume flow exceeds the capacity of the regulator.	Start the regulator again and replace it.
	False dimensions of the gas installation.	Increase the nominal values of the pipeline.
	The gas filter upstream of the regulator is soiled.	Clean the gas filter, replace the filter mat.
	The lever system is damaged.	Replace the lever system.
	The pulse line is blocked.	Check the pulse line.
	The SAV is damaged.	Check the SAV.
Gas escapes at the vent connection.	The working diaphragm is damaged.	Replace the working diaphragm.
	The compensation unit is damaged.	Replace the control plate.
	The O-rings of the compensation axis are leaky.	Replace the lever system.

14. Maintenance

14.1 General information

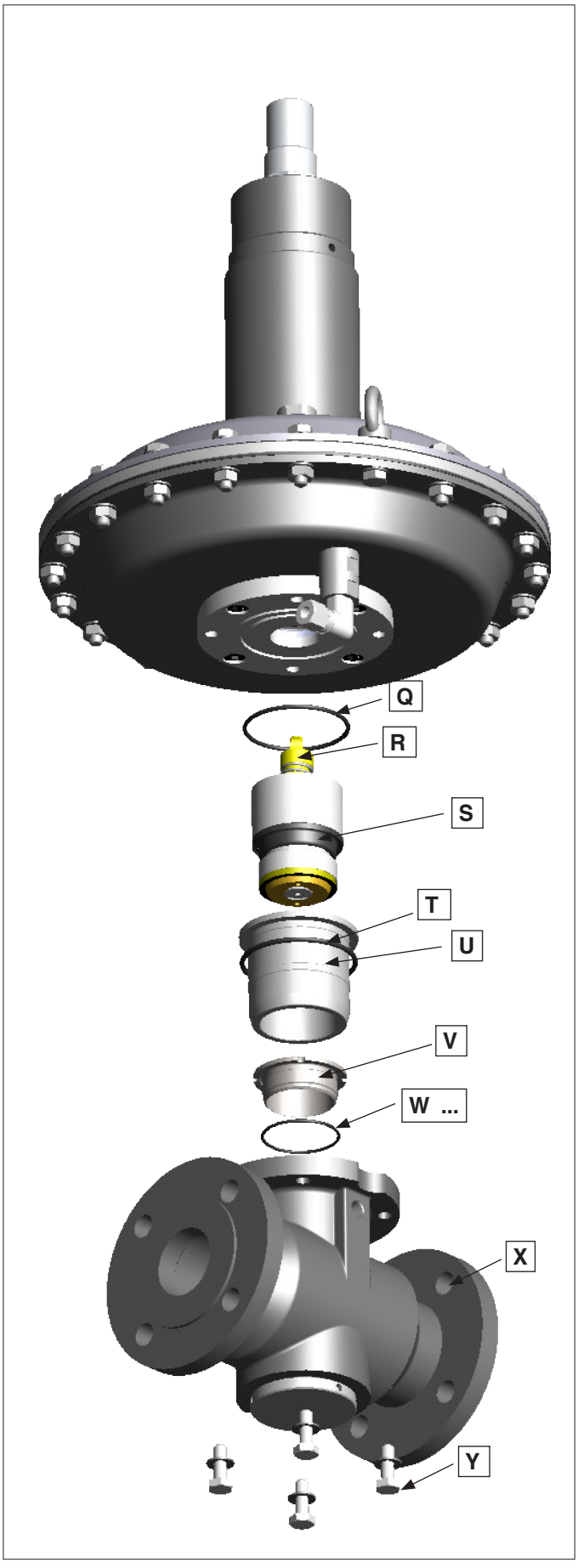
• The Pressure Equipment Directive (PED) requires the regulator to be checked at regular intervals to ensure: safety and correct functioning of the device, high long-term utilisation ratios, resulting in minimum environmental impact.

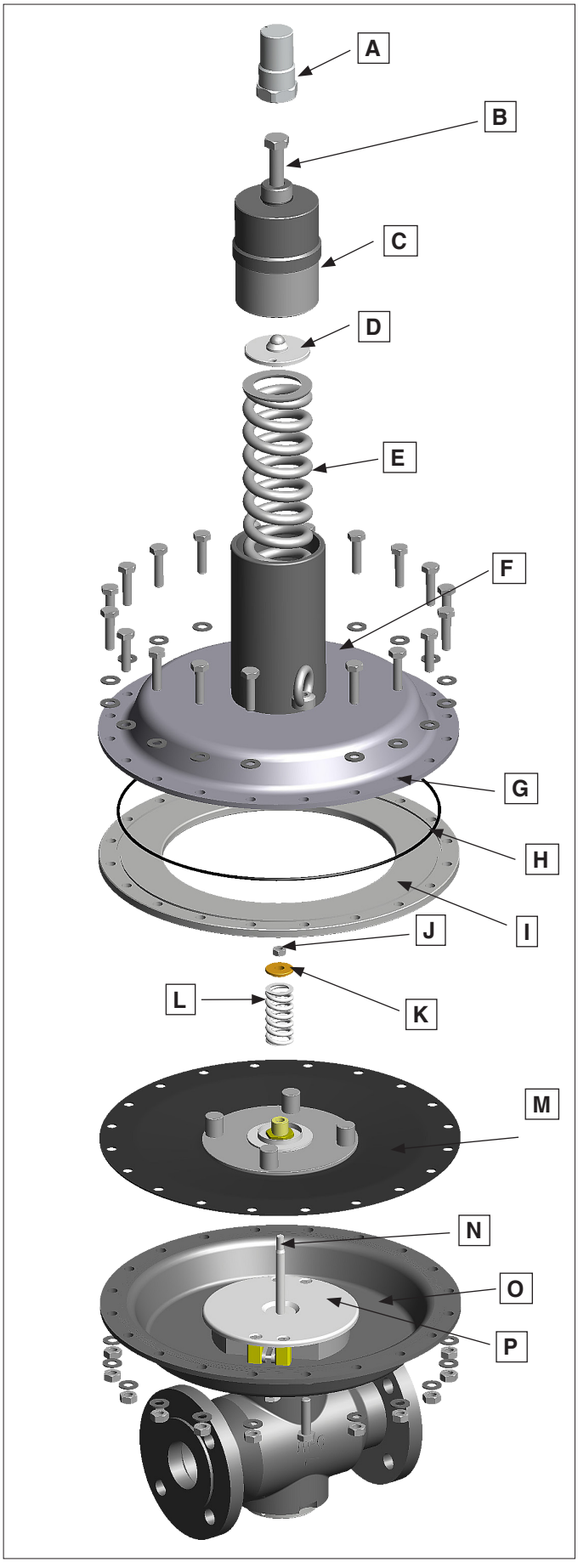
- **The maintenance of the device can only be carried out in compliance with the rules and standards applicable and in accordance with current local regulations.**
- **Maintenance work must only be performed by authorised and skilled personnel.**
- **Adhere to the maintenance intervals indicated.**
- **The risks in case of an escape of flammable or noxious gases into the atmosphere have to be assessed.**
- **Always install new seals after replacement or modification of parts.**
- **Only use original spare parts.**
- **Do not use alcohol-based or solvent-containing cleaning solutions for cleaning the device.**

Prior to maintenance

- Shut-off valves both on the inlet and outlet side are closed.
- Lines are unstressed and free from combustible gas.
- Prevent explosive gas-air mixture: the room atmosphere must constantly be monitored through gas concentration measuring devices for the detection of gas leakages.
- SAV is in the closing position.
- Original spare parts are available.

Pos.	Designation
A	Protective cap
B	Adjusting screw
C	Sealing cap
D	Spring washer with ball
E	Setpoint spring
F	Diaphragm hood
G	Hexagon screws + nut washer
H	O-ring (HD version only)
I	Reducing washer (HD version only)
J	Locking nut
K	Spring washer
L	Locking spring
M	Working diaphragm
N	Guide rod
O	Lower diaphragm shell
P	Lower diaphragm disc
Q	Sealing ring
R	Connection pin
S	Control plate
T	O-ring
U	Control plate sleeve
V	Valve disc seat
W ...	O-ring
X	Housing
Y	Hexagon screws + washer

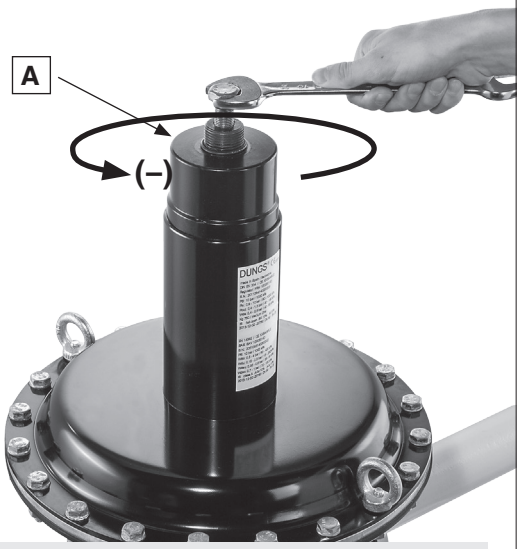

Q
R
S
T
U
V
W ...
X
Y


A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P

14.2 Maintenance instructions of the regulator

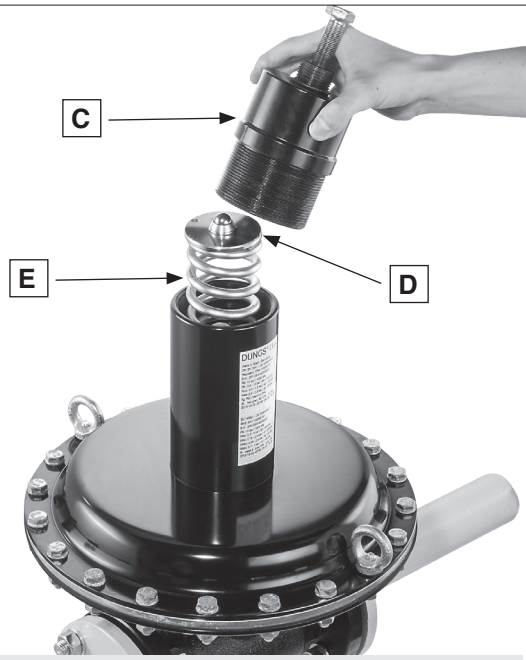
14.2.1 Preparation

1



1. Loosen the pulse imline and the vent line and remove them.
2. Remove the protective cap **A**.
3. Completely release the setpoint spring at the adjusting screw **B** using an open-ended wrench **SW 24**.

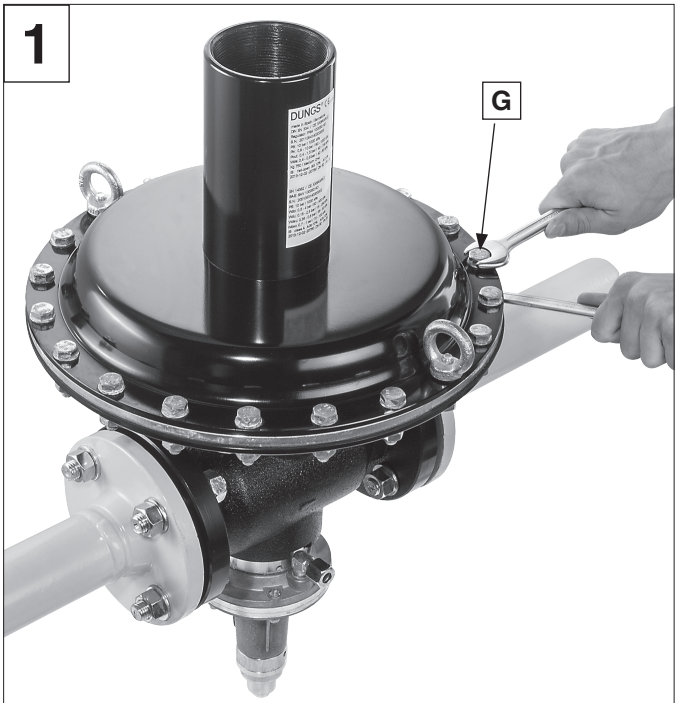
2



4. Unscrew the sealing cap **C** from the spring dome using a jointed hook wrench **90-155**.
5. Remove the spring washer **D** incl. ball and the setpoint spring **E**.

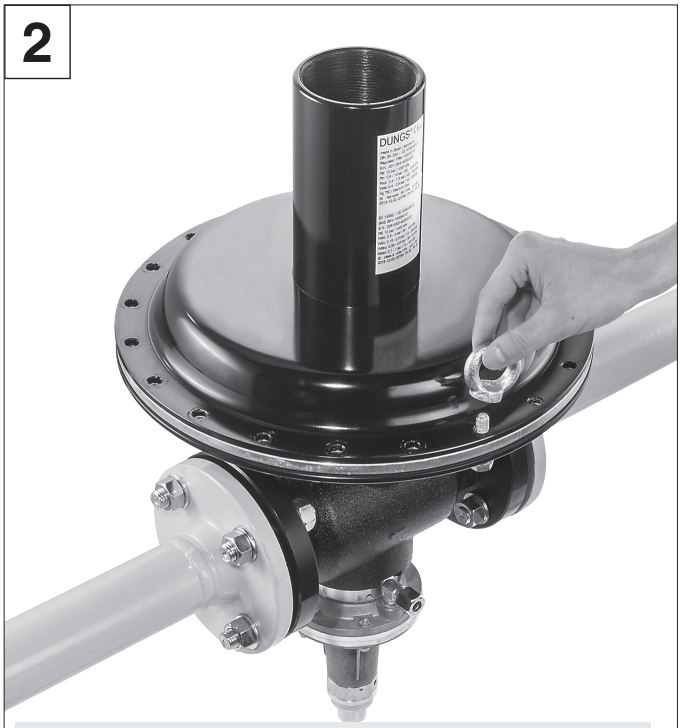
14.2.2 Replacement of the working diaphragm

1



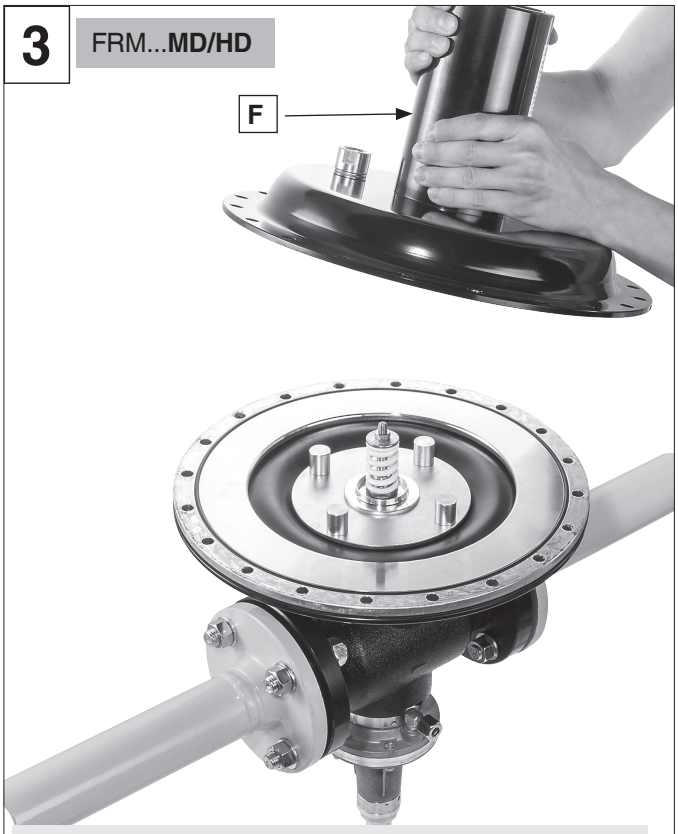
Loosen the screws **G** (M10) using an open-ended wrench **SW 17**.

2



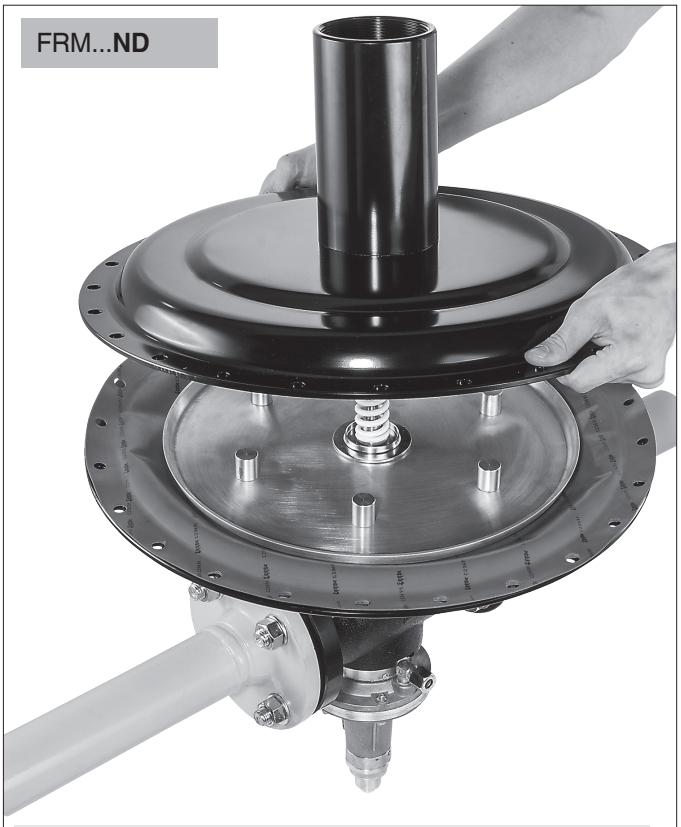
Loosen the loops using an open-ended wrench **SW 17**.

3 FRM...**MD/HD**



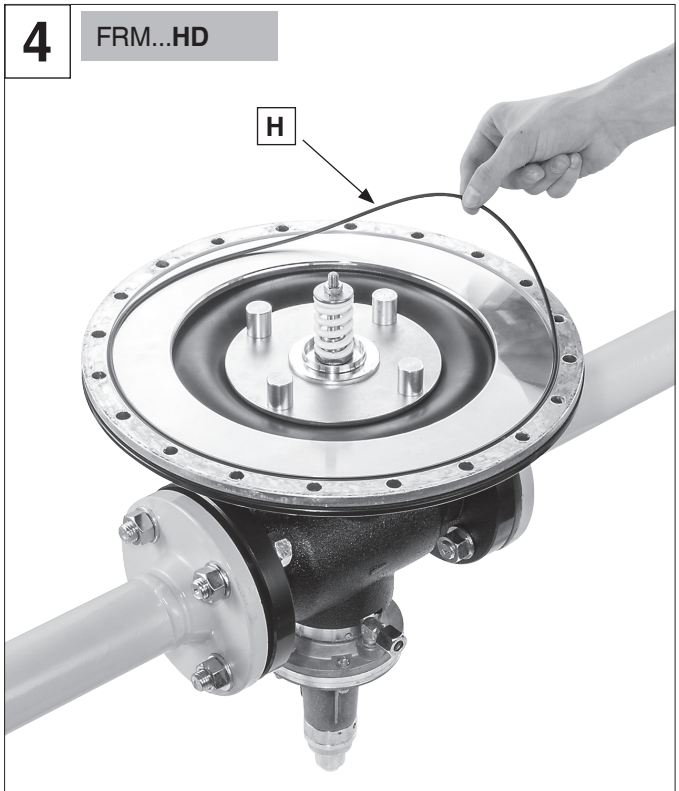
Remove the upper diaphragm shell **F.**

FRM...**ND**



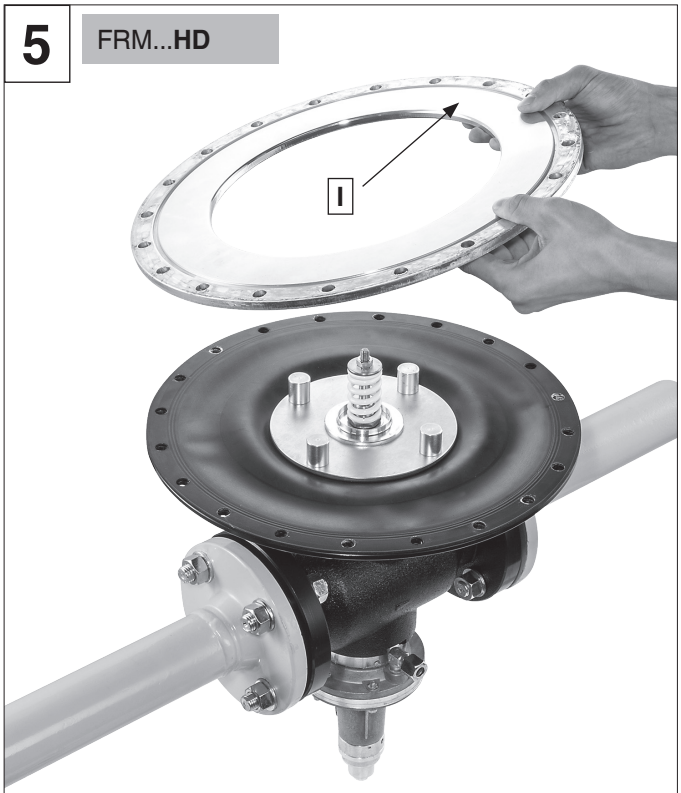
Remove the upper diaphragm shell **F**.

4 FRM...**HD**



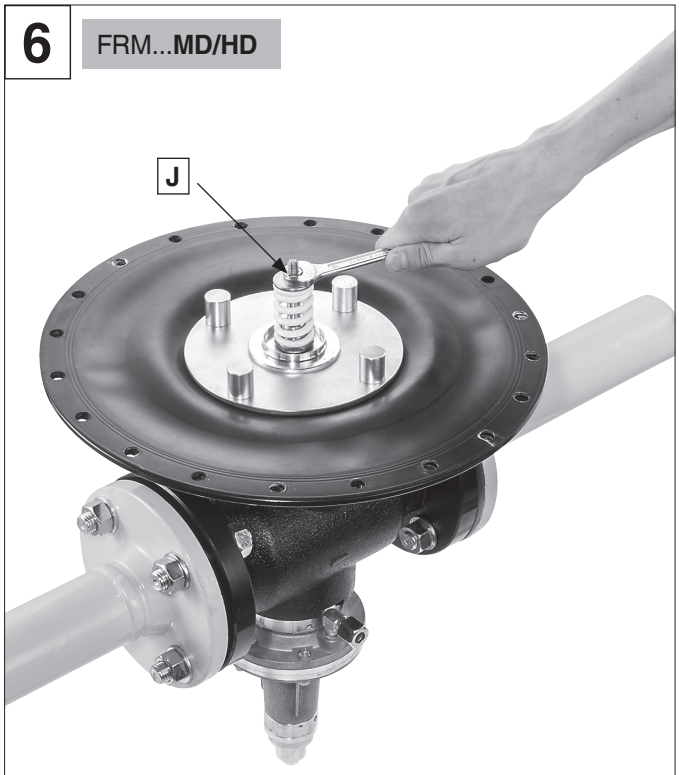
Remove the O-ring **H** (HD version only).

5 FRM...**HD**



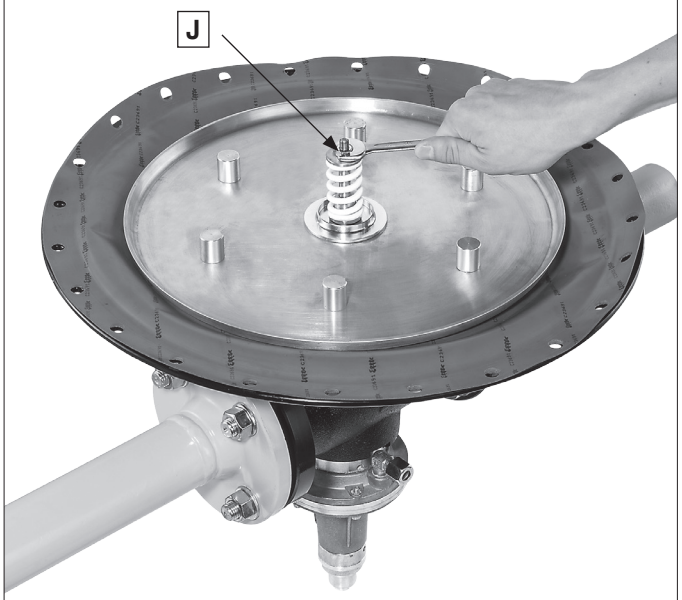
Remove the reducing washer **I** (HD version only).

6 FRM...**MD/HD**



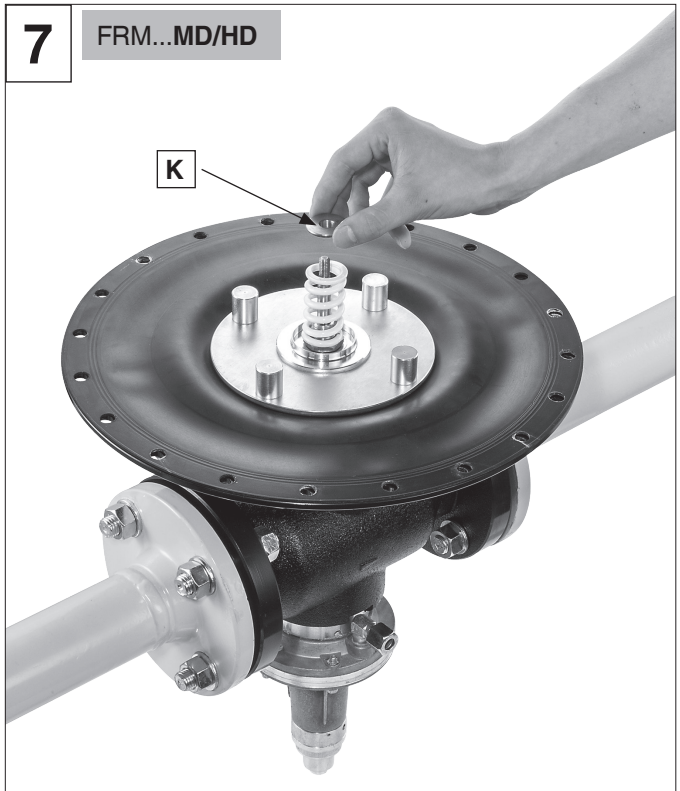
Loosen the nut **J** (M 8) using an open-ended wrench **SW 13**.

FRM...**ND**



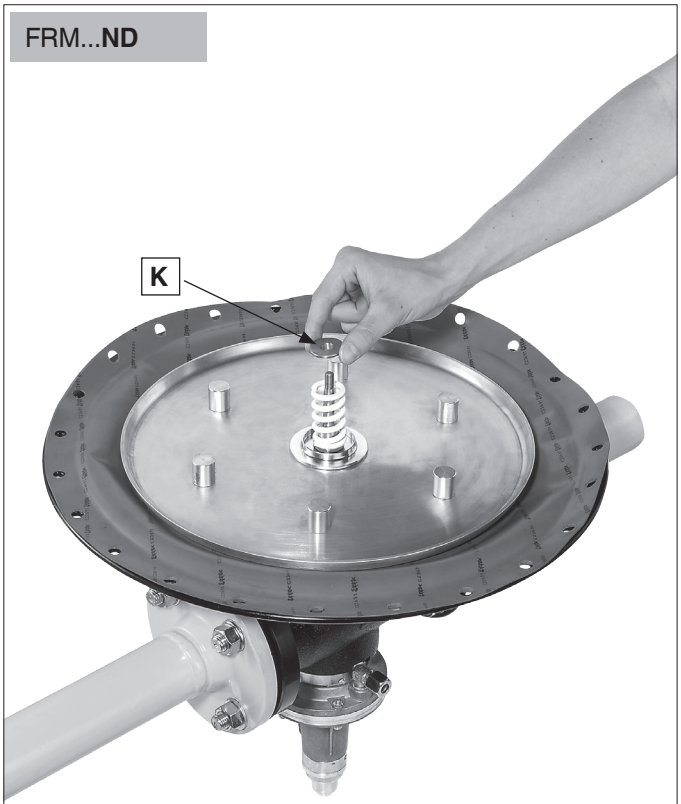
Loosen the nut **J** (M 8) using an open-ended wrench **SW 13**.

7 FRM...**MD/HD**



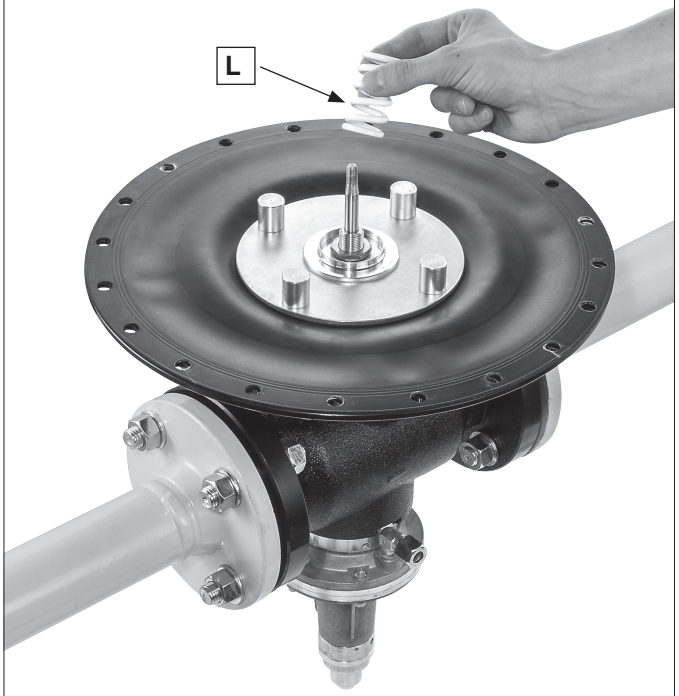
Remove the spring washer **K**.

FRM...**ND**



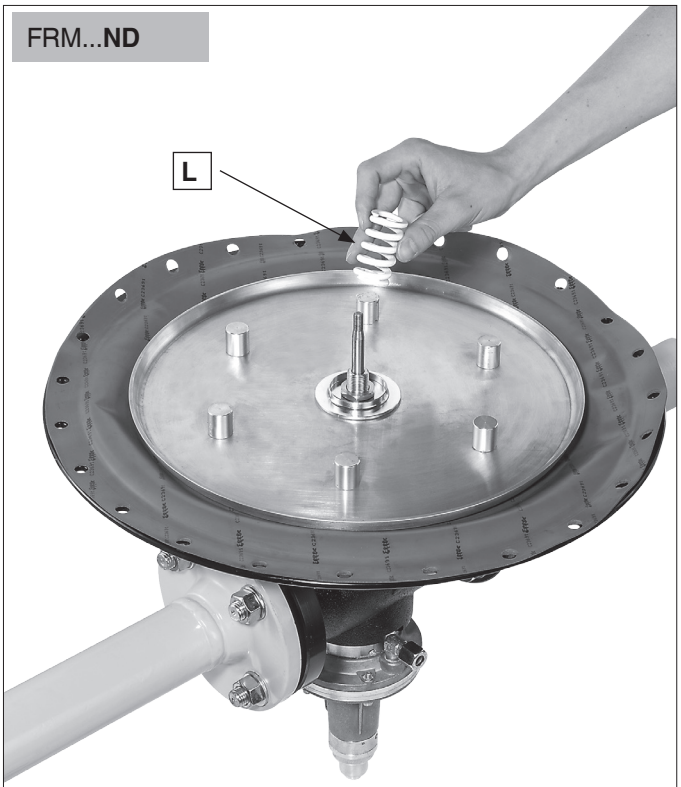
Remove the spring washer **K.**

8 FRM...**MD/HD**



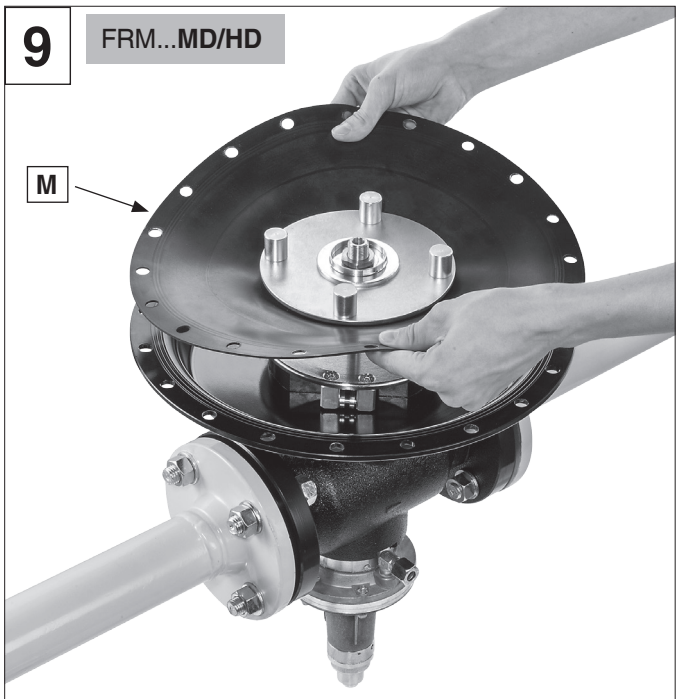
Remove the safety spring **L.**

FRM...**ND**



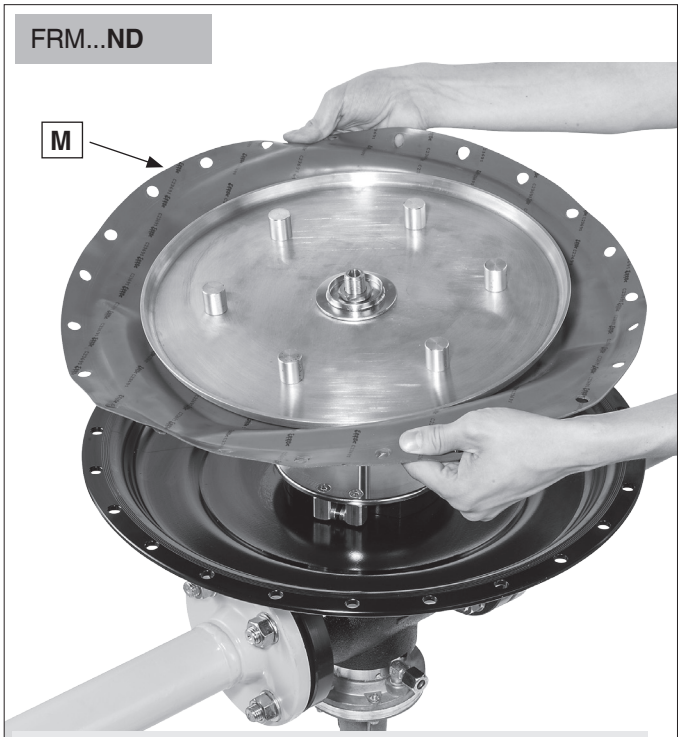
Remove the safety spring **L.**

9 FRM...**MD/HD**



Remove the working diaphram **M** from the guide rod **N** and check for signs of damage or wear. If necessary, reassemble a new working diaphragm **M** (maintenance kit 2).

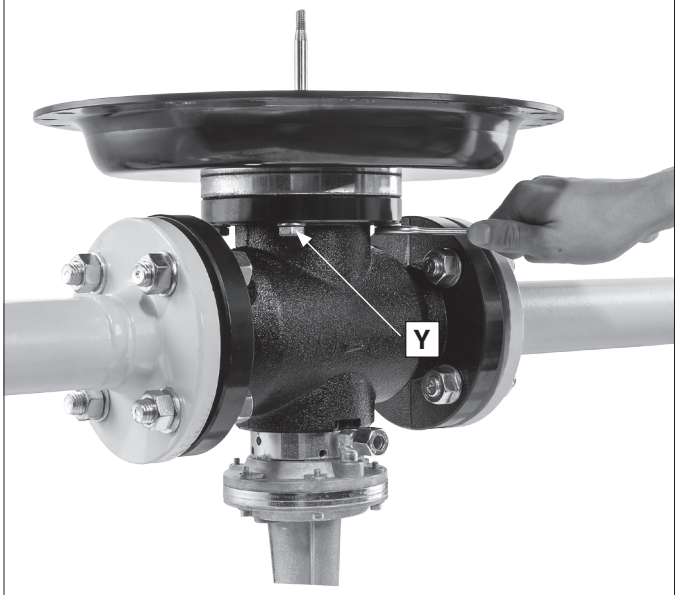
FRM...**ND**



Remove the working diaphram **M** from the guide rod **N** and check for signs of damage or wear. If necessary, reassemble a new working diaphragm **M** (maintenance kit 2).

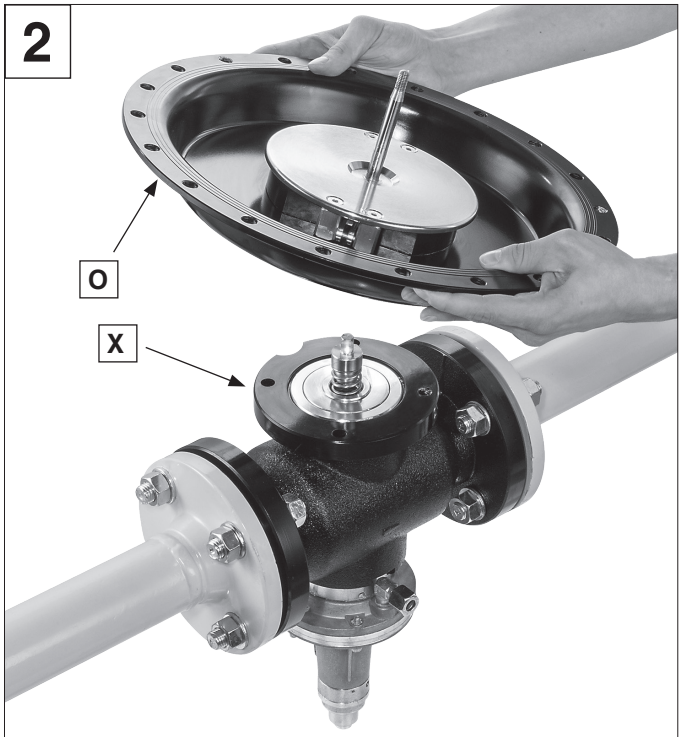
14.2.3 Replacement of the control plate / valve seat

1



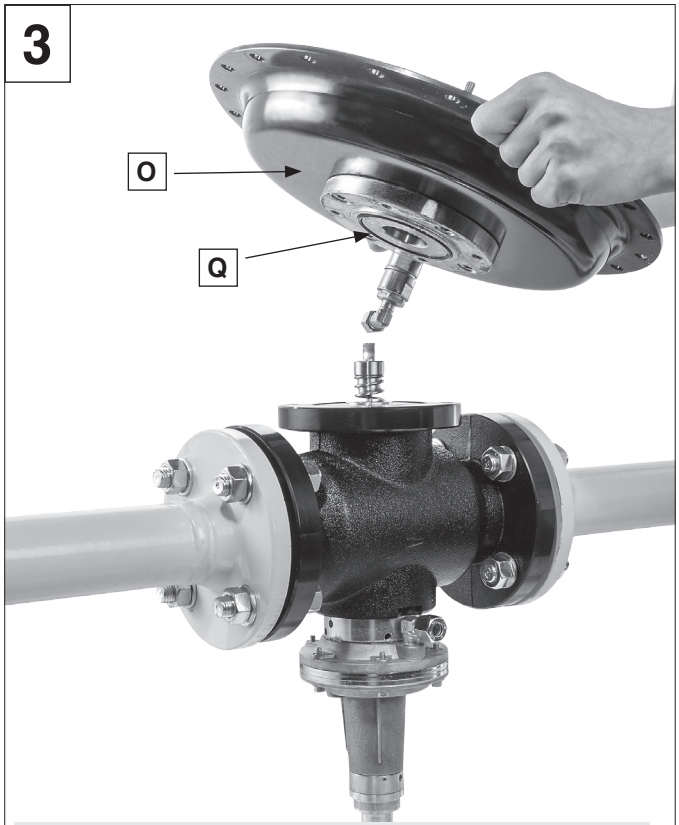
4 Loosen the screws **Y.**

2



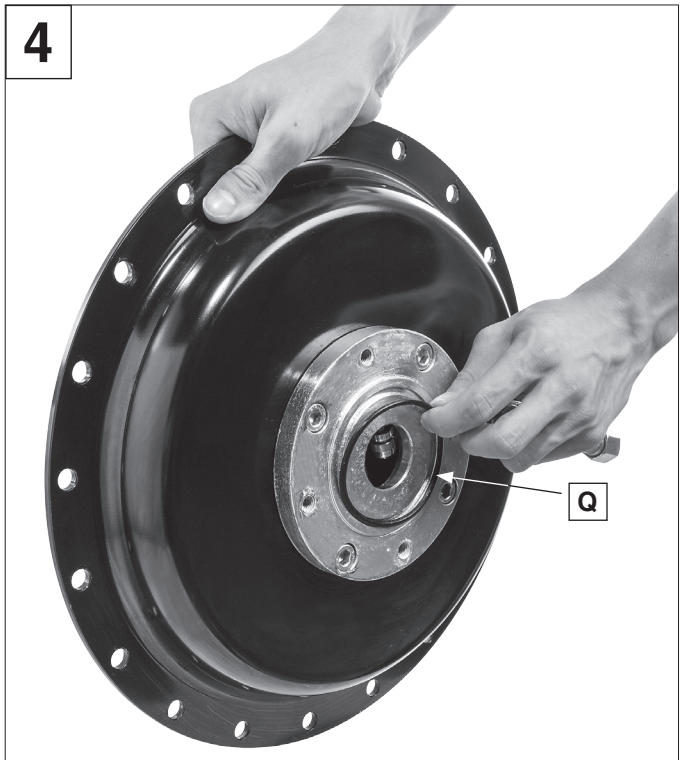
Remove the lower diaphragm shell **O** from the housing **X**. To do this, the diaphragm shell **O** has to be turned cautiously.

3

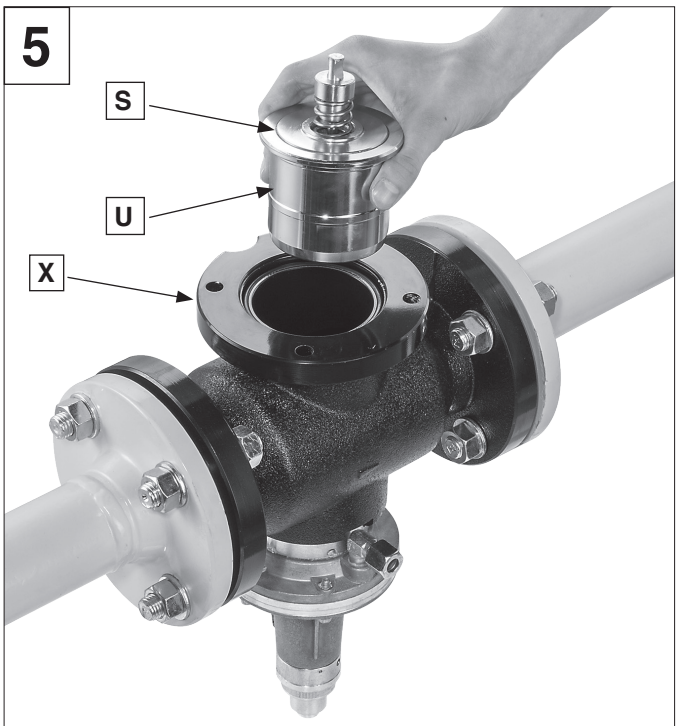


Remove the O-ring **Q** from the lower diaphragm shell **O**.

4

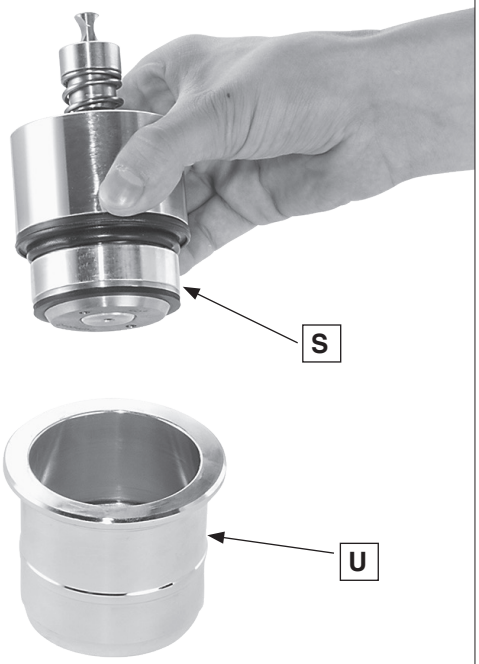


5



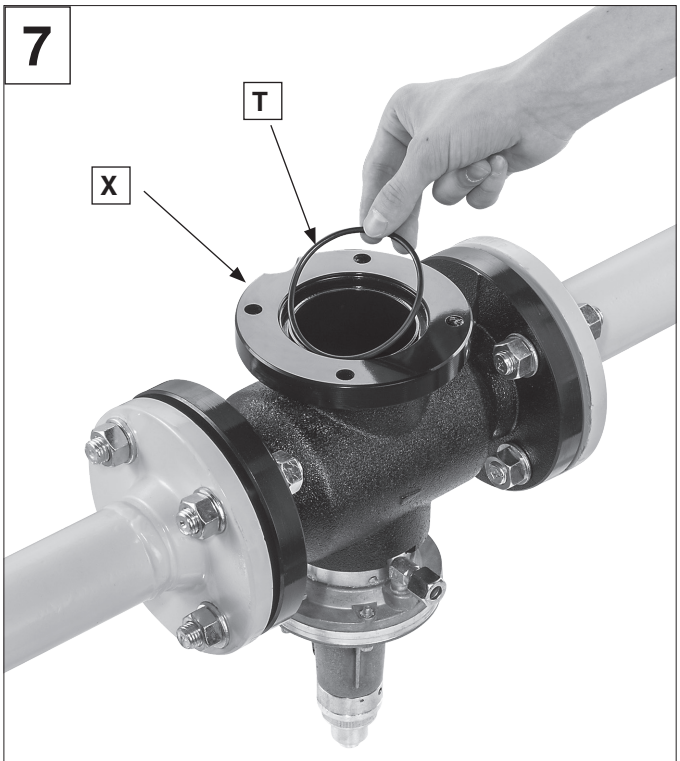
Remove the assembly of the control plate **S** incl. the sleeve **U** from the housing **X**.

6



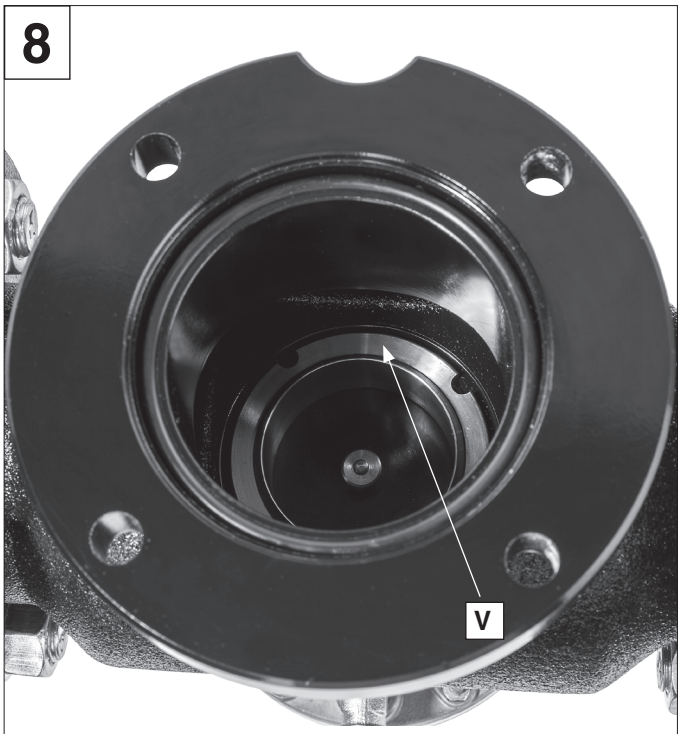
Remove the control plate **S** from the control plate sleeve **U** and check it for damage. If necessary, replace the control plate **S** incl. the sleeve **U**.

7



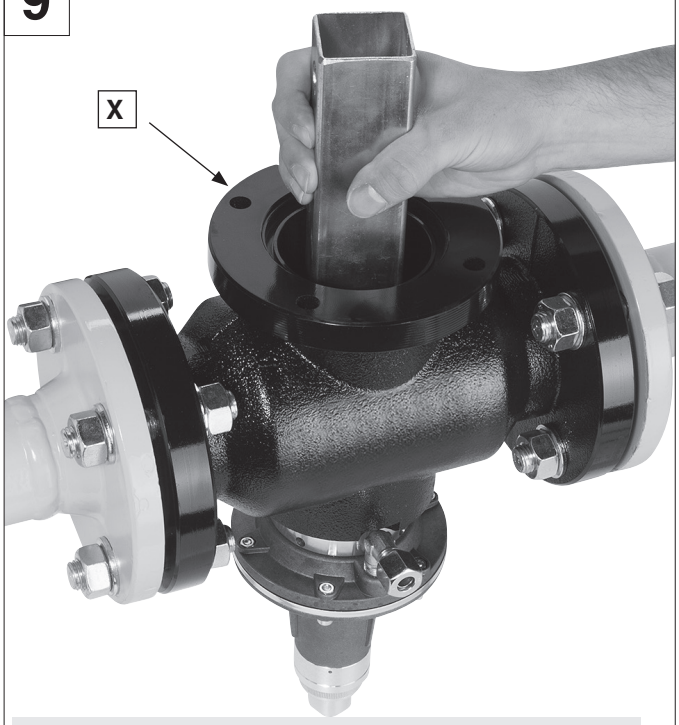
Remove the O-ring **T** from the housing **X**. Clean the inside of the regulator housing **X**.

8



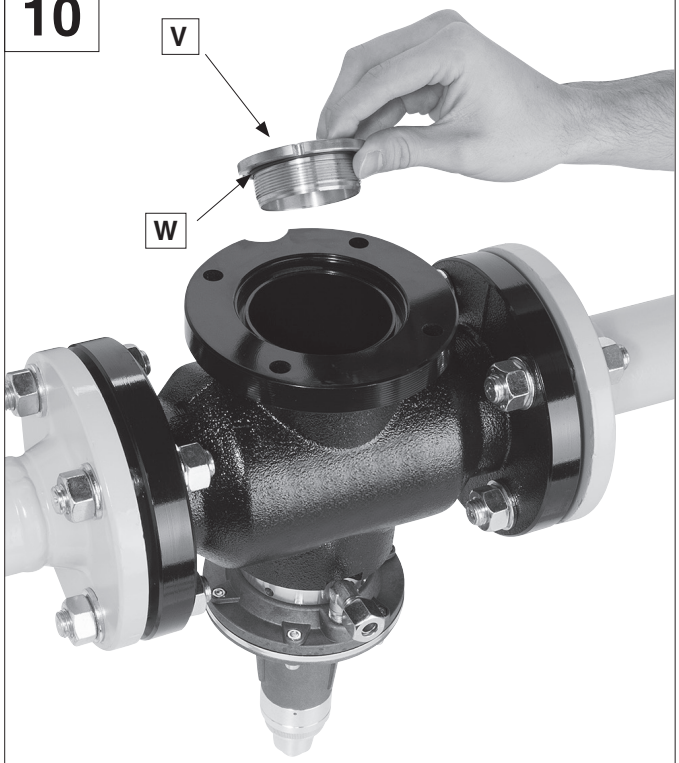
Check the valve seat **V** for dirt or damage.

9



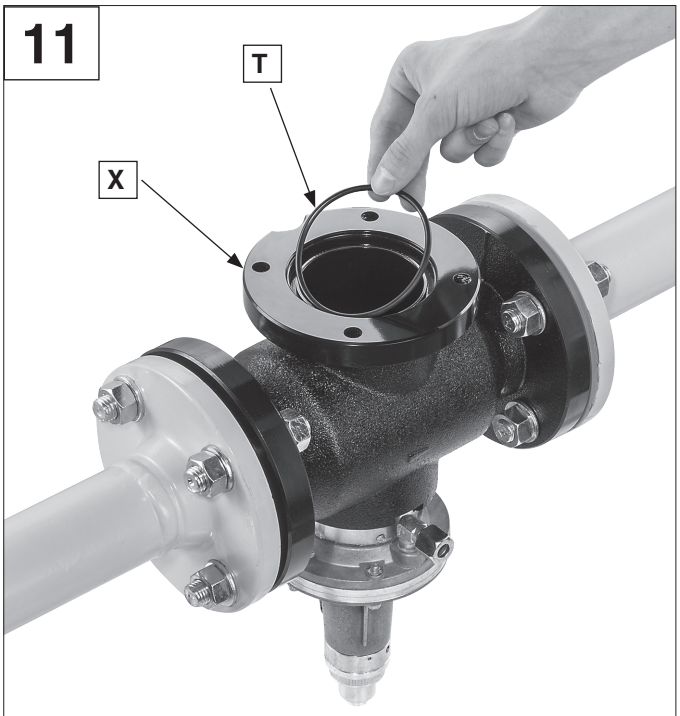
If necessary, replace the valve seat **V**:
screw out the valve seat **V** from the housing **X** by using a socket wrench.

10



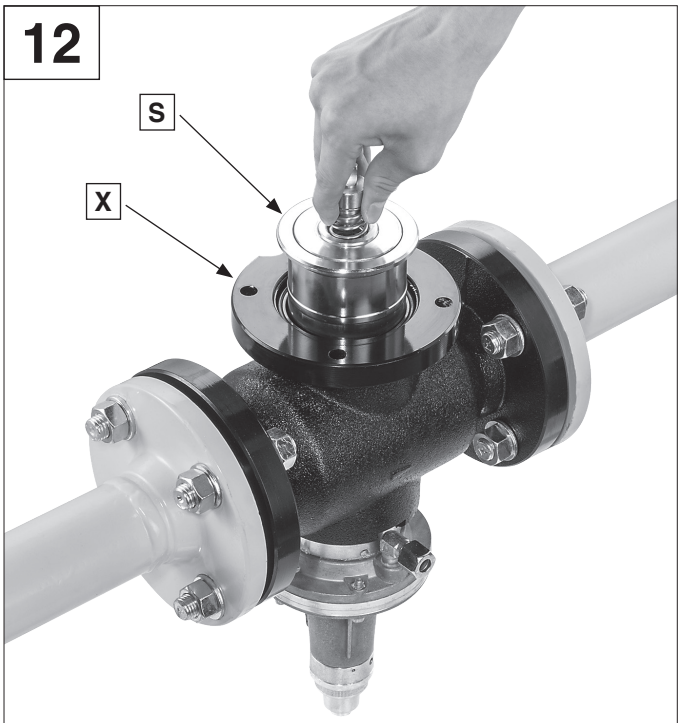
Tighten the new valve seat **V** with the new O-ring **W** (maintenance set 4) in the housing **X**.

11



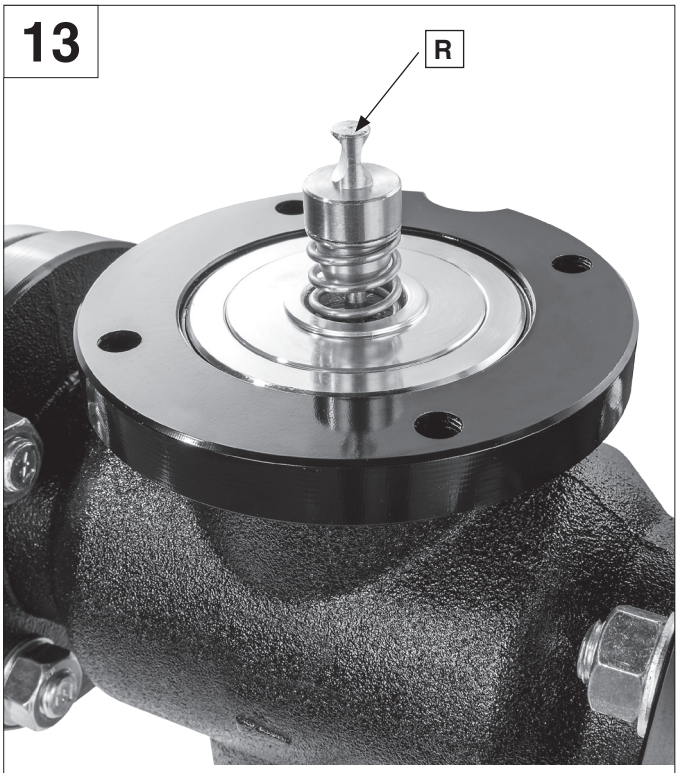
Place the new O-ring **T** (maintenance kit 3 or 5) in the turned groove in the housing **X**.

12



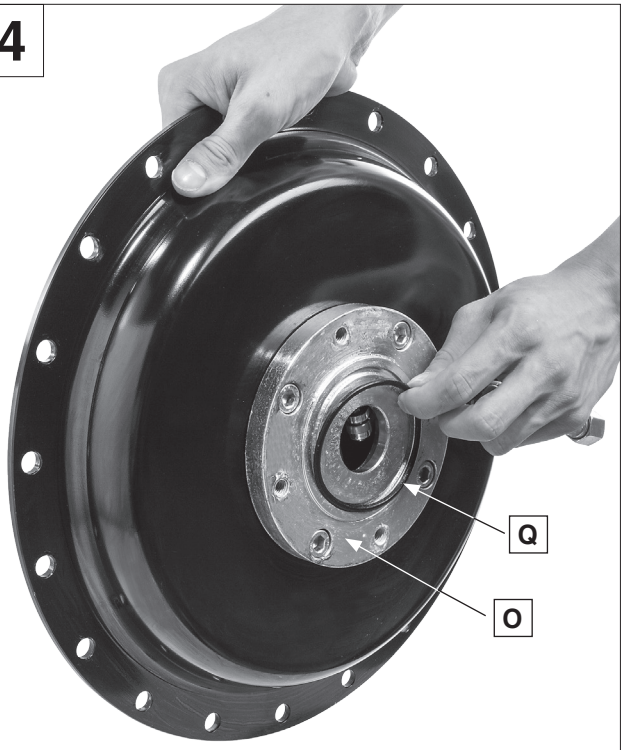
Insert the control plate **S** with the sleeve **U** (maintenance set 3) in the housing **X** again.

13



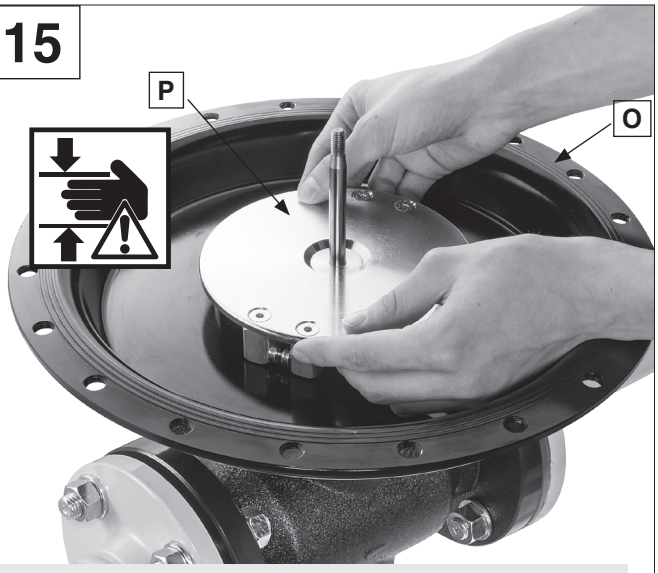
Make sure that the connection pin **R** 45° is oriented opposite to the direction of the flow (non-aligned!)

14



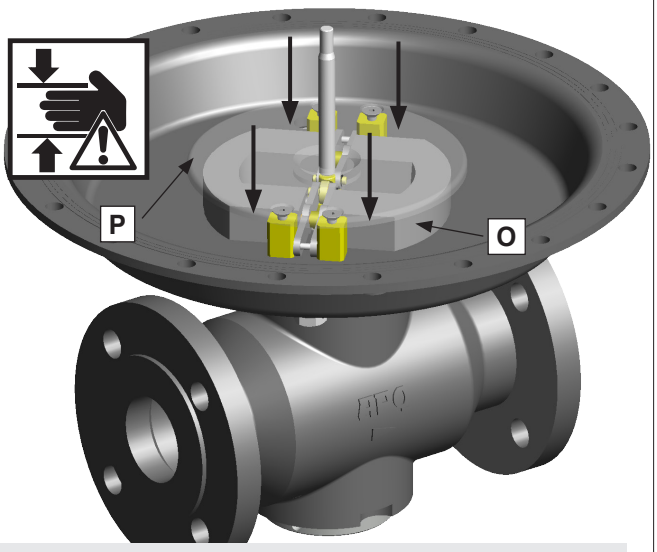
Insert the new O-ring **Q** (maintenance kit 3, 4 or 5) in the turned groove in the lower diaphragm shell **O** using grease if necessary to hold it in place.

15

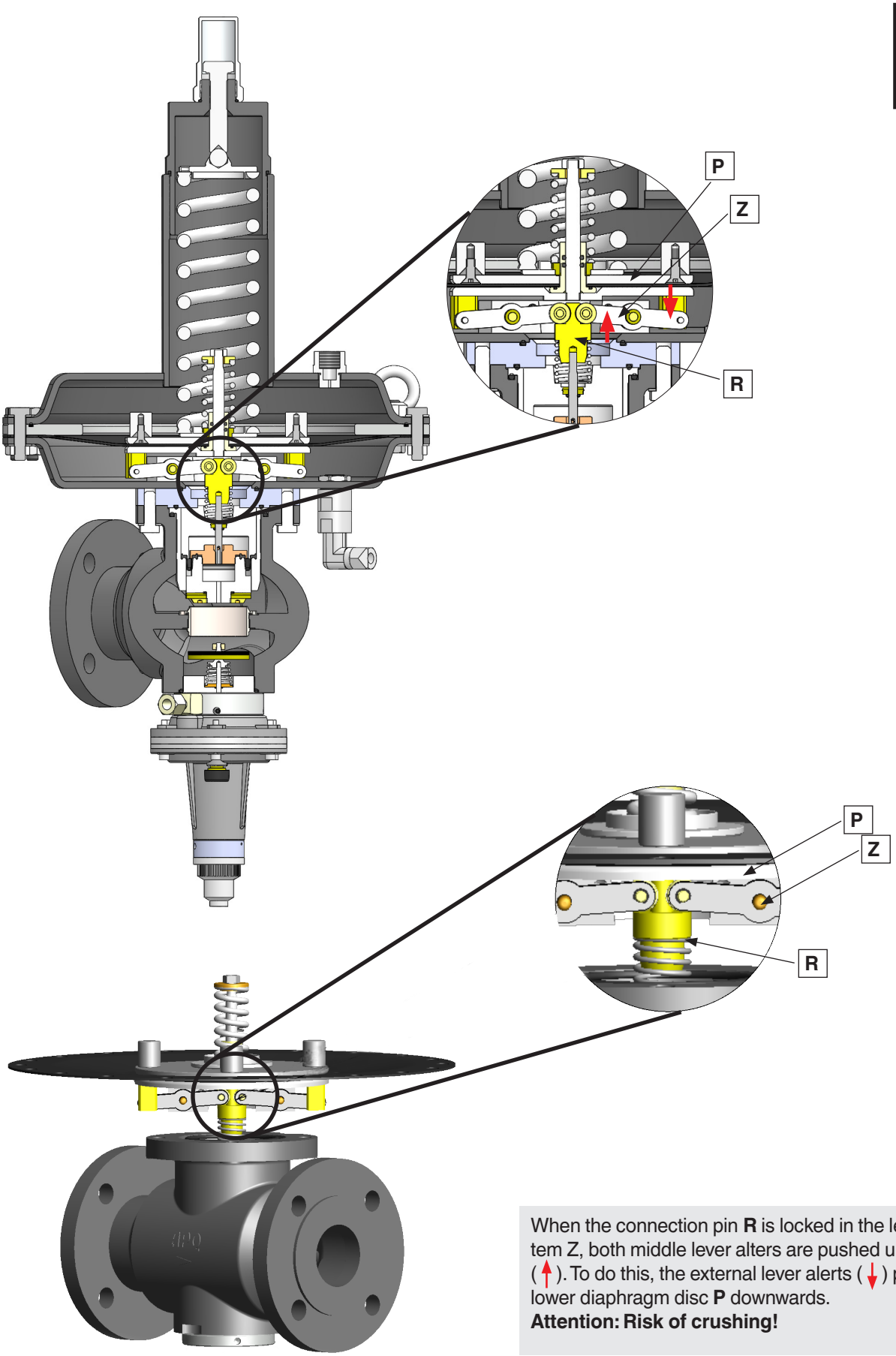


Put on the diaphragm shell **O**:
secure the lower diaphragm shell **O** at the lower diaphragm disc **P** (to do this, the diaphragm disc is dragged upwards) and put it on the connection pin **R**.
Lock the connection pin **R** of the valve disc in the coupling of the lever system in the diaphragm shell **O** by turning it cautiously.
Attention: Risk of crushing!

16

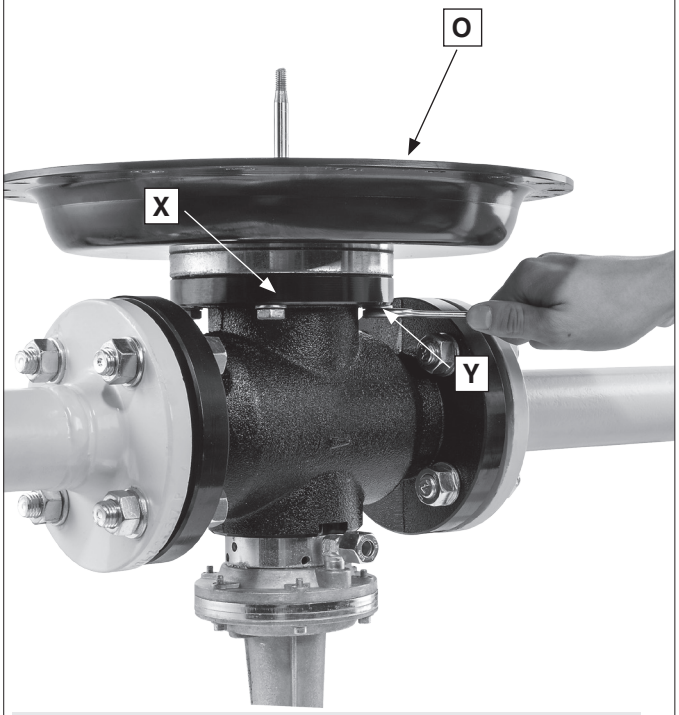


Attention: Risk of crushing!
Place fingers at the marked positions (🡻).
Fingers may be squeezed between the diaphragm disc **P** and the diaphragm shell **O**. Do not slide fingers under the diaphragm disc!!



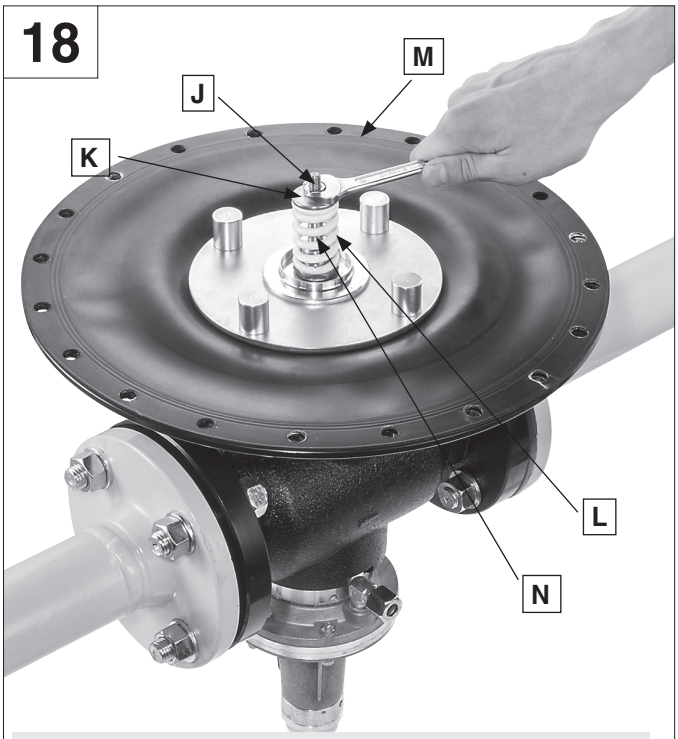
When the connection pin **R** is locked in the lever system Z, both middle lever alters are pushed upwards (↑). To do this, the external lever alerts (↓) pull the lower diaphragm disc **P** downwards.
Attention: Risk of crushing!

17



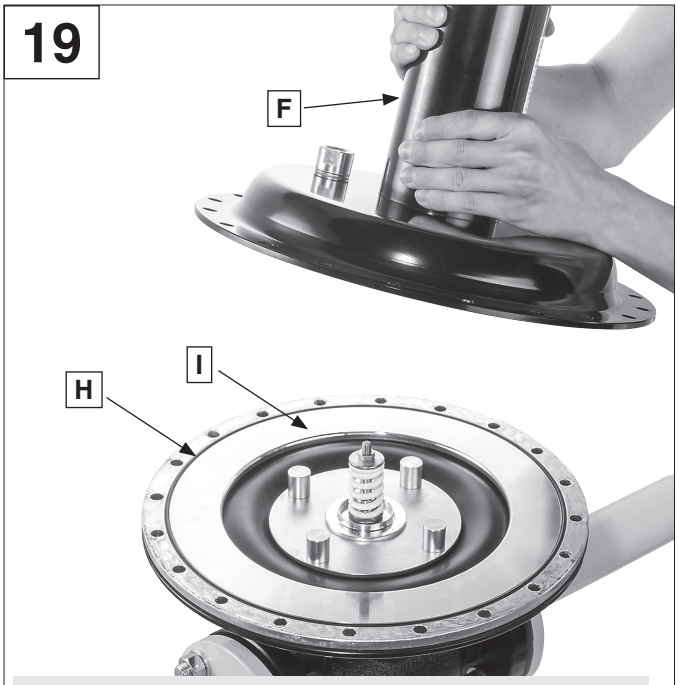
Fix the diaphram housing **O** by tightening the 4 screws **Y**.

18



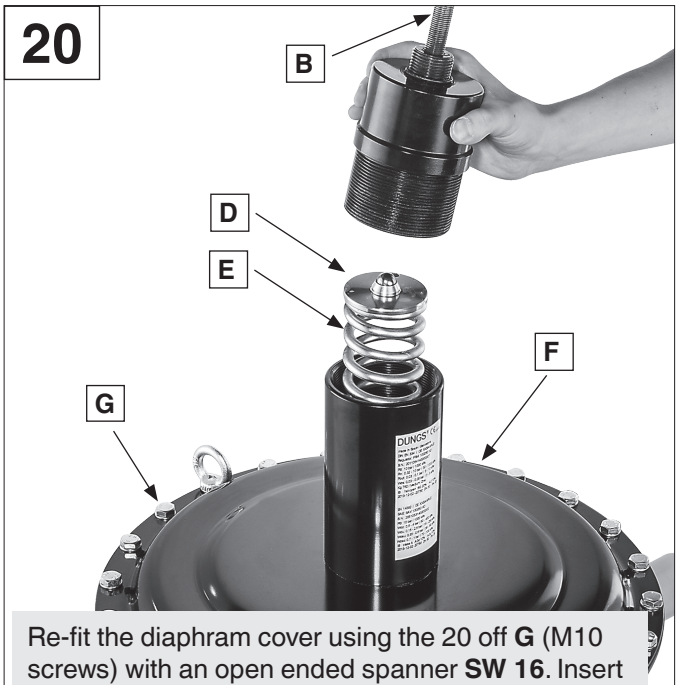
Reinsert the working diaphragm **M** on the guide rod **N**. Put on the safety spring **L** and the spring washer **K**. Screw on the nut **J** (M 8).
Tighten to the stop using an open-ended screw **SW 13**.

19



Reinsert the diaphragm disc **I** (HD version only) (maintenance set 2). Insert the new O-ring **H** (HD only) (maintenance set 2) in the turned groove of the diaphragm disc **I**. Put on the upper diaphragm hood **F**.

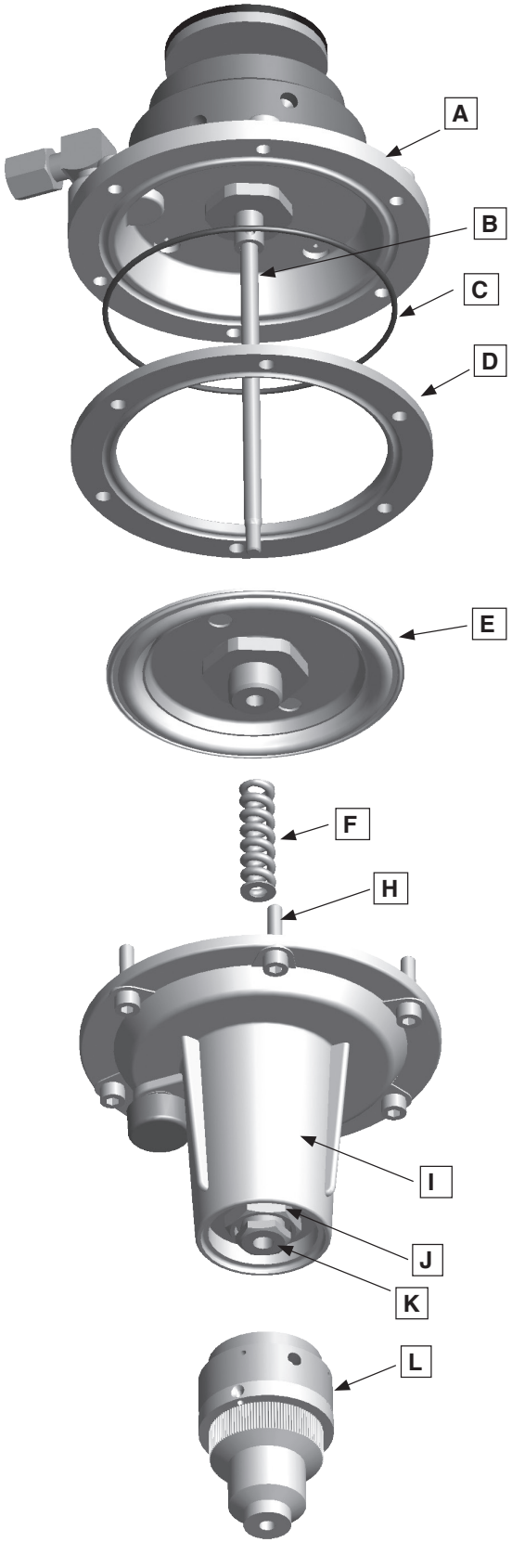
20



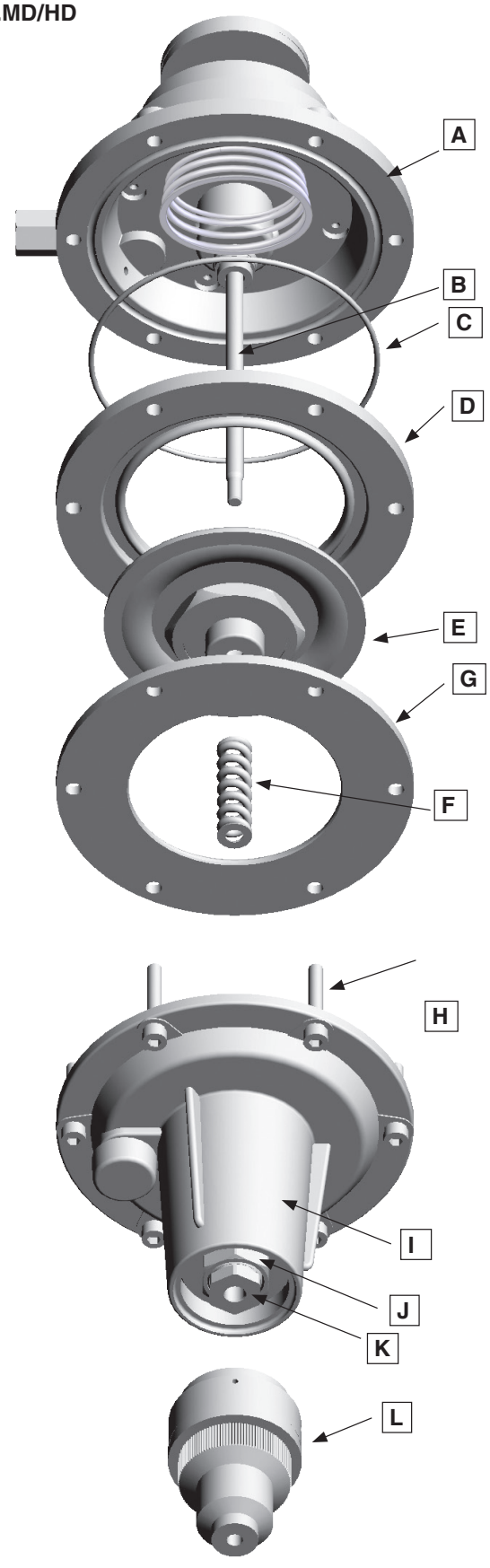
Re-fit the diaphram cover using the 20 off **G** (M10 screws) with an open ended spanner **SW 16**. Insert the setpoint spring **E** in the spring dome **F**. Insert the spring washer **D** incl. ball on the spring. Tighten the sealing cap **C** in the spring dome **F**. Tighten the adjusting screw **B** such that the required preload is reached. Install the protective cap **A**.

14.3 Maintenance instructions of the SAV

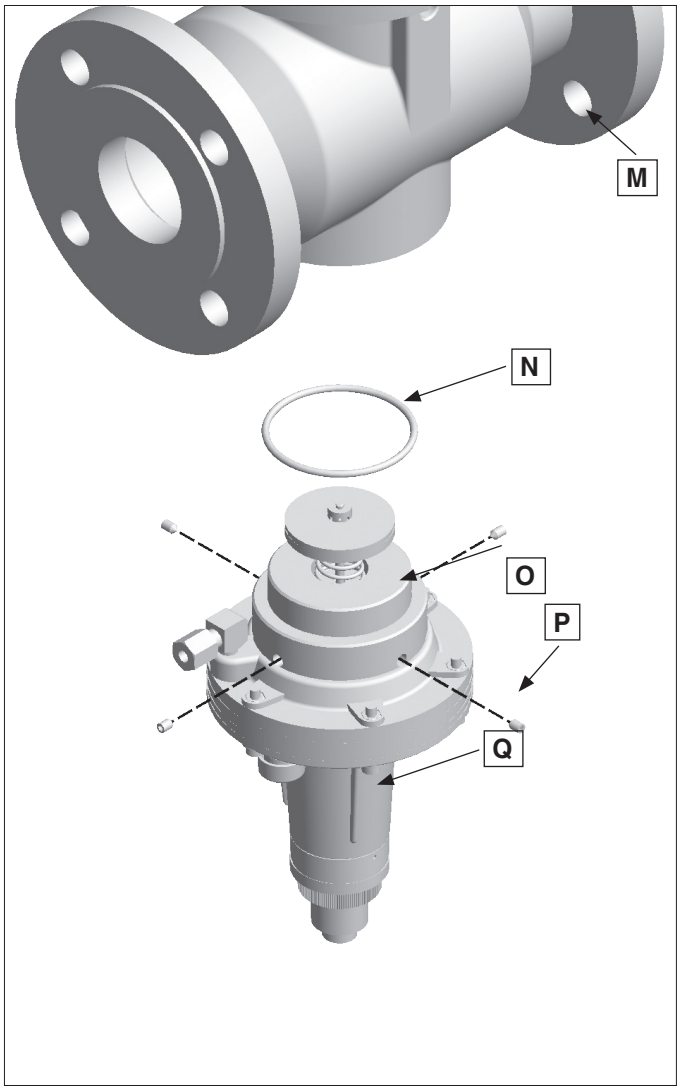
ASE...ND



ASE...MD/HD

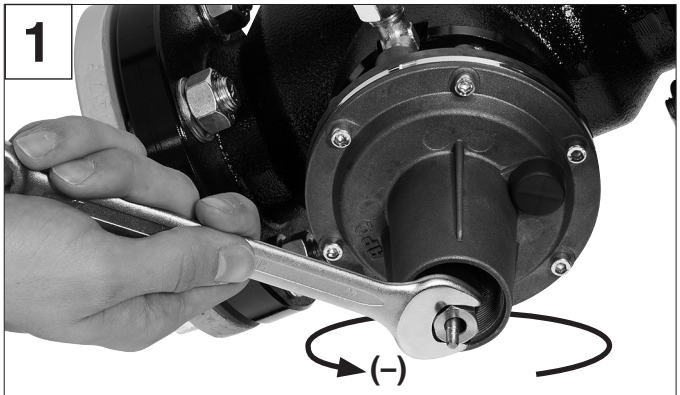


Pos.	Designation
A	Diaphragm shell
B	Push rod
C	O-ring of the diaphragm shell
D	Lower diaphragm disc
E	Working diaphragm
F	Setpoint spring of the lower shut-down pressure
G	Upper diaphragm disc (HD version only)
H	Allen screw, 6 pieces
I	Spring dome ASE
J	Adjusting screw of the upper shut-down pressure
K	Adjusting screw of the lower shut-down pressure
L	Protective cap
M	Housing ASE
N	O-ring
O	Connecting piece ASE/housing
P	Hexagonal socket grub screws, 4 pieces
Q	ASE



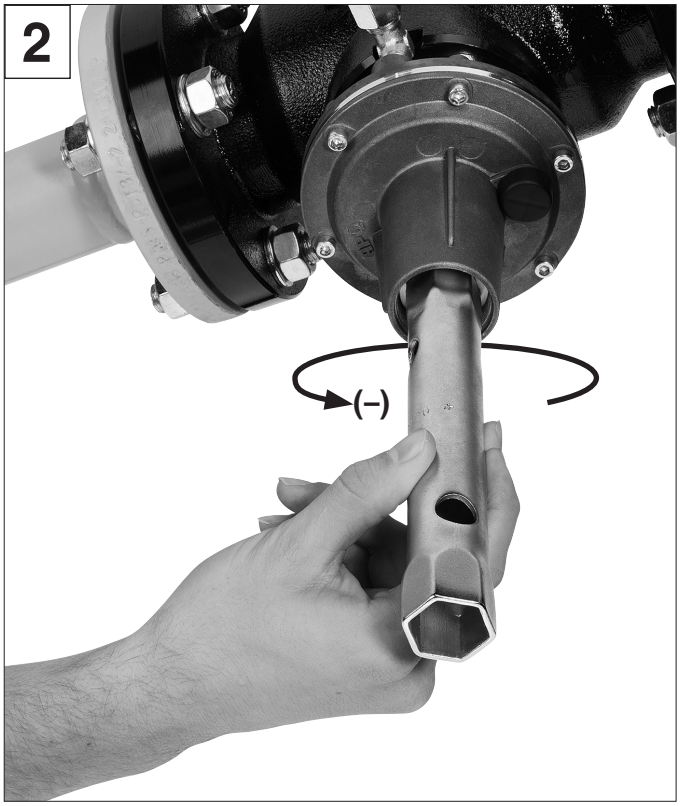
14.3.1 Preparation

1



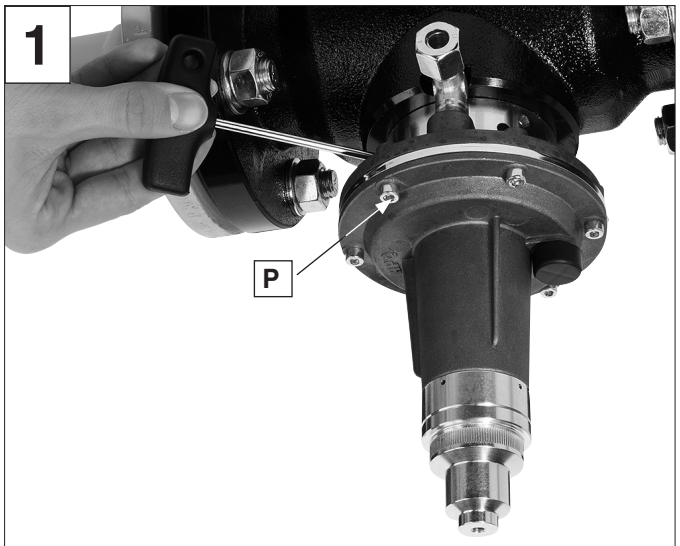
1. Loosen the pulse lines and the vent lines and remove them.
2. Remove the protective cap **L**.
3. Release the setpoint springs at the adjusting screws **J** and **K**.

2



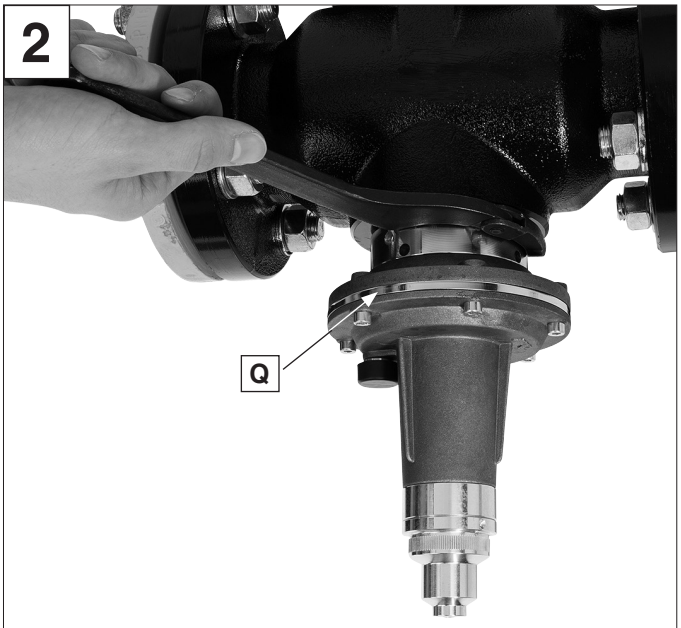
13.3.2 Removing the ASE from the housing

1



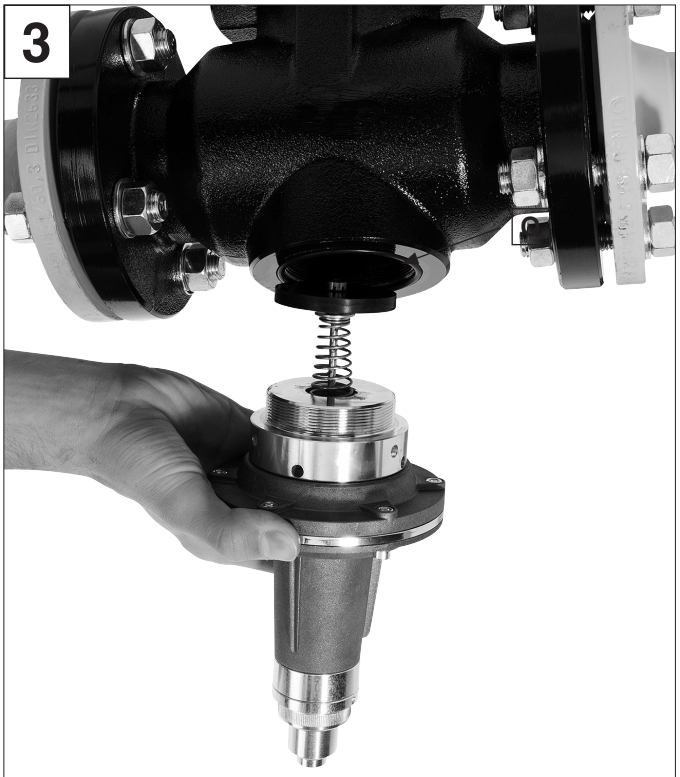
Loosen four hexagonal socket grub screws (M5x8) using an internal hex key **SW 2.5.**

2



Remove the ASE **Q** from the housing using a hook wrench **60-90**.

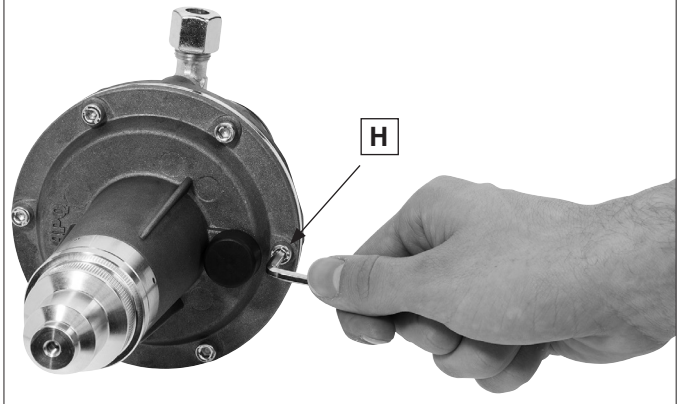
3



Remove the ASE **Q.**

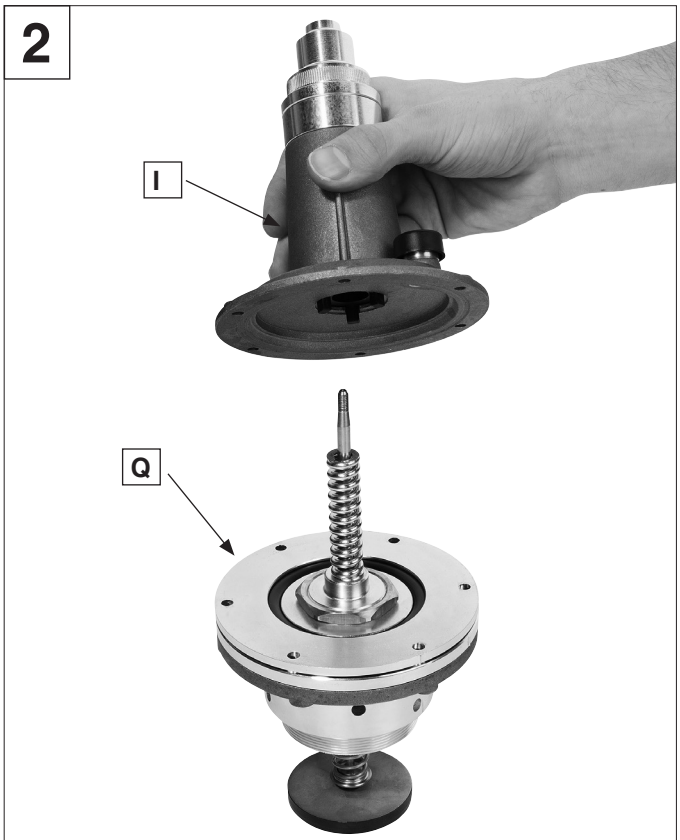
14.3.3 Check / replacement of the working diaphragm, MD/HD version

1



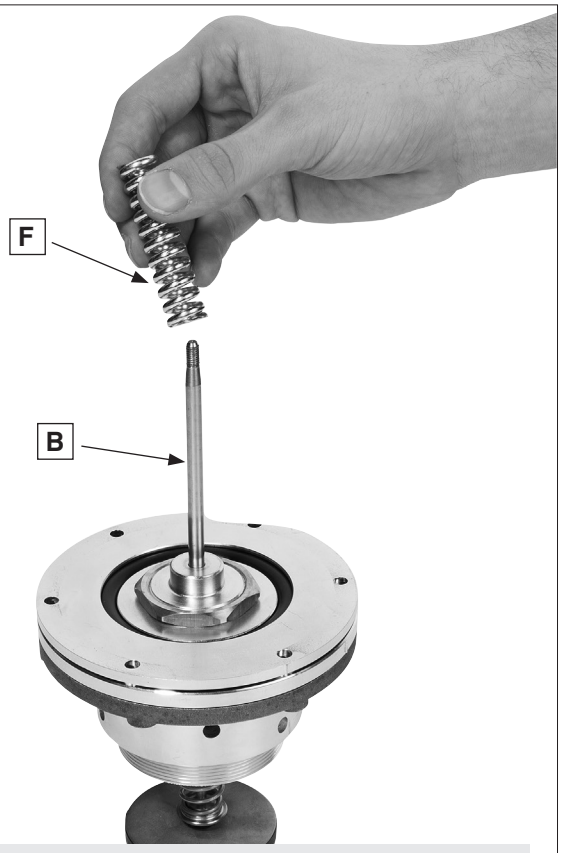
Loosen the six Allen screws **H** (M5) using an internal hex key **SW 4**.

2



Remove the cover **I** of the ASE **Q**.

3

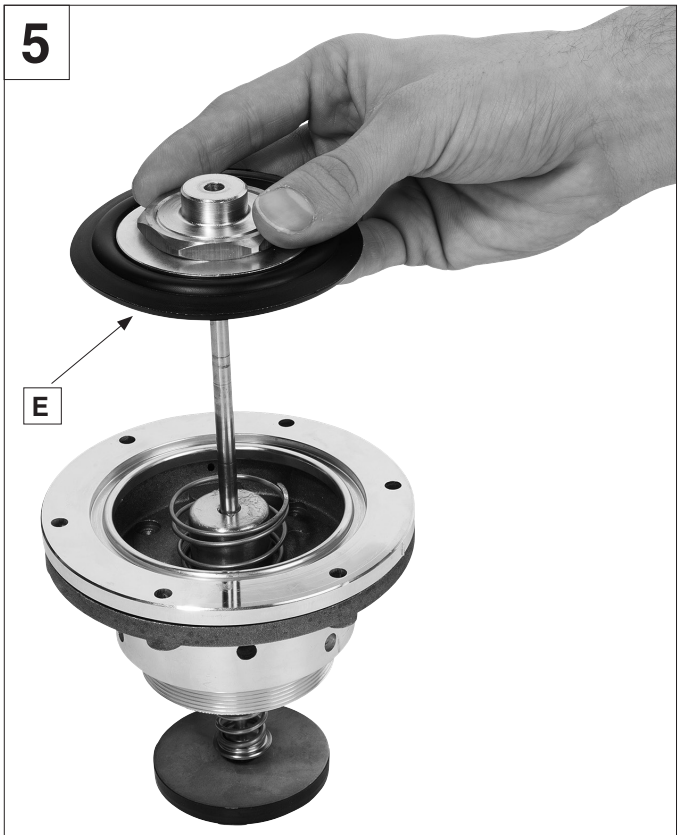


Extract the setpoint spring **F** for lower shut-down pressure from push rod **B** and then clean it.

4

Remove the thin diaphragm ring **G** (HD version only).

5

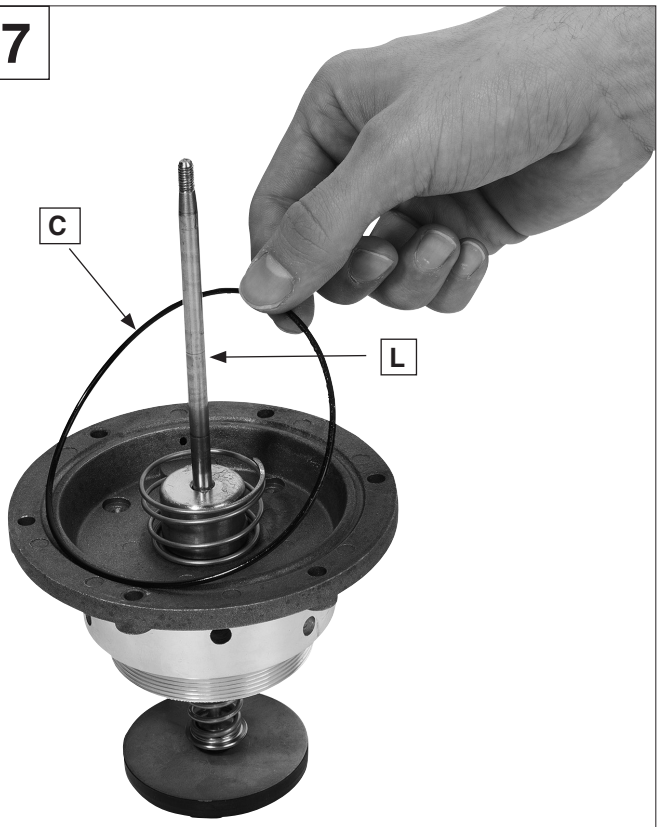


Remove the working diaphragm **E**.

6

Remove the thick diaphragm ring **D**.

7

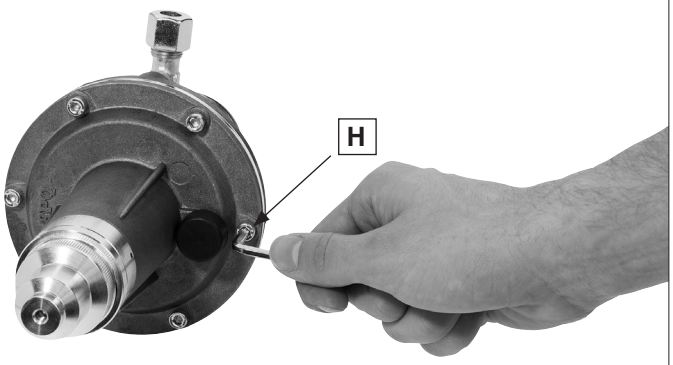


Remove the O-ring **C** and clean the push rod **L**.

8	Insert the new O-ring **C** (maintenance set 7) in the turned groove of the diaphragm shell **A**.
9	Reinsert the diaphragm ring **D** with the turned groove upwards.
10	Check the state of the working diaphragm **E**. If necessary, reassemble a new working diaphragm **O** (maintenance set 2).
11	Insert the working diaphragm **E** on the push rod **B**. Place the external bead of the working diaphragm **E** in the turned groove of the diaphragm ring **D**.
12	Reinsert the working diaphragm **G** with chamfer upwards (HD version only).
13	Place the setpoint spring **F** for lower shut down pressure on the push rod **L**.
14	Place the I cover of the ASE **Q** back.
15	Tighten the 6 Allen screws **H** (M5), in order to lock the ASE **Q** .

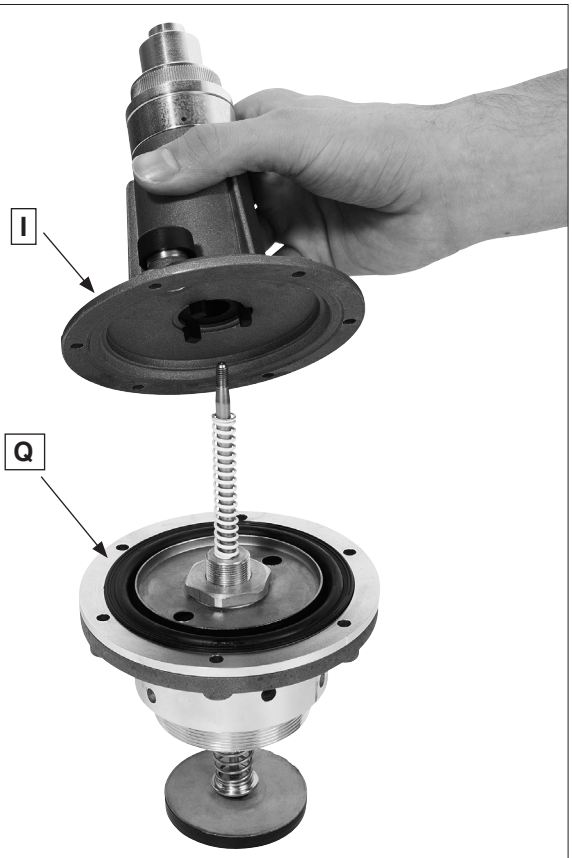
14.3.4 Check / replacement of the working diaphragms, ND version

1



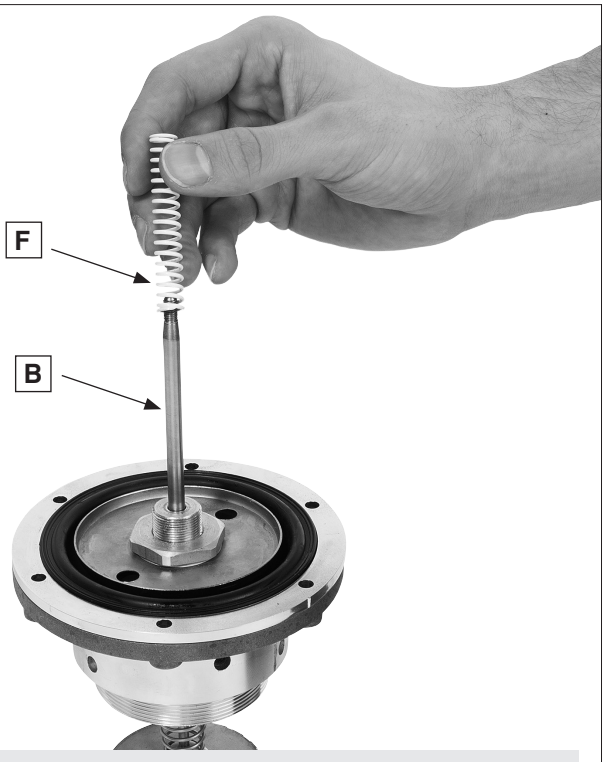
Loosen the six Allen screws **H** (M5) using an internal hex key **SW 4**.

2



Remove the cover **I** of the ASE **Q**.

3



Extract the setpoint spring **F** for lower shut-down pressure from the push rod **B** and then clean it.

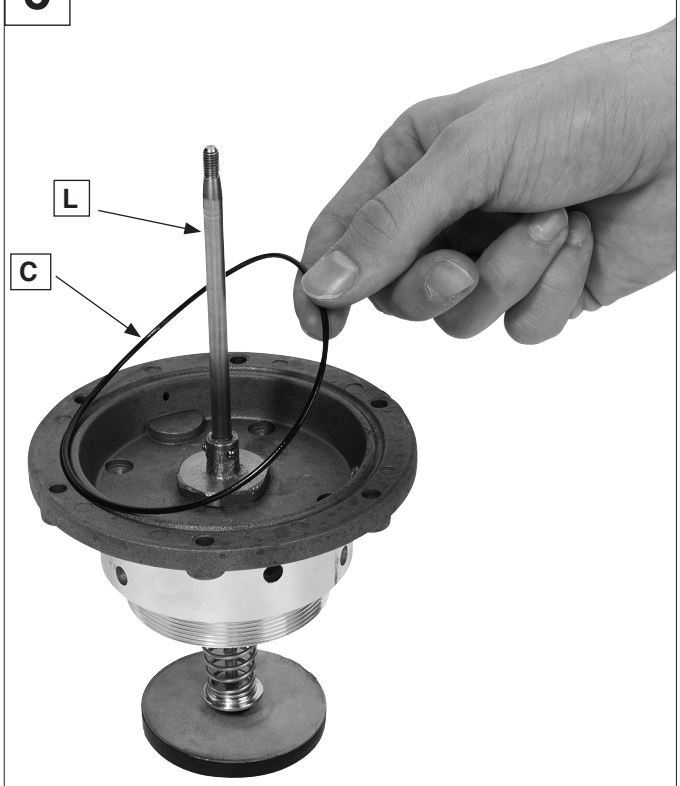
4

Remove the working diaphragm **E.**

5

Remove the diaphragm ring **D**.

6



Remove the O-ring **C**. Clean the push rod **L.**

7	Insert the new O-ring **C** (maintenance set 7) in the turned groove of the diaphragm shell **K**.
8	Reinsert the diaphragm ring **D** with the turned groove upwards.
9	Check the state of the working diaphragm **E**. If necessary, reassemble a new working diaphragm **E** (maintenance set 2).
10	Insert the working diaphragm **E** on the push rod **B**. Place the external bead of the working diaphragm **E** in the turned groove of the diaphragm ring **D**.
11	Place the setpoint spring **F** for lower shut down pressure on the push rod **B**.
12	Re fit the ASE cover **Q**.
13	Tighten the 6 Allen screws **H** (M5), in order to lock the ASE **Q** .

14.3.4 Mounting of the ASE on the housing

1	Place the new O-ring ***N*** (maintenance kit 4 or 5) in the turned groove in the housing **M**.
2	Tighten the threads of the connecting piece **O** in the housing **M** using a hook wrench **60-90**.
3	Fix the connecting piece **O** of the ASE **Q** using 4 hexagonal socket grub screws **P** (M5x8).

14.4 Required tools

A

B

C1

C2

D

E

Order no. 271170

SAV

Work step		Tool designation	Pressure rating	Wrench size		
				DN 25	DN 40	DN 50
1	Loosen the pulse lines.	Open-ended screw (A)	ND/MD/HD	SW 24	SW 24	SW 24
2	Release the setpoint springs.	Tube/socket wrench (B)	ND/MD/HD	SW 17	SW 17	SW 17
		Tube/socket wrench (B)		SW 22	SW 22	SW 22
3	Loosen ASE from the housing.	Internal hex key (C1)	ND/MD/HD	SW 2.5	SW 2.5	SW 2.5
		Jointed hook wrench with pins according to DIN 1810 (D)		60-90	60-90	60-90
4	Replace the working diaphragm on the ASE.	Internal hex key (C2)	ND/MD/HD	SW 4	SW 17	SW 4

Regulator

Work step		Tool designation	Pressure rating	Wrench size		
				DN 25	DN 40	DN 50
1	Loosen the pulse lines.	Open-ended screw (A)	ND/MD/HD	SW 24	SW 24	SW 24
2	Release the setpoint springs.	Open-ended screw (A)	ND/MD/HD	SW 24	SW 24	SW 24
		Hinged hook wrench (D)		90-155	90-155	90-155
3	Replace the working diaphragm.	Open-ended wrench (A)	ND/MD/HD	SW 17	SW 17	SW 17
		Open-ended wrench (A)		SW 13	SW 13	SW 13
4	Replace the control plate.	Open-ended wrench (A)	ND/MD/HD	SW 13	SW 17	SW 17
5	Replace the valve seat.	Tube socket wrench (B)/ valve wrench (E)	ND/MD/HD	SW 30	SW 46	D 60

14.5 Leakage test

After maintenance or repair works, check the device for internal and external leakages.

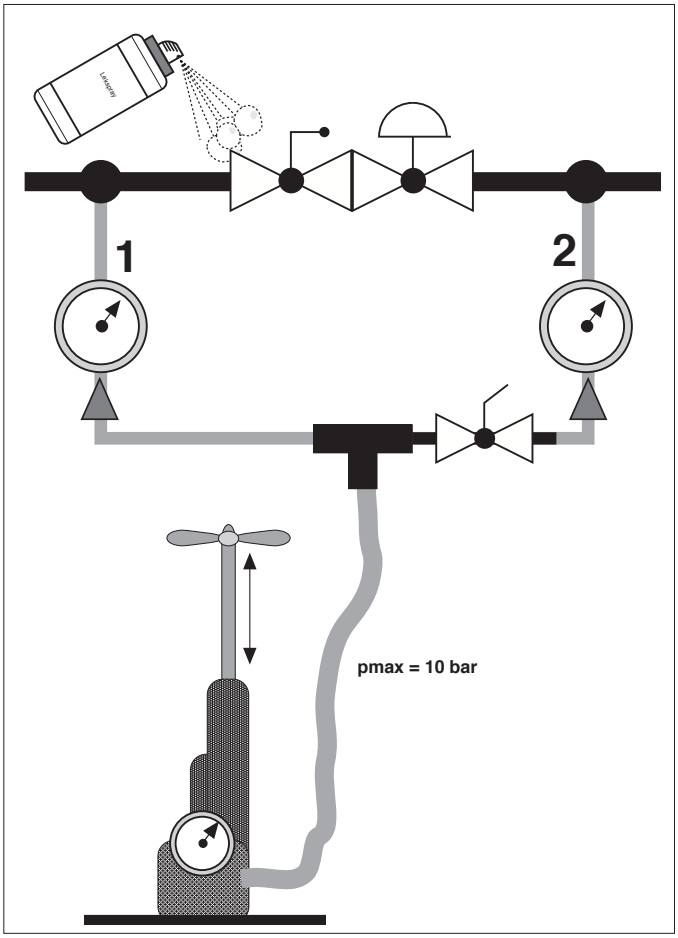
1. Test gases of the leakage test: air or inert gases.
2. Upstream and downstream shutoff valves must be closed.
3. Test pressure > blow-off pressure SBV: block the line upstream of the SBV.
4. Connect the test section to the test device and apply pressure.
5. Test pressure: 1.1 x system-specific operating pressure Maximum PS of the device (SAV 100… 10 bar/SAV 60…6 bar). Different pressure ratings of the system must be taken into account.
6. Observe the waiting time necessary for the pressure compensation according to the system-specific volumes.

External leakage

7. Use a suitable leak detection spray on the device.
8. Monitor the foam formation.

Internal tightness

9. Remove the pressure in the test section downstream of the device.
10. Monitor the increase in pressure on the outlet side: pressure gauge accuracy 0.1 mbar
11. Once the leakage test has been carried out, open the shutoff valve upstream of the SBV.
12. Release pressure in the test section.
13. Check the correct functioning and set values, see section 11.3.

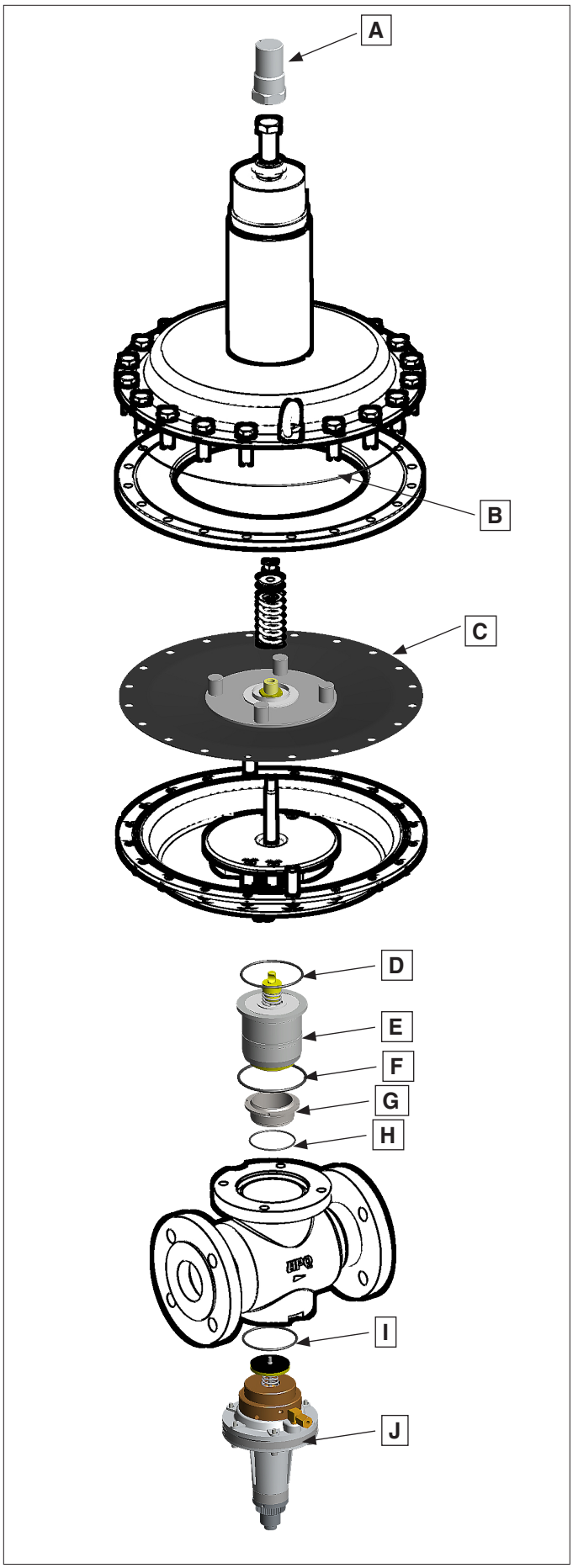


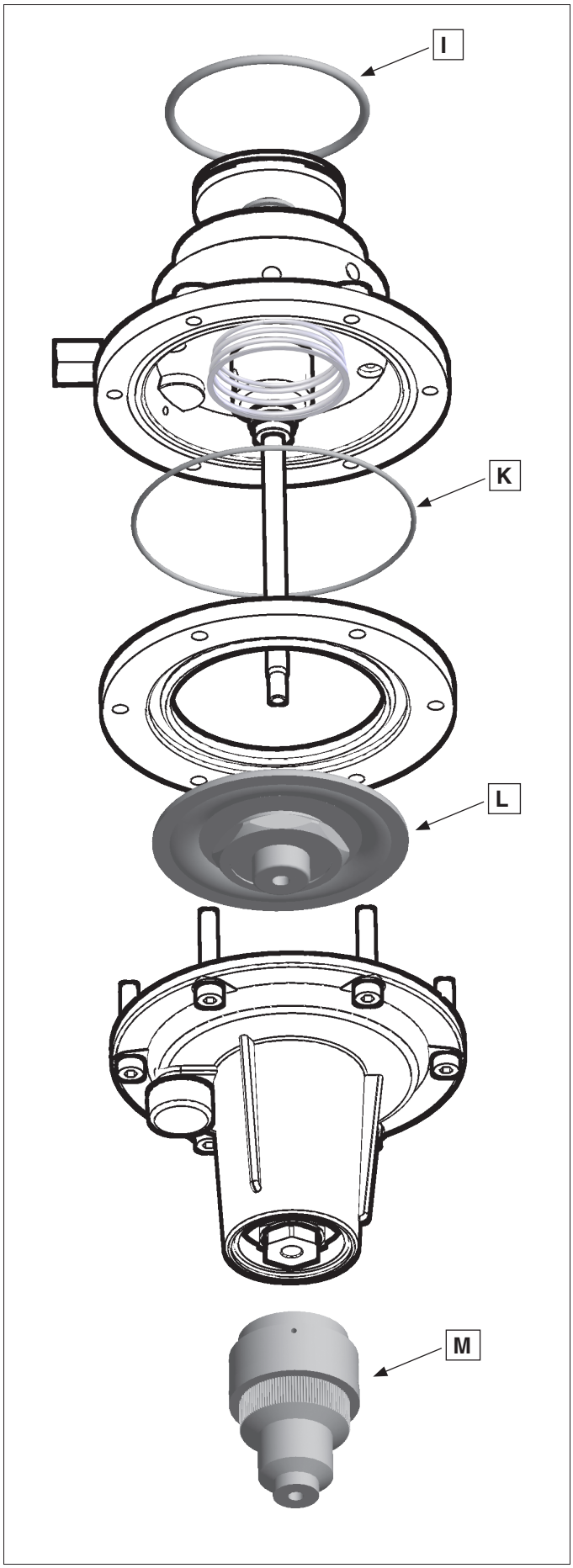
14.6 Recommended maintenance intervals

1. The maintenance intervals depend on the system-specific operating and environmental conditions, gas quality, state of the pipelines, etc.
2. The maintenance intervals have to be set by the system operator according to the system requirements.
3. It is recommended to perform a functional test on a monthly base and carry out maintenance works every year, in order to guarantee the system availability.
4. It is necessary to comply at least with the maintenance intervals specified in G 495.

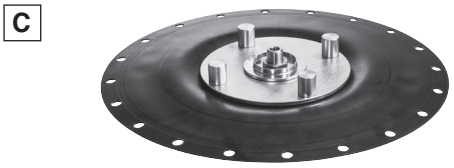
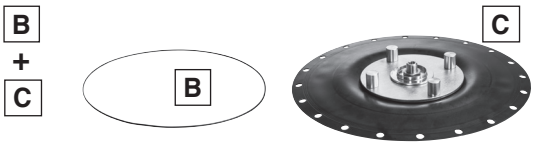
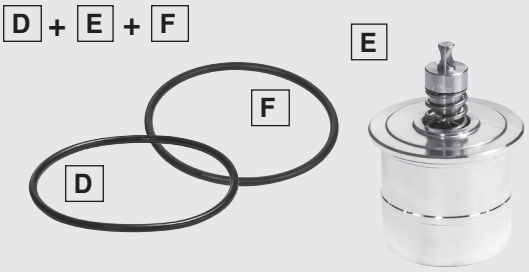
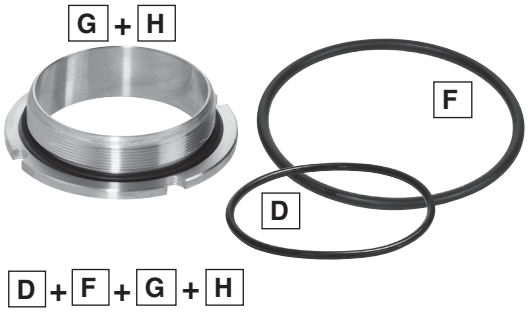
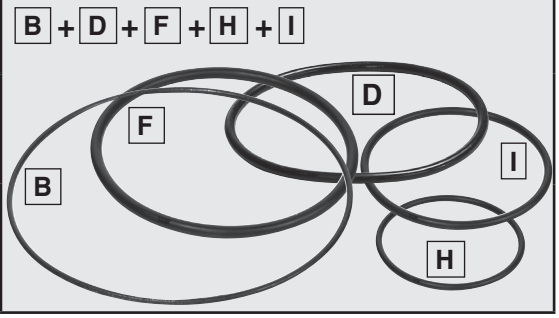
Max. inlet pressure [bar]	Functional test	Maintenance
> 0.1 to 1	every 4 years	every 8 years
> 1 to 5	every 2 years	every 4 years
> 5	once a year	every 2 years

15. Spare parts

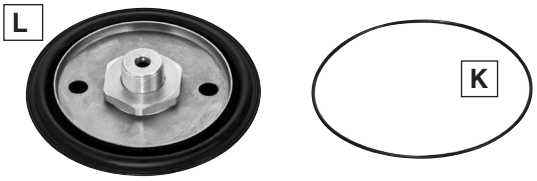
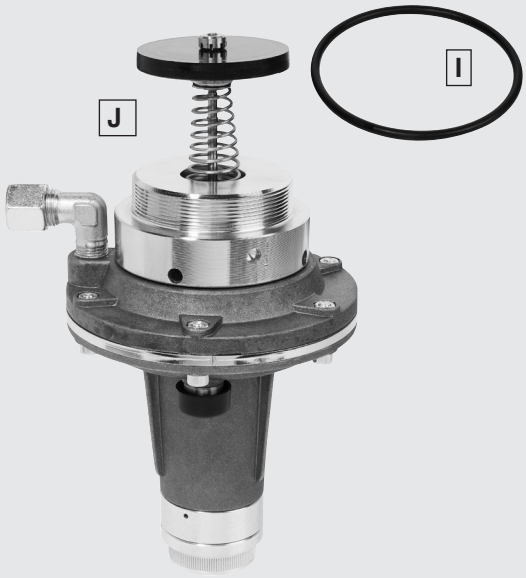




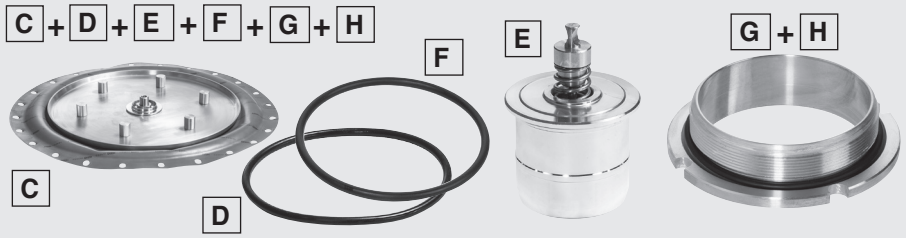
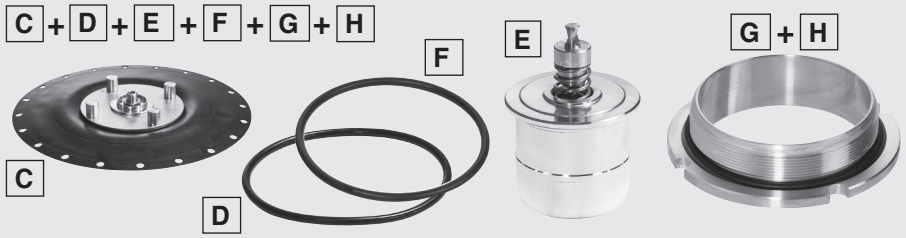
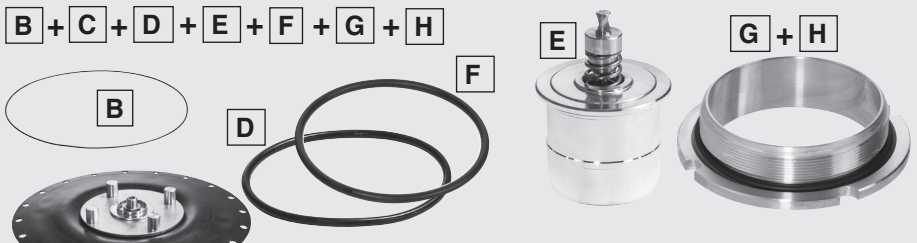
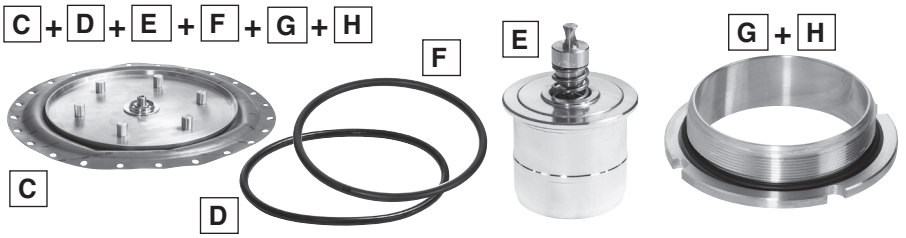
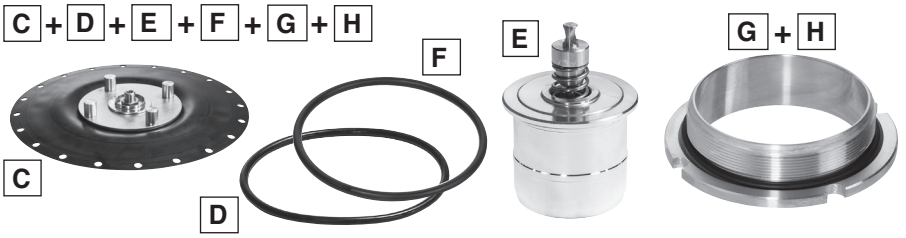
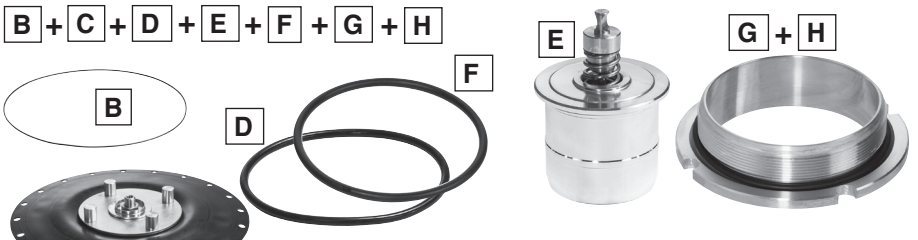
15.1 List of spare parts of the regulator

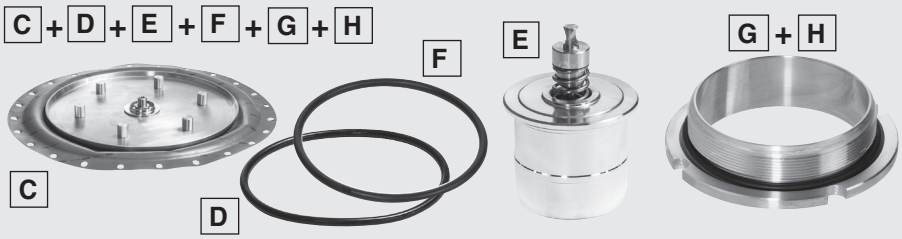
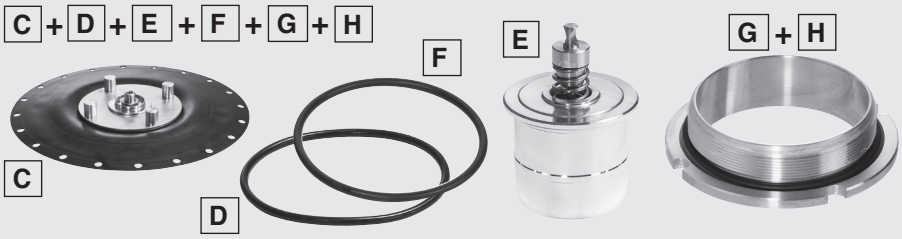
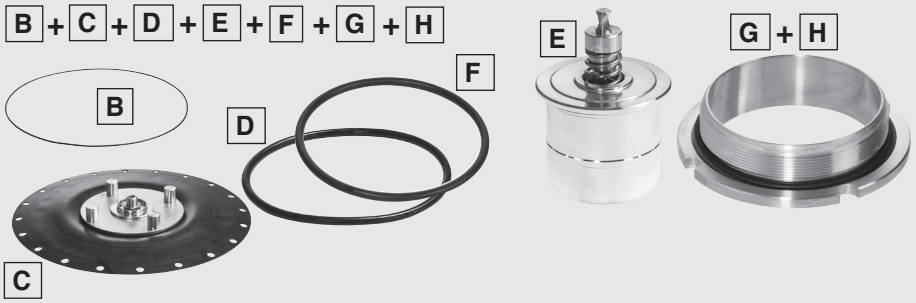
Kit	Spare part	Version	Order number	Spare part / image
1	Protective cap	FRM 100025-100050	270396	
2	Working diaphragm with O-ring	FRM 100025-100050 ND	270384	
		FRM 100025-100050 MD	270385	
		FRM 100025-100050 HD	270386	
3	Compen-sation unit with O-rings	FRM 100025 ND FRM 100025 MD FRM 100025 HD	270387	
		FRM 100040 ND FRM 100040 MD FRM 100040 HD	270388	
		FRM 100050 ND FRM 100050 MD FRM 100050 HD	270389	
4	Valve seat with sealing ring and O-ring	FRM 100025 ND FRM 100025 MD FRM 100025 HD	270390	
		FRM 100040 ND FRM 100040 MD FRM 100040 HD	270391	
		FRM 100050 ND	270389	
		FRM 100050 MD FRM 100050 HD	271092	
5	Kit O-rings	FRM 100025 ND FRM 100025 MD FRM 100025 HD	270387	
		FRM 100040 ND FRM 100040 MD FRM 100040 HD	270388	
		FRM 100050 ND FRM 100050 MD FRM 100050 HD	270389	

15.2 List of spare parts of SAV

Kit	Spare part	Version	Order number	Spare part / image
6	Protective cap	SAV 100025-100050 ND/MD/HD SAV 6010-6020 ND/MD/HD	on request	
7	Working diaphragm with O-ring	SAV 100025-100050 ND SAV 6010-6020 ND	on request	
		SAV 100025-100050 MD SAV 6010-6020 MD	on request	
		SAV 100025-100050 HD SAV 6010-6020 HD	on request	
8	ASE with o-ring	SAV 100025 ND SAV 6010 ND SAV 6015 ND	270375	
		SAV 100025 MD SAV 6010 MD SAV 6015 MD	270376	
		SAV 100025 HD SAV 6010 HD SAV 6015 HD	270377	
		SAV 100040 ND SAV 6020 ND	270378	
		SAV 100040 MD SAV 6020 MD	270379	
		SAV 100040 HD SAV 6020 HD	270380	
		SAV 100050 ND	270381	
		SAV 100050 MD	270382	
		SAV 1000050 HD	270383	

15.3 Complete regulator sets

Version	Order number	Contents
FRM 100025 ND	271093	
FRM 100025 MD	271094	
FRM 100025 HD	271095	
FRM 100040 ND	271096	
FRM 100040 MD	271097	
FRM 100040 HD	271098	

Version	Order number	Contents
FRM 100050 ND	271099	
FRM 100050 MD	271100	
FRM 100050 HD	271101	

15.3 Storage conditions

Basically, DIN 7716 (standards for storage, maintenance and cleaning of rubber products) applies to the storage of diaphragms and O-rings.

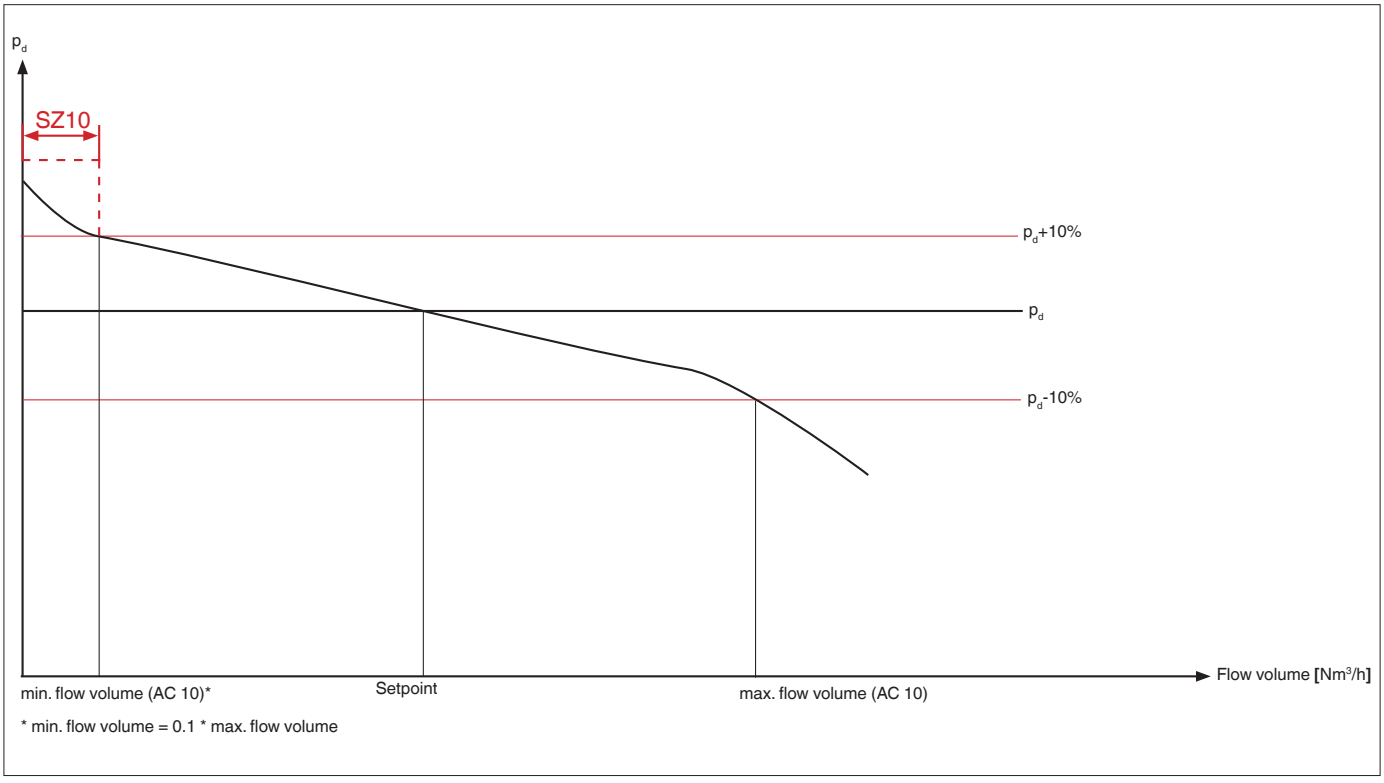
The ageing process mostly depends on the following factors:

- Temperature
- Thermal radiation
- Solar radiation
- Humidity
- Relative humidity
- Ozone
- Stress conditions of the components

Proper storage

- Storage temperature between 5° C and 20° C
- No direct solar radiation
- No direct heat sources in the storage area
- No exposure to ozone
- Tension-free storage
- Storage in polyethylene bags
- Do not exceed the max. storage periods of 3 years

16. Flow volume tables



* min. flow volume = 0.1 * max. flow volume

16.1 Natural gas flow volume tables

FRM 100025 … DN 25 - max. flow volume natural gas of density 0.81 kg/m³ (AC 10)

FRM ...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	186	217	229	235	192	186	173	161							
0,75	198	266	285	297	235	240	224	223	210						
1	210	297	346	359	273	306	308	325	313	297	285				
1,5	223	322	433	458	371	377	396	371	384	384	371	384	396		
2	235	346	507	532	445	445	445	445	483	445	445	445	445	458	470
2,5	247	371	569	594	507	507	582	594	606	557	557	557	557	557	557
3	272	396	631	656	557	582	681	693	730	643	643	643	643	643	643
3,5	297	421	693	705	594	656	779	779	841	705	755	792	792	792	792
4	309	445	755	755	631	718	866	866	940	792	891	940	940	940	940
4,5	322	470	804	804	656	767	953	965	1039	866	990	1052	1076	1076	1089
5	334	495	841	854	681	817	1027	1052	1126	928	1064	1151	1175	1175	1237
6	346	507	866	891	718	891	1114	1175	1287	1052	1237	1336	1423	1423	1423
7	346	520	891	940	742	977	1175	1336	1411	1163	1373	1509	1608	1608	1608
8	359	532	916	977	767	1052	1237	1398	1509	1274	1485	1658	1732	1732	1732
9	359	544	940	1015	792	1089	1287	1460	1621	1349	1596	1794	1794	1794	1794
10	371	557	965	1052	817	1138	1312	1509	1695	1411	1707	1881	1881	1881	1881

FRM 100040 … DN 40 - max. flow volume natural gas of density 0.81 kg/m³ (AC 10)

FRM...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	297	359	359	371	334	334	334	334							
0,75	322	396	445	557	421	433	433	433	433						
1	346	433	569	705	495	507	507	544	582	582	582				
1,5	396	557	681	804	569	656	656	668	730	755	767	779	916		
2	433	656	779	891	681	767	767	792	866	903	953	1015	1039	1039	1089
2,5	513	718	866	990	761	866	866	928	990	1039	1076	1262	1274	1274	1361
3	569	779	965	1101	829	953	953	1027	1101	1163	1163	1423	1608	1608	1608
3,5	625	829	1064	1200	885	1039	1039	1151	1225	1274	1287	1646	1757	1769	1856
4	668	866	1175	1274	934	1114	1114	1262	1361	1398	1411	1745	1905	1967	2103
4,5	705	928	1299	1361	977	1188	1188	1361	1485	1509	1522	1905	2054	2140	2351
5	755	990	1398	1460	1015	1262	1262	1448	1584	1608	1621	2066	2215	2326	2536
6	866	1114	1534	1670	1114	1386	1411	1633	1794	1794	1856	2351	2462	2660	2846
7	977	1225	1646	1831	1213	1460	1559	1794	1967	1955	2079	2623	2747	2969	3093
8	1076	1324	1745	1918	1287	1509	1670	1943	2165	2091	2252	2846	2994	3217	3279
9	1151	1411	1794	1955	1336	1547	1757	2091	2326	2215	2413	3093	3217	3403	3464
10	1175	1472	1819	2004	1373	1571	1831	2202	2475	2239	2487	3229	3403	3526	3600

FRM 100050 … DN 50 - max. flow volume natural gas of density 0.81 kg/m³ (AC 10)

FRM...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	198	210	285	285	260	260	260	260							
0,75	247	272	334	334	371	396	396	396	396						
1	272	322	408	408	483	495	507	507	544	470	470				
1,5	303	371	483	483	594	656	656	693	829	582	582	656	761		
2	334	408	569	569	705	779	779	866	1076	742	742	866	866	866	928
2,5	365	445	668	668	804	903	903	1015	1237	916	953	1089	1114	1114	1163
3	396	495	718	718	891	1027	1027	1138	1361	1064	1213	1287	1336	1336	1386
3,5	427	532	767	767	965	1101	1151	1274	1460	1188	1349	1485	1534	1534	1608
4	452	582	792	792	1052	1175	1250	1386	1559	1287	1485	1633	1707	1707	1881
4,5	470	631	854	854	1138	1213	1336	1485	1608	1386	1596	1782	1856	1856	2029
5	507	674	916	916	1213	1287	1411	1571	1670	1460	1670	1893	1955	2004	2153
6	582	742	990	990	1312	1398	1534	1707	1794	1596	1806	1943	2054	2202	2425
7	643	817	1064	1076	1411	1497	1646	1794	1918	1707	1905	1980	2140	2400	2673
8	705	878	1126	1151	1485	1571	1732	1881	2042	1794	1980	2017	2239	2635	2895
9	767	928	1175	1213	1547	1633	1819	1930	2165	1856	2029	2054	2314	2772	3007
10	841	977	1225	1299	1608	1707	1868	1967	2289	1893	2079	2079	2351	2895	3106

16.2 Air flow volume tables

FRM 100025... DN25 - max. air flow volume (AC 10)

FRM ...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	150	175	185	190	155	150	140	130							
0,75	160	215	230	240	190	194	181	180	170						
1	170	240	280	290	221	247	249	263	253	240	230				
1,5	180	260	350	370	300	305	320	300	310	310	300	310	320		
2	190	280	410	430	360	360	360	360	390	360	360	360	360	370	380
2,5	200	300	460	480	410	410	470	480	490	450	450	450	450	450	450
3	220	320	510	530	450	470	550	560	590	520	520	520	520	520	520
3,5	240	340	560	570	480	530	630	630	680	570	610	640	640	640	640
4	250	360	610	610	510	580	700	700	760	640	720	760	760	760	760
4,5	260	380	650	650	530	620	770	780	840	700	800	850	870	870	880
5	270	400	680	690	550	660	830	850	910	750	860	930	950	950	1000
6	280	410	700	720	580	720	900	950	1040	850	1000	1080	1150	1150	1150
7	280	420	720	760	600	790	950	1080	1140	940	1110	1220	1300	1300	1300
8	290	430	740	790	620	850	1000	1130	1220	1030	1200	1340	1400	1400	1400
9	290	440	760	820	640	880	1040	1180	1310	1090	1290	1450	1450	1450	1450
10	300	450	780	850	660	920	1060	1220	1370	1140	1380	1520	1520	1520	1520

FRM 100040... DN40 - max. air flow volume (AC 10)

FRM...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	240	290	290	300	270	270	270	270							
0,75	260	320	360	450	340	350	350	350	350						
1	280	350	460	570	400	410	410	440	470	470	470				
1,5	320	450	550	650	460	530	530	540	590	610	620	630	740		
2	350	530	630	720	550	620	620	640	700	730	770	820	840	840	880
2,5	415	580	700	800	615	700	700	750	800	840	870	1020	1030	1030	1100
3	460	630	780	890	670	770	770	830	890	940	940	1150	1300	1300	1300
3,5	505	670	860	970	715	840	840	930	990	1030	1040	1330	1420	1430	1500
4	540	700	950	1030	755	900	900	1020	1100	1130	1140	1410	1540	1590	1700
4,5	570	750	1050	1100	790	960	960	1100	1200	1220	1230	1540	1660	1730	1900
5	610	800	1130	1180	820	1020	1020	1170	1280	1300	1310	1670	1790	1880	2050
6	700	900	1240	1350	900	1120	1140	1320	1450	1450	1500	1900	1990	2150	2300
7	790	990	1330	1480	980	1180	1260	1450	1590	1580	1680	2120	2220	2400	2500
8	870	1070	1410	1550	1040	1220	1350	1570	1750	1690	1820	2300	2420	2600	2650
9	930	1140	1450	1580	1080	1250	1420	1690	1880	1790	1950	2500	2600	2750	2800
10	950	1190	1470	1620	1110	1270	1480	1780	2000	1810	2010	2610	2750	2850	2910

FRM 100050... DN50 - max. air flow volume (AC 10)

FRM...	ND				MD					HD					
p_a [bar] / p_e [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	160	170	230	230	210	210	210	210							
0,75	200	220	270	270	300	320	320	320	320						
1	220	260	330	330	390	400	410	410	440	380	380				
1,5	245	300	390	390	480	530	530	560	670	470	470	530	615		
2	270	330	460	460	570	630	630	700	870	600	600	700	700	700	750
2,5	295	360	540	540	650	730	730	820	1000	740	770	880	900	900	940
3	320	400	580	580	720	830	830	920	1100	860	980	1040	1080	1080	1120
3,5	345	430	620	620	780	890	930	1030	1180	960	1090	1200	1240	1240	1300
4	365	470	640	640	850	950	1010	1120	1260	1040	1200	1320	1380	1380	1520
4,5	380	510	690	690	920	980	1080	1200	1300	1120	1290	1440	1500	1500	1640
5	410	545	740	740	980	1040	1140	1270	1350	1180	1350	1530	1580	1620	1740
6	470	600	800	800	1060	1130	1240	1380	1450	1290	1460	1570	1660	1780	1960
7	520	660	860	870	1140	1210	1330	1450	1550	1380	1540	1600	1730	1940	2160
8	570	710	910	930	1200	1270	1400	1520	1650	1450	1600	1630	1810	2130	2340
9	620	750	950	980	1250	1320	1470	1560	1750	1500	1640	1660	1870	2240	2430
10	680	790	990	1050	1300	1380	1510	1590	1850	1530	1680	1680	1900	2340	2510

The maximum indicated volume flow refers to natural gas with a density 0.81 kg/m³ or to air with a density of 1.24 kg / m³ at 15 °C under standard conditions. In case of different types of gases, a conversion of the volume flow according to the equation below is carried out.

$$\dot{V}_{gas\ used} = \dot{V}_{air} \times f$$

$$f = \sqrt{\frac{\text{Air density}}{\text{spec. weight of the gas used}}}$$

Type of gas	Density [kg/m³]	dv	f
Natural gas	0.81	0.65	1.24
City gas	0.58	0.47	1.46
LPG	2.08	1.67	0.77
Air	1.24	1.00	1.00

16.3 Valve flow volume coefficient K_G

Type	DN	K_G-value
FRM 100025...	25	370
FRM 100040...	40	815
FRM 100050...	50	1150

The valve flow volume coefficient K_G f FRM is equal to the flow volume for a completely open firing valve with an absolute inlet pressure of p_d= 2.01325 bar and absolute outlet pressure of p_u= 1.01325 bar. The K_G-value value refers to natural gas with a density ratio of d= 0.64 according to a standard density of p_n= 0.83 kg/m³ and gas inlet temperature of t= 15 °C

The mass flow through a nozzle increases at constant upstream pressure with sinking pressure downstream of the nozzle, until it reaches its maximum at critical pressure ratio and remains constant from that moment on.
At constant outlet pressure, further increase of the upstream pressure causes a mass flow increase through the regulator. Therefore, to calculate the mass flow through a nozzle, a distinction is made between two ranges:

a) subcritical or critical pressure ratio

$$\frac{p_d}{p_u} \geq 0{,}53$$

$$K_G = \frac{Q_N}{\sqrt{(p_d+1{,}013)*(p_u+1{,}013)-(p_d+1{,}013)}}$$

b) supercritical pressure ratio

$$\frac{p_d}{p_u} < 0{,}53$$

$$K_G = \frac{Q_N*2}{\sqrt{(p_u+1{,}013)}}$$

with
Q_n= power of the regulator under standard conditions

The Pressure Equipment Directive (PED) and the Energy Performance for Buildings Directive (EPBD) require the heating installations to be checked at regular intervals to ensure high long-term utilisation ratios, resulting in minimum environmental impact.

It is necessary to replace safety-related components after the end of their service life. This recommendation applies only to heating installations and not to thermal process installations. DUNGS recommends to exchange them according to the following table:

Safety-relevant component	**SERVICE LIFE** **DUNGS recommends exchanging them after:**	**operating cycles**	**EN Standard**
Valve proving systems	**10 years**	250,000	EN 1643
Pressure switches	**10 years**	N/A	EN 1854
Automatic burner with flame safeguard	**10 years**	250,000	EN 1854
UV flame sensor	**10,000 h operating hours**		
Gas pressure regulators	**15 years**	N/A	EN 334
Gas valve without valve proving system*	**10 years**	50,000-500,000 size-dependent	EN 126 EN 161
Min. gas pressure switch	**10 years**	N/A	IEN 1643
Safety relief valve	**10 years**	N/A	EN 88 EN 14382
Safety shutoff valve	**10 years**	N/A	EN 14382
Air/gas combined system	**10 years**	N/A	EN 12067
* Gas families I, II, III	**N/A** cannot be used.		

Subject to technical modification in the interest of technical progress.

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