GB

DUNGS®
Combustion Controls

Instruction Manual

FRM 100025 - 100050 - 250025 - 250050

1. Target group

The target group of this manual is qualified personnel of the gas safety and regulating technology. Due to their specialist training, knowledge and experience, they should be 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.

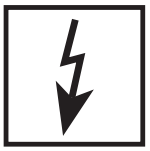
Hang this instruction manual in a readily visible place inside the installation room! Do not carry out any work until you have read the safety instructions of this instruction manual and are qualified to do so.

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 or for use in gas piping systems according to NFPA 54 or CSA B149.1 or for use in gas trains according to NFPA 86, NFPA 37, NFPA 85 or CSA B149.3.
- Use with gases of the 1st, 2nd and 3rd gas families according to EN 437 only (e.g. manufactured gas (town gas), commercial grade natural gas and commercial grade LPG gases in the vaporized phase).
- 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. EU Declaration of conformity

Produkt / Product Produit / Producto	**FRM 100025 - 100050 FRM 250025 - 250050**	**Medium Pressure Regulator 10 bar / 25 bar**	
Hersteller / Manufacturer Fabricant / El Fabricante	**Karl Dungs GmbH & Co. KG Karl-Dungs-Platz 1 73660 Urbach, Germany**		
bescheinigt hiermit, dass die in dieser Übersicht genannten Produkte einer **EU-Baumusterprüfung (Baumuster)** unterzogen wurden und die wesentlichen Sicherheitsanforderungen der: • **EU-Druckgeräterichtlinie 2014/68/EU** in der gültigen Fassung erfüllen. Bei einer von uns nicht freigegebenen Änderung des Gerätes verliert diese Erklärung ihre Gültigkeit. Der oben beschriebene Gegenstand der Erklärung entspricht den einschlägigen Harmonisierungsrechtsvorschriften der Union. Die alleinige Verantwortung für die Ausstellung dieser Konformitätserklärung trägt der Hersteller.	certifies herewith that the products named in this overview were subjected to an **EU-Type Examination (production type)** and meet the essential safety requirements: • **EU-Pressure Equipment Directive "2014/68/EU"** as amended. In the event of an alteration of the equipment not approved by us this declaration loses its validity. The object of the declaration described above conforms with the relevant Union harmonisation legislation. This declaration of conformity is issued under the sole responsibility of the manufacturer.	certifie par la présente que le produit mentionné dans cette vue d'ensemble a été soumis à **un examen UE de type (type de fabrication)** et qu'il est conforme aux exigences en matières de sécurité des dernières versions en vigueur de : • **Directive européenne relative aux appareils sous pression 2014/68/UE** Ce communiqué n'est plus valable si nous effectuons une modification libre de l'appareil. L'objet décrit ci-dessus de la présente déclaration correspond aux prescriptions légales applicables en matière d'harmonisation de l'Union. Le fabricant porte l'entière responsabilité pour l'établissement de la présente déclaration de conformité.	certifica que los productos mencionados en este resumen han sido sometidos a un **examen UE de tipo (tipo de producción)** y cumplen con los requisitos mínimos de seguridad de: • **Directiva de equipos a presión de la UE 2014/68/UE** en su versión vigente. En caso de una modificación no autorizada por nosotros, esta declaración pierde su validez. El objeto de la declaración descrita anteriormente es conforme a la legislación de armonización pertinente de la Unión. El fabricante es el único responsable de la expedición de esta declaración de conformidad.
Prüfgrundlage der EU-Baumusterprüfung (Baumuster) Specified requirements of the EU-Type Examination (production type) Base d'essai de l'examen UE de type (type de fabrication) Requisitos específicos del examen UE de tipo (tipo de producción))	**DIN EN 334 DIN EN 14382**		
Gültigkeitsdauer/Bescheinigung Term of validity/attestation Validité/certificat Periodo de validez / Certificado	**2024-09-12 CE-0085CP0256**		
Notifizierte Stelle (EU Baumusterprüfung: Modul B) Notified Body (EU type-examination: Module B) Organisme notifié (Examen de type de l'UE: module B) Organismo notificado (Examen tipo UE: Módulo B)	**DVGW CERT GmbH** Josef-Wirmer-Straße 1-3 D-53123 Bonn, Germany Notified Body number: 0085		
Überwachung des QM-Systems (Modul D) Monitoring of the QM system (module D) Contrôle de la gestion de l'assurance qualité (module D) Supervisión del sistema de calidad y seguridad módulo D)	**TÜV SÜD Industrie Service GmbH** Westendstraße 199 D-80686 München, Germany Notified Body number: 0036		
B. Sc., MBA, Simon P. Dungs Geschäftsführer / Chief Operating Officer Directeur / Gerente Urbach, 2022-08-01			

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Combustion Controls

3. Declaration of conformity

Product	**FRM 100025 - 100050** **FRM 250025 - 250050**	**Medium Pressure Regulator 10 bar / 25 bar**
Manufacturer	**Karl Dungs GmbH & Co. KG · Karl-Dungs-Platz 1 · D-73660 Urbach/Germany**	

Certifies herewith that the products named in this overview were subjected to a **Type Examination (production type)** and meet the essential safety requirements:

- **The Pressure Equipment Safety Regulations, UKSI 2016:1105 (as amended by UKSI 2019: 969)**

In the event of an alteration of the equipment not approved by us this declaration loses its validity.
The object of the declaration described above conforms with the relevant legislation.
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Specified requirements of the Type Examination (production type)	**DIN EN 334** **DIN EN 14382**
Term of validity	**2032-07-13**
Approved Body	**2016 No. 1105** **TUV SUD BABT Unlimited** Octagon House, Concorde Way, Segensworth North, Fareham, Hampshire, PO15 5RL, United Kingdom Approved Body Number: 0168
Monitoring of the QA system	Conformity process adopted: Module B+D
B.Sc., MBA Simon P. Dungs, Chief Operating Officer Urbach, 2022-08-01	

4. Table of contents

5. List of abbreviations

Abbreviation	Description
AG_o	Response pressure group of the overpressure shut-off (OPSO)
AG_u	Response pressure group of the underpressure shut-off (UPSO)
AC	Accuracy class
ASE	Safety shutoff valve (SAV) without housing (as spare part)
K_G	Flow volume coefficient for natural gas
DN	Nominal diameter
Fail-open	If the main diaphram or the auxiliary pressure required for the actuation of the main valve fails, the main valve moves automatically to the open position.
IS	Type: integral strength range (max. casing pressure) Maximum rated operating pressure for both, body and upper housing
DS	Type: differential strength range
Class A	Functional class: in case the membrane is damaged or in the event of a breakdown of the impulse line pressure the SAV closes
MOP	Maximum admissible operating pressure
p_d	Outlet pressure
$p_{d, abs.}$	Output pressure as absolute pressure
p_u	Inlet pressure
$p_{u, abs.}$	Inlet pressure as absolute pressure
p_{do}	Overpressure shut-off (OPSO)
p_{du}	Underpressure shut-off (UPSO)
p_{max}	Maximum operating pressure
PN	Nominal pressure rating of the flange
PS	Maximum admissible pressure
SAV	Safety shutoff valve / Slam-shut valve (same as ASE but with housing)
SBV	Safety relief valve
SG	Lock-up pressure class
SN	Serial number
SZ	Lock up pressure zone group
Tp.	Operating temperature -20 °C ... +60 °C
W_{ds}	Specific guide range
W_{do}	Adjustment range for the overpressure shut-off (OPSO) through regulation of the available adjusting springs
W_{du}	Adjustment range for the underpressure shut-off (UPSO) through regulation of the available adjusting springs
W_{dso}	Specific adjustment range of the adjusting spring installed for the over pressure shut-off (OPSO)
W_{dsu}	Specific adjustment range of the adjusting spring installed for the under pressure shut-off (UPSO)

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6. Features

6.1. Technical data

Technical data	FRM …
Device	Spring-loaded medium pressure regulator according to EN 334
Type	IS (FRM 100...) / DS (FRM 250...)
Type of gas	Family 1+2+3 (e.g. manufactured gas (town gas), commercial grade natural gas and commercial grade LPG gases in the vaporized phase).
Nominal diameters Flange	Connecting flanges PN 25 according to EN 1092-1 or ANSI Class 150 per B16.5 DN 25 40 50 NPS 1" 1.5" 2"
Admissible pressure load	FRM 250... 25 bar (2 500 kPa / 360 PSI)* / FRM 100... 10 bar (1 000 kPa / 145 PSI)
Max. inlet pressure	FRM 250... 25 bar (2 500 kPa / 360 PSI)* / FRM 100... 10 bar (1 000 kPa / 145 PSI)
Outlet pressure range	30 - 4 000 mbar (3 - 400 kPa) / 12 - 1 600 "W.C. (0.4 - 58 PSI)
Minimum inlet pressure for ND versions	200 mbar (20 kPa) / 80 "W.C. (2.9 PSI)
Minimum inlet pressure for MD version	300 mbar (30 kPa) / 120 "W.C. (4.3 PSI)
Minimum inlet pressure for HD versions	750 mbar (75 kPa) / 301 "W.C. (10.9 PSI)
Minimum inlet pressure for UHD versions	1 500 mbar (150 kPa) / 600 "W.C. (21 PSI)
Materials	Main body housing: cast iron GJS 400-15 (GJS 400-18 LT ductible iron on request) Diaphragm housing: steel Diaphragms: NBR
Ambient temperature	-20 °C to + 60 °C / -4 °F to + 140 °F

*19 bar (1 900 kPa / 275 PSI) with ANSI 150 flanges

Technical data	SAV …
Device	Safety shutoff valve / slam-shut valve in compliance with EN14382, class A
Type	IS (FRM 100...) / DS (FRM 250...)
Response time	≤ 2s
Adjustment range below W_{du}	10 - 3 000 mbar (1 - 300 kPa) / 4 - 1 200 "W.C. (0.15 - 43 PSI)
Adjustment range above W_{do}	40 - 5 000 mbar (4 - 500 kPa) / 16 - 2 005 "W.C. (0.6 - 72 PSI)
Materials	Main body housing: cast iron GJS 400-15 (GJS 400-18 LT on request) 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**						
Maximum operating pressure MOP	100 …	10 000 mbar (1 000 kPa) 4 018 "W.C. (145 PSI)					
	250...	25 000 mbar (2 500 kPa) 2 500 "W.C. (360 PSI)					
Nominal diameter	025	DN 25 (1")					
	040	DN 40 (1½")					
	050	DN 50 (2")					
Pressure range, outlet pressure	ND	Low pressure					
	MD	Medium pressure					
	HD	High pressure					
	UHD	Ultra high pressure					
Safety device	SAV	Integrated safety shutoff valve					
Pressure range, trip pressure	ND	Low pressure					
	MD	Medium pressure					
	HD	High pressure					
	UHD	Ultra high pressure					
Flange type		with standard PN-25					
	ANSI	with ANSI Class 150					

6.3 Adjustment range

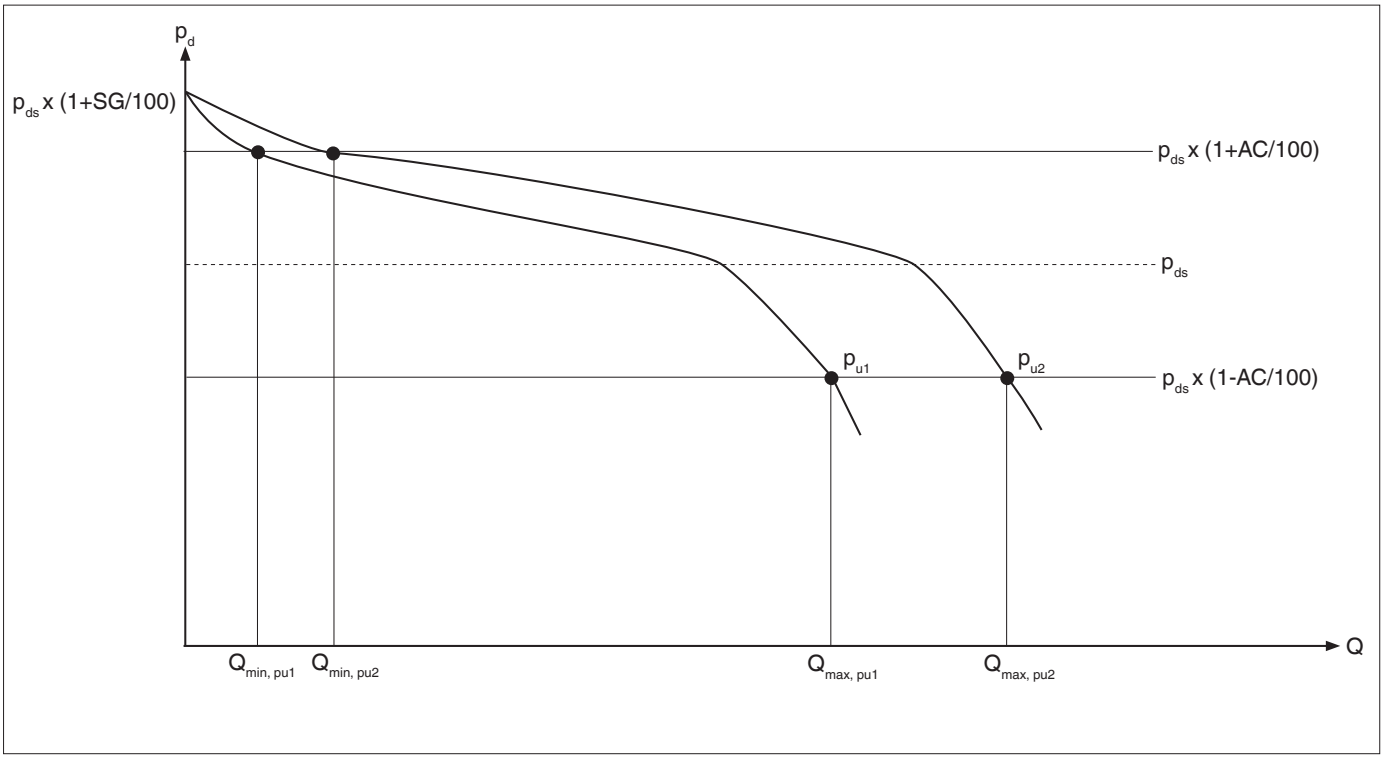
Type	Connec-tion	Ver-sion	Accuracy class* [AC]	Lock-up pressure class* [SG]	Outlet pressure range W_d	Lower tripping point SAV		Upper tripping point SAV	
						W_{du}	AG	W_{do}	AG
FRM 100025 ND	DN 25	ND	AC 10	SG 20	30 - 100 mbar 12 - 40 "W.C.				
FRM 100025 MD	DN 25	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.				
FRM 100025 HD	DN 25	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.				
FRM 250025 UHD	DN 25	UHD	AC 5	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.				
FRM 100025 ND / SAV ND	DN 25	ND	AC 10	SG 20	30-100 mbar 12 - 40 "W.C.	10 - 115 mbar 4 - 46 "W.C.	AG 10	40 - 240 mbar 16 - 96 "W.C.	AG 10
FRM 100025 MD / SAV MD	DN 25	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.	35 - 400 mbar 12 - 160 "W.C.	AG 10	180 - 800 mbar 72 - 321 "W.C.	AG 10
FRM 100025 HD / SAV HD	DN 25	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.	150 - 1 400 mbar 60 - 562 "W.C.	AG 5	500 - 3 500 mbar 200 - 1 406 "W.C.	AG 5
FRM 250025 UHD / SAV UHD	DN 25	UHD	AC 10	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.	150 - 3 000 mbar 60 - 1 200 "W.C.	AG 5	1 300 - 5 000 mbar 522 - 2 005 "W.C.	AG 5
FRM 100040 ND	DN 40	ND	AC 10	SG 20	30 - 100 mbar 12 - 40 "W.C.				
FRM 100040 MD	DN 40	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.				
FRM 100040 HD	DN 40	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.				
FRM 250040 UHD	DN 40	UHD	AC 5	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.				
FRM 100040 ND / SAV ND	DN 40	ND	AC 10	SG 20	30 - 100 mbar 12 - 40 "W.C.	10 - 115 mbar 4 - 46 "W.C.	AG 10	40 - 240 mbar 16 - 96 "W.C.	AG 10
FRM 100040 MD / SAV MD	DN 40	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C	35 - 400 mbar 14 - 160 W.C.	AG 10	180 - 800 mbar 72 - 321 "W.C.	AG 10
FRM 100040 HD / SAV HD	DN 40	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.	150 - 1 400 mbar 60 - 562 W.C.	AG 5	500 - 3 500 mbar 200 - 1406 "W.C.	AG 5
FRM 250040 UHD / SAV UHD	DN 40	UHD	AC 10	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.	150 - 3 000 mbar 60 - 1 200 "W.C.	AG 5	1 300 - 5 000 mbar 522 - 2 005 "W.C.	AG 5
FRM 100050 ND	DN 50	ND	AC 10	SG 20	30 - 100 mbar 12 - 40 "W.C.				
FRM 100050 MD	DN 50	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.				
FRM 100050 HD	DN 50	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.				
FRM 250050 UHD	DN 50	UHD	AC 5	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.				
FRM 100050 ND / SAV ND	DN 50	ND	AC 10	SG 20	30 - 100 mbar 12 - 40 "W.C.	10 - 115 mbar 4 - 46 "W.C.	AG 10	40 - 240 mbar 16 - 96 "W.C.	AG 10
FRM 100050 MD / SAV MD	DN 50	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.	35 - 400 mbar 12 - 160 "W.C.	AG 10	180 - 800 mbar 72 - 321 "W.C.	AG 10
FRM 100050 HD / SAV HD	DN 50	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.	150 - 1 400 mbar 60 - 562 "W.C.	AG 5	500 - 3 500 mbar 200 - 1 406 "W.C.	AG 5
FRM 250050 UHD / SAV UHD	DN 50	UHD	AC 10	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.	150 - 3 000 mbar 60 - 1 200 "W.C.	AG 5	1 300 - 5 000 mbar 522 - 2 005 "W.C.	AG 5

*Accuracy class / lock-up pressure class according to EN 334
**p_d = 90 - 180 mbar / 36 - 72 "W.C.: AC 10, SG 20
p_d= 180 - 420 mbar / 72 - 168 "W.C.: AC 5, SG 10

6.4 Accuracy class / lock-up pressure class

Version	Outlet pressure range	Accuracy class [AC]	Lock-up pressure
FRM...ND	30 - 50 mbar / 12 - 20 "W.C.	AC 15	p_d + 15 mbar / 6 "W.C.
	50 - 80 mbar / 20 - 32 "W.C	AC 10	
	90 - 100 mbar / 36 - 40 "W.C.	AC 5	
FRM...MD	90 - 120 mbar / 36 - 48 "W.C.	AC 15	p_d + 25 mbar / 10 "W.C
	120 - 180 mbar / 48 - 72 "W.C.	AC 10	
	180 - 420 mbar / 72 - 168 "W.C.	AC 5	
FRM...HD	400 - 450 mbar / 160 - 180 "W.C.	AC 10	p_d + 50 mbar / 20 "W.C.
	450 - 500 mbar / 180 - 200 "W.C.	AC 5	
	500 - 1 500 mbar / 200 - 602 "W.C.	AC 2.5	
FRM...UHD	1 000 - 4 000 mbar / 400 - 1 600 "W.C.	AC 5	p_d + 50 mbar / 20 "W.C.

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
$p_{u½}$	Inlet pressure
p_{ds}	Set nominal value of the outlet pressure
SG	Lock-up pressure class
$Q_{min\ /\ pu½}$	AC minimum flow volume at a specific inlet pressure p_u (lower limit of the volume flow at which the stable operating conditions for a given nominal value within the given operating temperature range).
$Q_{max\ /\ pu½}$	AC maximum flow volume at a specific inlet pressure p_u (upper limit of the volume flow at which a given accuracy class for a given nominal value within the given operating temperature range).

6.5 Selection of regulator springs

Adjustment range, outlet pressure W_{du}								
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range			
					ND	MD	HD	UHD
Silver	270341	5.5	300	60	30 - 40 mbar 12 - 16 "W.C.	90 - 110 mbar 36 - 44 "W.C.		
Green	270345	6.5	280	62.5	40 - 55 mbar 16 - 22 "W.C.	110 - 170 mbar 44 - 68 "W.C.		
Yellow	270346	7.0	300	63	55 - 80 mbar 22 - 32 "W.C.	170 - 240 mbar 68 - 98 "W.C.		
Blue	270347	8.0	300	65	80 - 100 mbar 32 - 40 "W.C.	240 - 330 mbar 96 - 132 "W.C.		
Black	270348	9.0	300	68		330 - 420 mbar 132 - 168 "W.C.	400 - 580 mbar 160 - 233 "W.C.	
Purple	270349	10.0	300	69			560 - 850 mbar 225 - 341 "W.C.	
Orange	270350	11.0	300	71			800 - 1 200 mbar 321 - 482 "W.C.	1 000 - 1 600 mbar 402 - 652 "W.C.
Pink	270352	12.0	300	73			1 100 - 1 500 mbar 442 - 602 "W.C.	
White	271113	13.0	300	75				1 500 - 2 500 mbar 603 - 1 004 "W.C.
Red	271132	14.0	300	77				1 900 - 3 300 mbar 763 - 1 325 "W.C.
Red/ Brown	276127	14.0/8.0	300	77/46				2 900 - 4 000 mbar 1 164 - 1 608 "W.C.

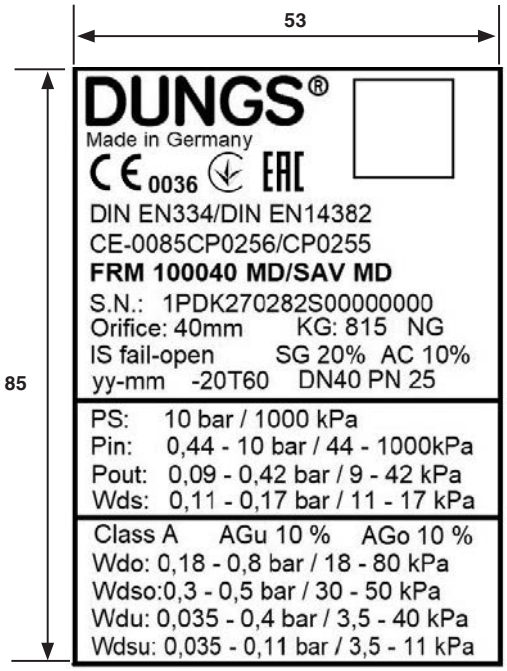
6.6 Selection of SAV springs

Specific adjustment range, underpressure W_{dsu}								
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range			
					ND	MD	HD	UHD
White	270353	1.2	60	10.0	10 - 32 mbar 4 - 12 "W.C.			
Yellow	270355	1.5	55	12.3	24 - 40 mbar 9 - 16 "W.C.			
Blue	270356	2.0	55	12.3	30 - 115 mbar 12 - 46 "W.C.	35 - 110 mbar 14 - 44 "W.C.		
Black	270357	2.3	55	12.3		50 - 250 mbar 20 - 100 "W.C.		
Purple	270358	2.5	55	12.3		80 - 400 mbar 32 - 160 "W.C.	150 - 500 mbar 60 - 200 "W.C.	150 - 500 mbar 62 - 101 "W.C.
Orange	270359	3.2	55	15.0			300 - 1 000 mbar 120 - 401 "W.C.	300 - 1 000 mbar 121 - 402 "W.C.
Silver	270360	3.0	60	15.0			800 - 1 400 mbar 321 - 563 "W.C.	800 - 1 400 mbar 321 - 563 "W.C.
Pink	276126	3.5	60	15.0				1 200 - 3 000 mbar 482 - 1 205 "W.C.

Specific adjustment range, overpressure W_{dso}								
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range			
					ND	MD	HD	UHD
Silver	270361	2.2	60	30.0	40 - 130 mbar 16 - 52 "W.C.			
Green	270366	2.5	60	30.0	60 - 190 mbar 24 - 76 "W.C.	180 - 290 mbar 72 - 116 "W.C.		
Red	270367	2.7	60	30.0	90 - 240 mbar 36 - 98 "W.C.	230 - 370 mbar 92 - 148 "W.C.		
Yellow	270368	3.2	60	30.0		300 - 500 mbar 120 - 200 "W.C.		
Blue	270369	3.5	60	30.0		400 - 800 mbar 160 - 321 "W.C.	500 - 1 000 mbar 120 - 401 "W.C.	
Black	270370	3.7	60	30.0			700 - 1 300 mbar 281 - 522 "W.C.	
Purple	270371	4.0	60	30.0			1 000 - 1 800 mbar 401 - 723 "W.C.	
Orange	270372	4.5	60	30.0			1 300 - 2 500 mbar 522 - 1 004 "W.C.	1 300 - 2 500 mbar 522 - 1 005 "W.C.
Pink	270373	4.8	60	30.0			1 800 - 3 500 mbar 723 - 1 406 "W.C.	1 800 - 3 500 mbar 723 - 1 407 "W.C.
White	271115	5.0	60	30.0				2 500 - 5 000 mbar 1 005 - 2 009 "W.C.

6.7 Type plate

Regulator



Abbreviation	Description
AG_o	Response pressure group of the overpressure shut-off (OPSO)
AG_u	Response pressure group of the underpressure shut-off (UPSO)
AC	Accuracy class
K_G	Flow volume coefficient for natural gas
DN	Nominal diameter
Fail-open	If the main diaphram or the auxiliary pressure required for the actuation of the main valve fails, the main valve moves automatically to the open position.
IS	Type: integral strength range (max. casing pressure)
DS	Type: differential strength range
Class A	Functional class: in case the membrane is damaged or in the event of a breakdown of the impulse line pressure 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 / slam-shut valve (ASE without housing)
SG	Lock-up pressure class
-20T60	Operating temperature -20 °C ... +60 °C / -4 °F to + 140 °F
SN	Serial number
W_{ds}	Specific guide range
W_{do}	Adjustment range for the overpressure shut-off (OPSO) through regulation of the available adjusting springs
W_{du}	Adjustment range for the underpressure shut-off (UPSO) through regulation of the available adjusting springs
W_{dso}	Specific adjustment range of the adjusting spring installed for the overpressure shut-off (OPSO)
W_{dsu}	Specific adjustment range of the adjusting spring installed for the underpressure shut-off (UPSO)

7. Function

The pressure regulator's function is to keep the outlet pressure 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.

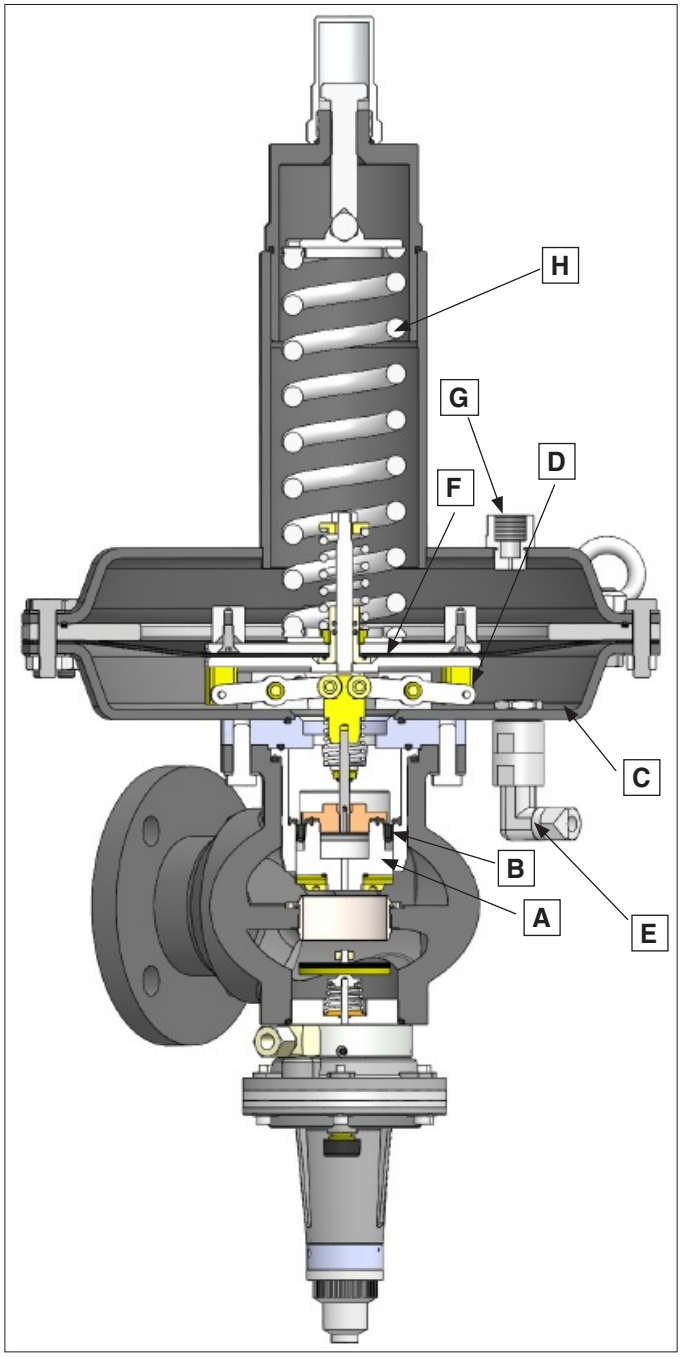
Main components
A Control plate
B Inlet pressure compensation diaphragm
C Lower diaphragm shell
D Lever system
E Impulse connection for the outlet pressure
F Working diaphragm
G Vent connection
H Setpoint spring

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 also. 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 downward 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 increased. 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.

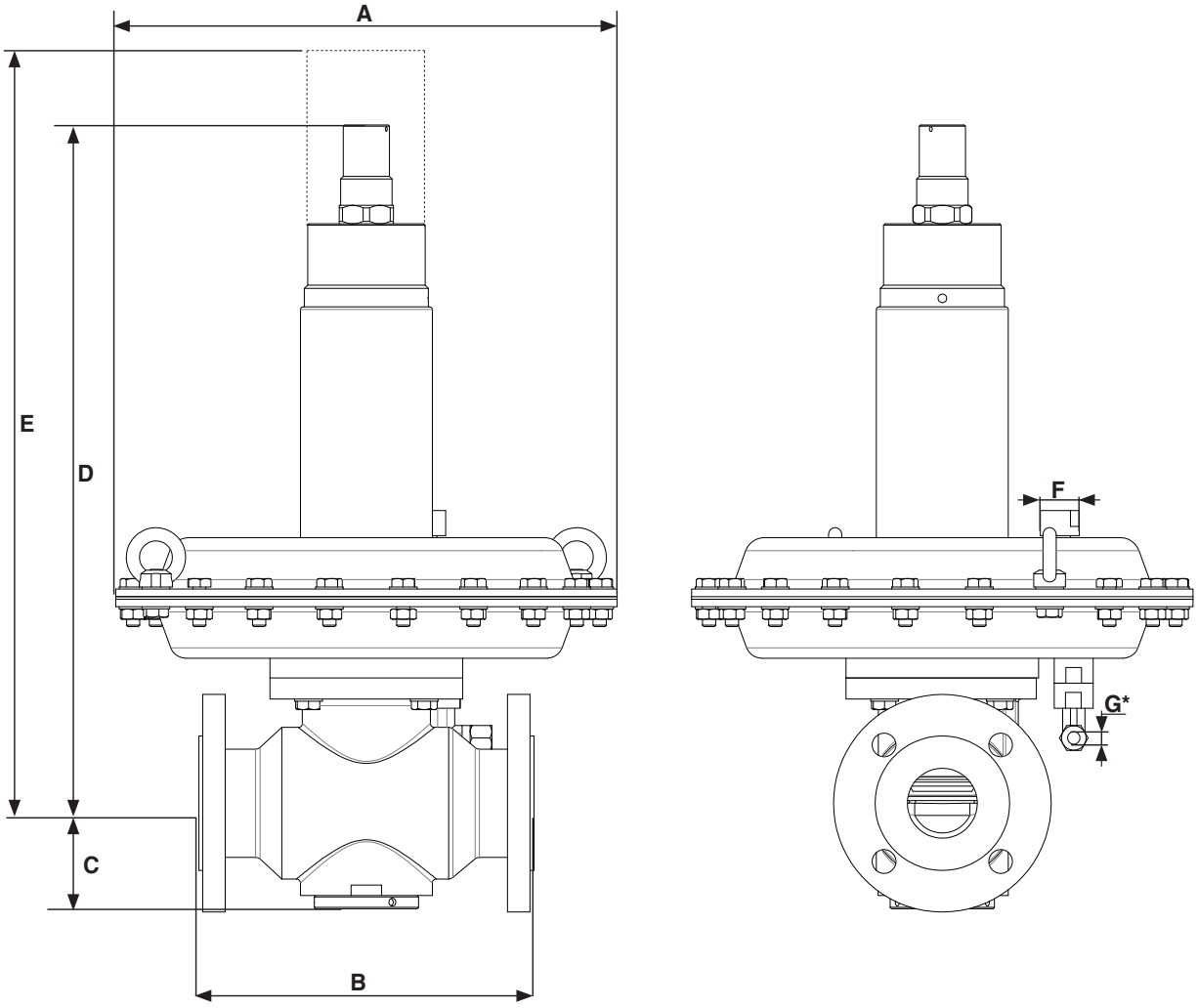
Inlet pressure compensation
Changes in the inlet pressure have no influence on the balance of forces. The inlet pressure is compensated by the inlet pressure compensation diaphragm **B**.



The inlet pressure is then transferred 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...

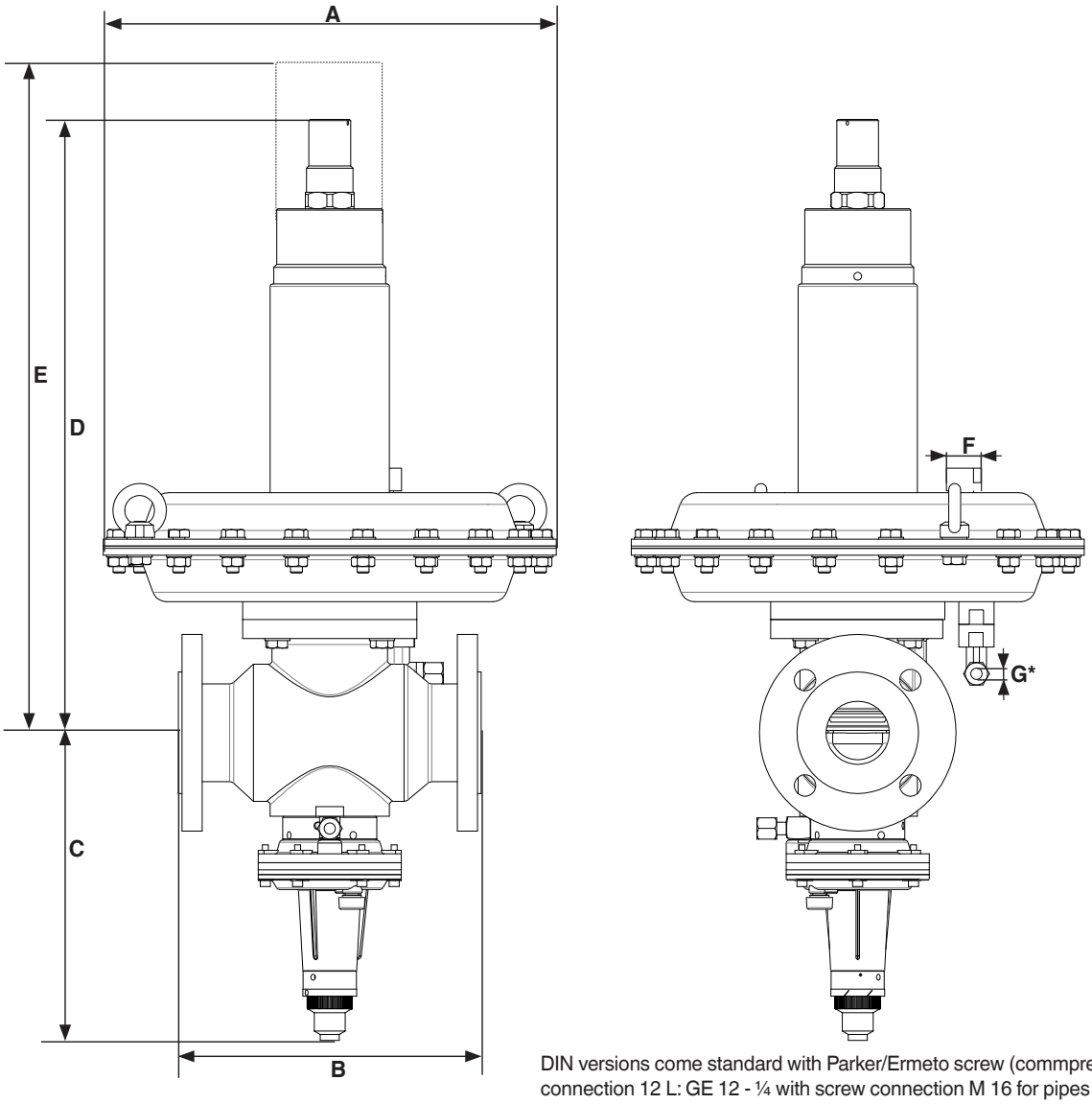


Ermeto screw (commpression) connection 12 L: GE 12 - ¼
with screw connection M 16 for pipes 12 x 1.5.
* Option only US/CDN
Optional with swagelok fitting for ½" tubing.

Type	Order number	$p_{max.}$ [bar/kPa/PSI]	DN	Dimensions							Weight [kg]
				A	B	C	D	E	F**	G	
FRM 100025 ND	270272	10 / 1 000 / 145	25	500	184	57	492	820	½ "G	⌀ 12	38 (83.8 lbs)
FRM 100025 MD	270273	10 / 1 000 / 145	25	380	184	57	492	820	½ "G	⌀ 12	32 (70.5 lbs)
FRM 100025 HD	270274	10 / 1 000 / 145	25	380	184	57	502	830	½ "G	⌀ 12	36 (79.4 lbs)
FRM 250025 UHD	271116	25 / 2 500 / 360	25	380	184	57	502	830	½ "G	⌀ 12	36 (79.4 lbs)
FRM 100040 ND	270278	10 / 1 000 / 145	40	500	223	69	505	830	½ "G	⌀ 12	42 (92.6 lbs)
FRM 100040 MD	270279	10 / 1 000 / 145	40	380	223	69	505	830	½ "G	⌀ 12	36 (79.4 lbs)
FRM 100040 HD	270280	10 / 1 000 / 145	40	380	223	69	515	840	½ "G	⌀ 12	40 (88.2 lbs)
FRM 250040 UHD	271118	25 / 2 500 / 360	40	380	223	69	515	840	½ "G	⌀ 12	40 (88.2 lbs)
FRM 100050 ND	270284	10 / 1 000 / 145	50	500	254	80	515	840	½ "G	⌀ 12	49 (108 lbs)
FRM 100050 MD	270285	10 / 1 000 / 145	50	380	254	80	515	840	½ "G	⌀ 12	43 (94.8 lbs)
FRM 100050 HD	270286	10 / 1 000 / 145	50	380	254	80	525	850	½ "G	⌀ 12	47 (103 lbs)
FRM 250050 UHD	271120	25 / 2 500 / 360	50	380	254	80	525	850	½ "G	⌀ 12	47 (103 lbs)

**½ "G to ½ "NPT adapter p/n 231945

FRM... / SAV



DIN versions come standard with Parker/Ermeto screw (commpression) connection 12 L: GE 12 - ¼ with screw connection M 16 for pipes 12 x 1.5.
* Option only US/CDN
Optional with swagelok fitting for ½" p/n 267856 or ¼" tubing p/n 267783.
US versions come standard with swagelok fitting for ½" tubing.

Type	Order number	p max. [bar/kPa/PSI]	DN	Dimensions							Weight [kg]
				A	B	C	D	E	F**	G	
FRM 100025 ND/SAV ND	270275	10 / 1 000 / 145	25	500	184	232	492	1 070	½ "G	⌀ 12	40 (88.2 lbs)
FRM 100025 MD/SAV MD	270276	10 / 1 000 / 145	25	380	184	229	492	1070	½ "G	⌀ 12	34 (75.0 lbs)
FRM 100025 HD/SAV HD	270277	10 / 1 000 / 145	25	380	184	236	502	1 080	½ "G	⌀ 12	38 (83.8 lbs)
FRM 250025 UHD/SAV UHD	271117	25 / 2 500 / 360	25	380	184	236	502	1 080	½ "G	⌀ 12	38 (83.8 lbs)
FRM 100040 ND/SAV ND	270281	10 / 1 000 / 145	40	500	223	243	505	1 080	½ "G	⌀ 12	44 (97.0 lbs)
FRM 100040 MD/SAV MD	270282	10 / 1 000 / 145	40	380	223	239	505	1 080	½ "G	⌀ 12	38 (83.8 lbs)
FRM 100040 HD/SAV HD	270283	10 / 1 000 / 145	40	380	223	247	515	1 090	½ "G	⌀ 12	42 (92.6 lbs)
FRM 250040 UHD/SAV UHD	271119	25 / 2 500 / 360	40	380	223	247	515	1 090	½ "G	⌀ 12	42 (92.6 lbs)
FRM 100050 ND/SAV ND	270287	10 / 1 000 / 145	50	500	254	252	515	1 090	½ "G	⌀ 12	51 (112.0 lbs)
FRM 100050 MD/SAV MD	270288	10 / 1 000 / 145	50	380	254	248	515	1 090	½ "G	⌀ 12	45 (99.2 lbs)
FRM 100050 HD/SAV HD	270289	10 / 1 000 / 145	50	380	254	256	525	1 100	½ "G	⌀ 12	49 (108.0 lbs)
FRM 250050 UHD/SAV UHD	271121	25 / 2 500 / 360	50	380	254	256	525	1 100	½ "G	⌀ 12	49 (108.0 lbs)

**½ "G to ½ "NPT adapter p/n 231945

Edition 2022.08 • No. 270 442 Rev. -0

9. Installation

9.1 General information

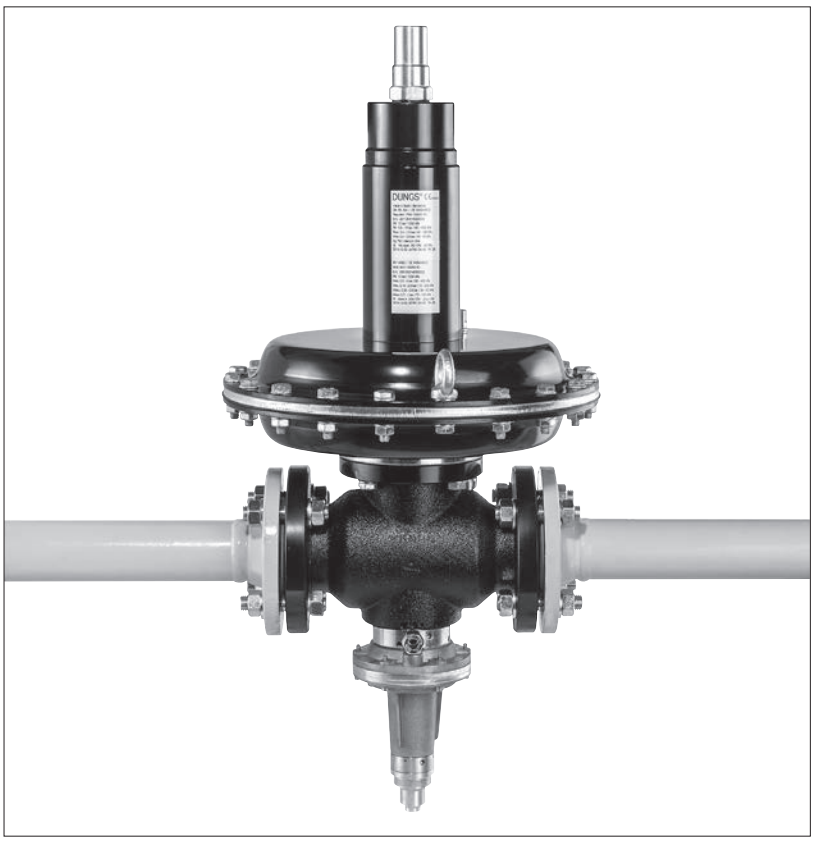
- **This device can only be installed in compliance with the rules and standards applicable and in accordanc with the local regulations and authorisantions.**
- **Install the device in a building or housing, do not install it outdoors without suitable protective measures!**
- **The lifting devices used 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.
- Upstream and downstream piping are free from combustible gas.
- Prevent explosive gas-air mixture: the room atmosphere must be monitored for gas leakages. For the US and Canada, piping shall be purged per NFPA 56, NFPA 54 or per B 149.1.
- Ensure electrical continuity with use of suitable bonding straps. Prevent contact voltage and ignitable flashover.
- The performance data on the type plate corresponds to the purchase ordering data.
- Flanges on the inlet side and outlet side of the connecting lines are parallel with the FRM flanges.
- 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 and changing springs must be observed.
- The pipeline on the inlet side must be free of water and dirt.

Note during installation!

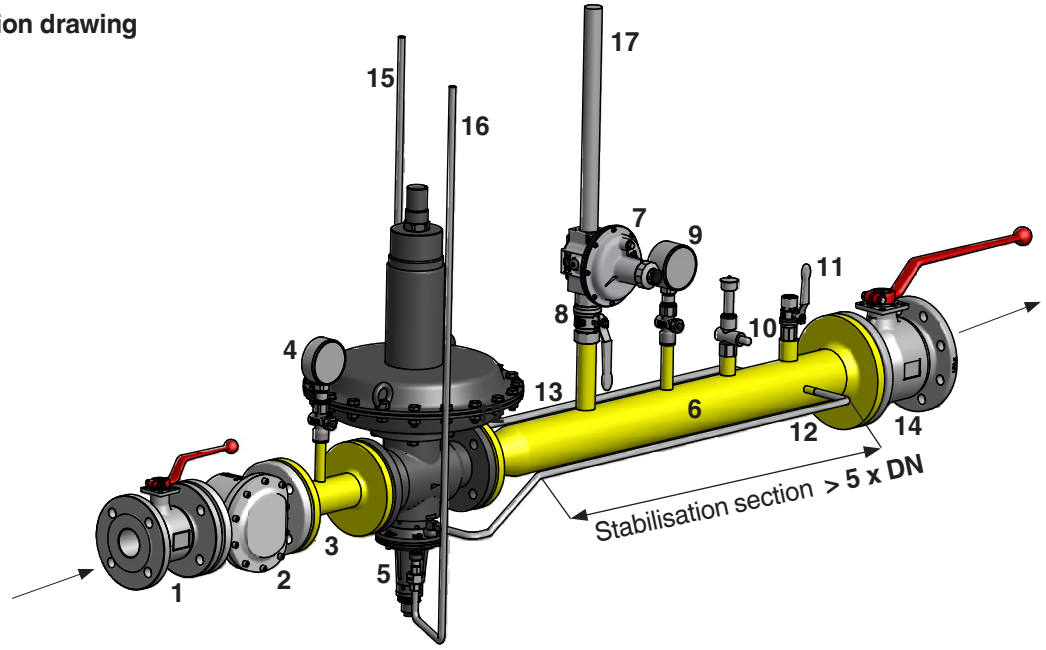
- Mounting must be carried out in a tension-free state. No excessive bending.
- Tighten the screws crosswise.
- Tightening torques must be observed.
- Vent lines and blow-off lines have to be positioned separately.
- Vent lines and blow-off lines must lead outdoors: gases must be able to escape to a non-hazardous environment. See section "vent lines".
- The impulse lines may not be shut off or isolated from the gas pressure.
- The specified distance between the measuring points of the impulse lines must be observed.
- The flow direction (arrow) on the housing must be followed.



9.2 Installation instructions

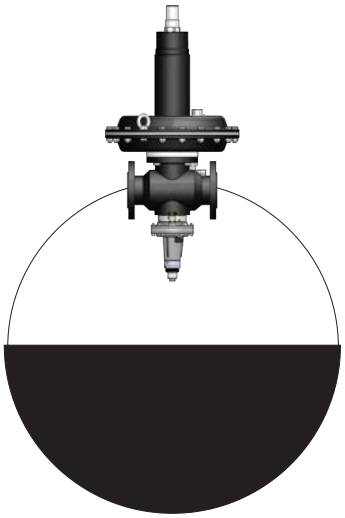
- The installation must be carried according to the installation scheme specified below, unless deviations required by regulations.
- Install the safety shutoff valve in the flow direction (arrow/housing).
- Design a straight stablisation section with the equal diameter.
- Make sure that the impulse tapping at the stablisation section is clean and free from burrs. Distance > 5 x DN
- Maximum flow velocity in the stablisation section: ≤ 30 m/s.
- Use steel pipe impulse lines:
  For versions using Ermeto screw connection 12 L:
  GE 12 - ¼, use D= 12 x 1.5
  For versions using fitting p/n 267856, use ½" tubing
- Avoid accumulation of condensate: install the impulse 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	Stabilisation section
7	SBV
8	Ball valve
9	Pressure gauge, outlet side
10	Test burner
11	Venting ball valve
12	Impulse line, SAV
13	Impulse 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 for SBV

Mounting position



9.3 Vent Lines (Only U.S.A and Canada)

In addition to the requirements below, vent lines shall be installed in accordance with the applicable installation code (e.g. NFPA 86, NFPA 37, NFPA 54, B149.3, B1491) and shall terminate to an approved and safe location.

Requirements for Vent line Installation

- Keep elbows to an absolute minimum, and when a 90 deg needs to be made, do as follows:
  - If using rigid pipe, use long radius elbows (not short). Long radius elbows have a bending radius of 1.5 times the pipe diameter. Short elbows have a bending radius of 1 times the pipe diameter.
  - If using tubing and permitted by code, use a minimum bending radius of 2 x the vent line outside diameter.
- Do not reduce along the entire run of the vent line the pipe size that is established at the regulator's threaded vent connection.
- Do not apply a bending moment on the vent line, if rigid pipe is used. This can apply a large bending force (a severe stress) to the vent connection of the regulator and damage the housing, which will bypass of the vent line.
- Apply proper pipe hangers and supports so that the vent line does not load or strain due to the regulator vent line connection due weight of the vent piping or due to a bending moment at the vent connection.

Manifolding of vent lines

- Do not manifold the FRM vent with the SAV vent or a relief valve vent.
- Do not manifold the SAV vent with a relief valve vent.
- Do not manifold other vents of similar devices (regulator to regulator, relief valve to relief valve, etc), unless permitted by and manifolded in accordance with the applicable installation code.

Requirements for Vent Line Length and Size for FRM and SAV vents

- The diameter of vent line shall be the same size at the vent connection.
- The vent line from the SAV vent connection to the point of termination shall be the same size.
- The vent line from the FRM vent connection to the point of termination shall be the same size if

  1. downstream equipment is an industrial application covered by NFPA 37, NFPA 85, NFPA 86, or NFPA 87, or
  2. a relief valve (or token relief valve) is mounted downstream of the FRM.

Otherwise, the following apply:

- Use schedule 40, ½ " pipe or minimum 15mm OD tubing.
- After a length of 15 ft: schedule 40, ¾ " pipe or minimum 20 mm OD tubing.
- After additional 15 ft, increase pipe to schedule 40, 1 " pipe or minimum 26 mm OD tubing until the point of termination.

Requirements for the Vent Line's Point of Termination

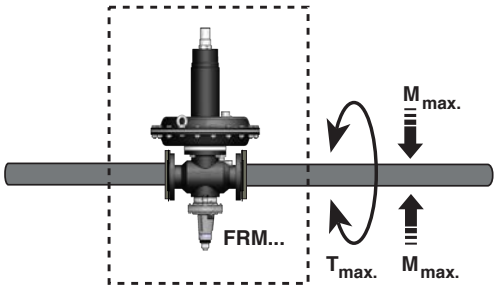
- Considerations depending on the gas type:
  - For Natural Gas and lighter than air combustible gases, the gas will eventually leave the area of discharge.
  - However, for heavier than air combustible or even non-combustible gases, they could accumulate at the point of discharge or even accumulate underneath the point of discharge which can create areas of retained combustible or non-breathable gases. Specific attention must be taken for such cases.

- If a vent line runs through a roof, verify that the vent line terminates above the point where water and snow accumulation on the roof does not cover or isolate the termination point from the atmosphere.
- To limit the consequences of rain or debris getting into the vent, always turn the outlet of the vent down towards the ground.
- Bug Screens:
  - Some bugs are attracted to the smell of the natural/ LP gas odorant and could nest in the vent line, which could seal the termination point. Install a bug screen on the termination point to deter insects from nesting in the line.
  - Do not paint the bug screen.
- Points of Discharge
  - The vent line must discharge away from where people might walk or work, such as pedestrians, roofers and other maintenance professionals.
  - The vent line must discharge away from fresh air intakes and from windows. See applicable fuel gas installation code (e.g. CSA B149.1, NFPA 54, or International Fuel Gas Code) for acceptable clearances.
  - The end shall be goose-necked downwards.

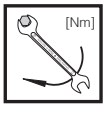
9.4 Torque

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	--	--	--



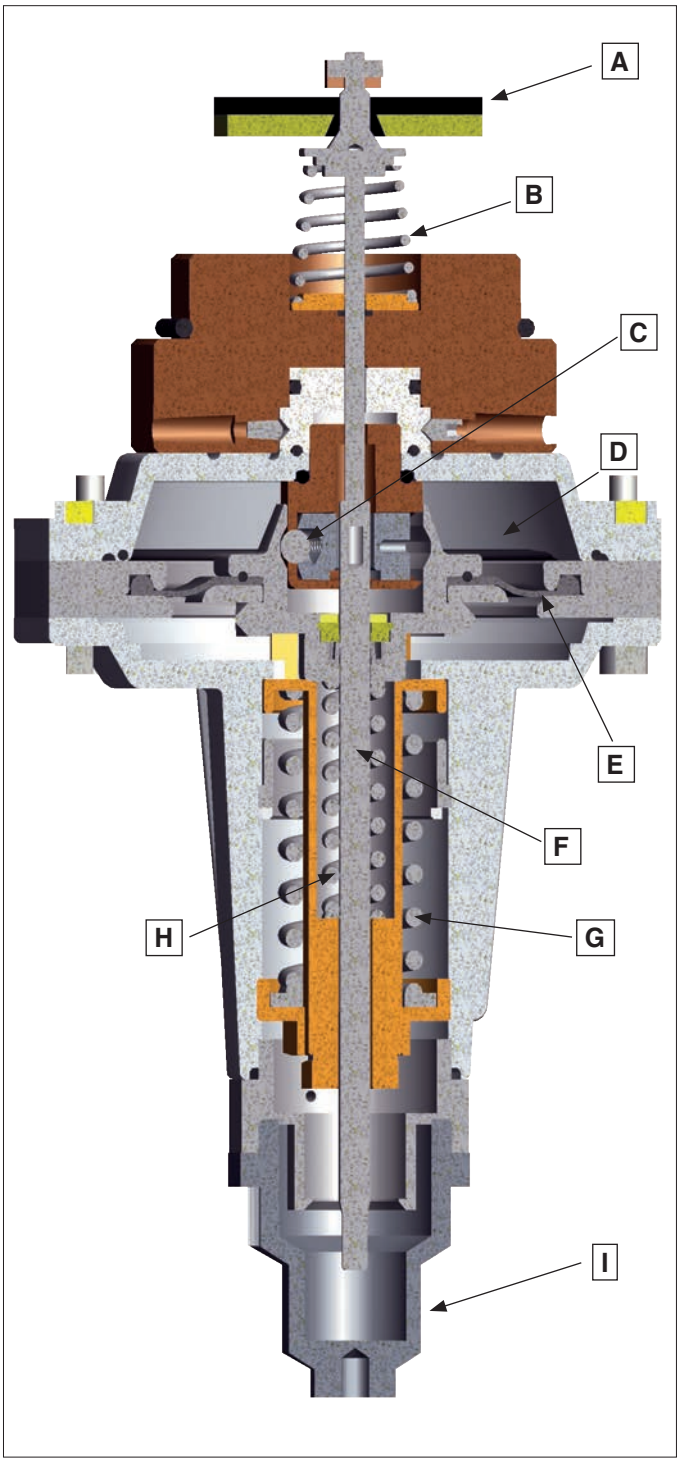
Max. torque system accessories									
M … / G …	M 4	M 5	M 6	M 8	M 10	G ⅛	G ¼	G ½	G ¾
$M_{max.}$ [Nm] t 10 s	2.5 Nm	5 Nm	7 Nm	15 Nm	40 Nm	5 Nm	7 Nm	10 Nm	15 Nm

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. Safety Shut off Valve (SAV and ASE)

10.1 Function

SAV protects downstream fittings or lines against pressures that are too high or too low. As soon as the pre-set trip pressure falls below or exceeds a limit due to a fault, the SAV automatically interupts the gas flow. Under normal operating condition the SAV is open.
If the equipment downstream of the regulator, including any pipework, cannot safely operate or contain a pressure equal to the highest supply pressure (inlet to regulator), a SAV must be installed. The SAV is designed to shut down the gas supply in the event of a fault condition.
The SAV complies with the requirements of EN 14382 as safety shutoff valve.

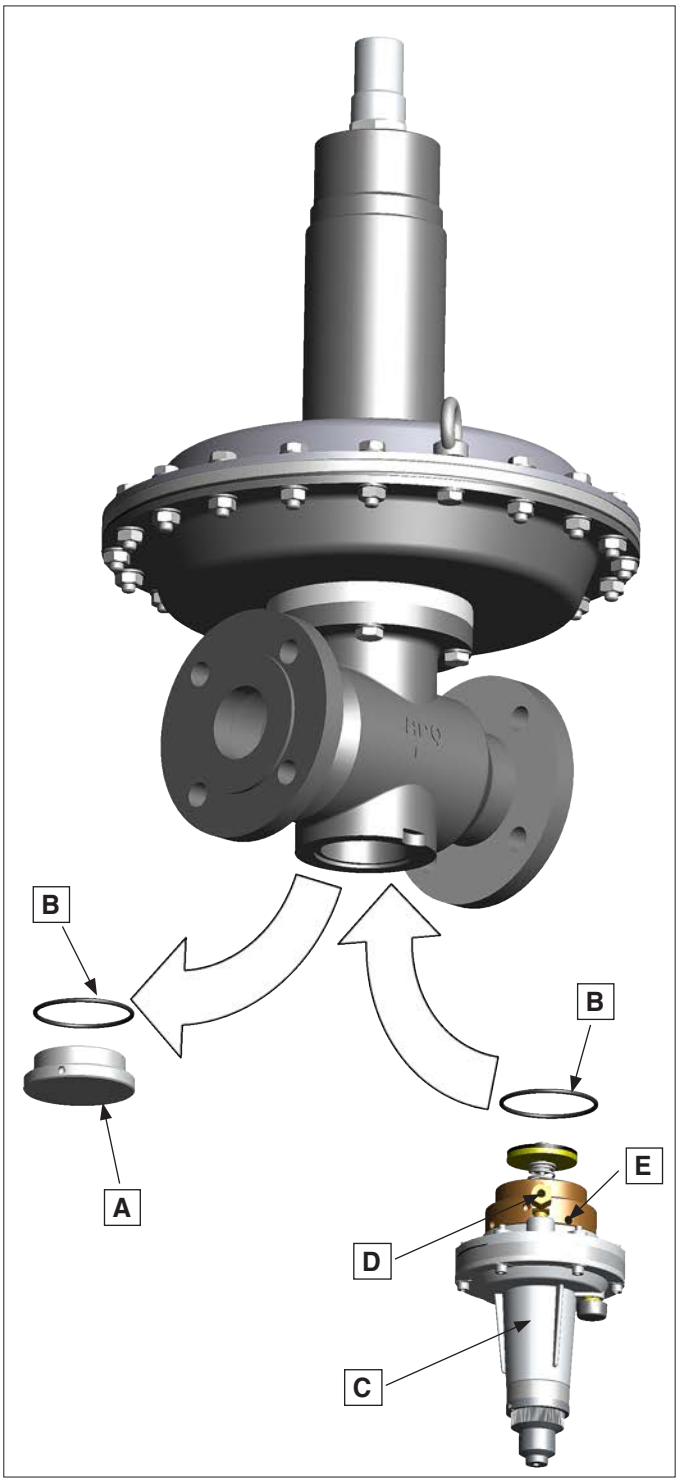


Main components
A Valve disc
B Closing spring
C Ball catch / trigger mechanism
D Chamber with the pressure to be monitored
E Working diaphragm
F Push rod
G Setpoint spring for p_{do}
H Setpoint spring for p_{du}
I Protective cap

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 an ASE to FRM type regulator

1. Loosen four hexagonal socket grub screws **E** (M 5x8) of the ASE **C** using an internal hex key **SW 2.5 mm.**
2. Remove the base plate **A** from the housing using a hook wrench **60-90 mm**.
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 mm**.
6. Align the ermeto/swagelok screw connection **D** of the pulse connection to the connection of the external pulse line.
7. Tighten four hexagonal socket grub screws (M 5x8) in the ASE **C,** using an internal hex key **SW 2.5 mm.**



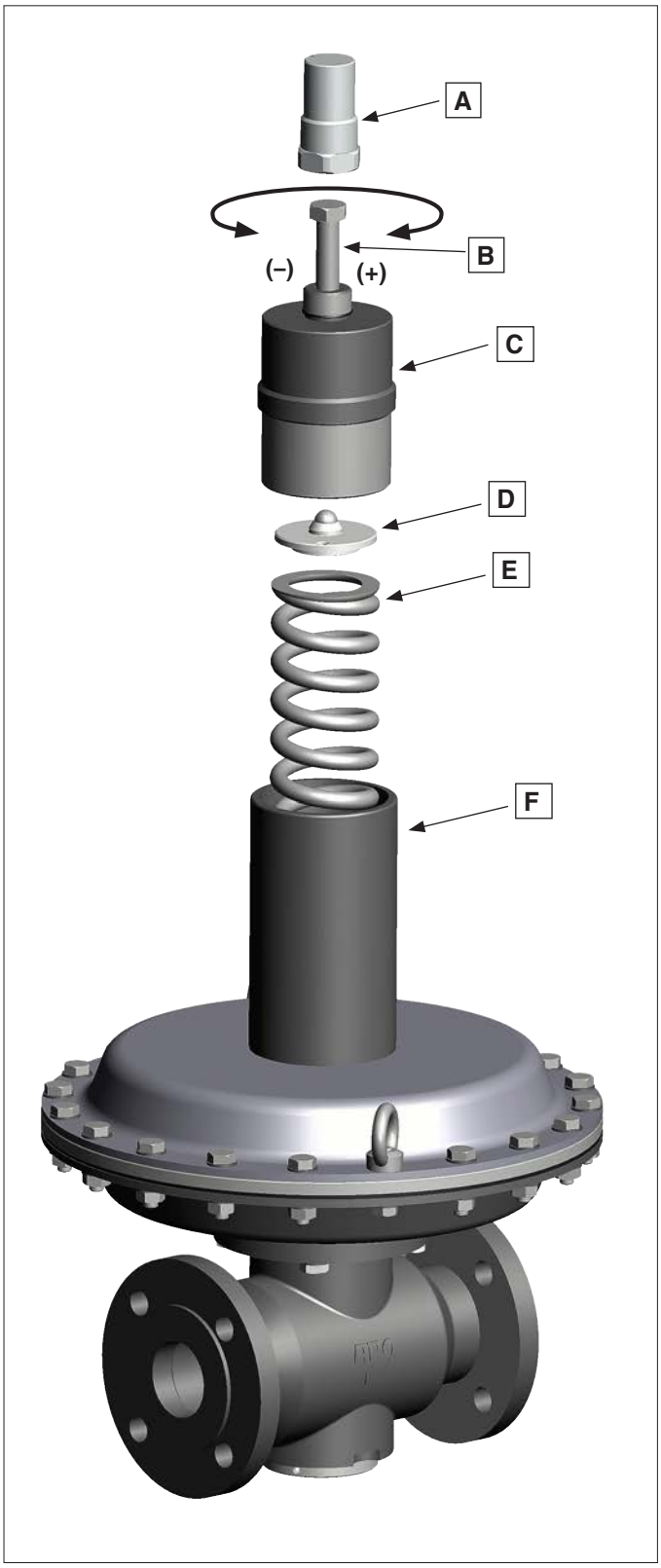
11. Settings

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 mm**.
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

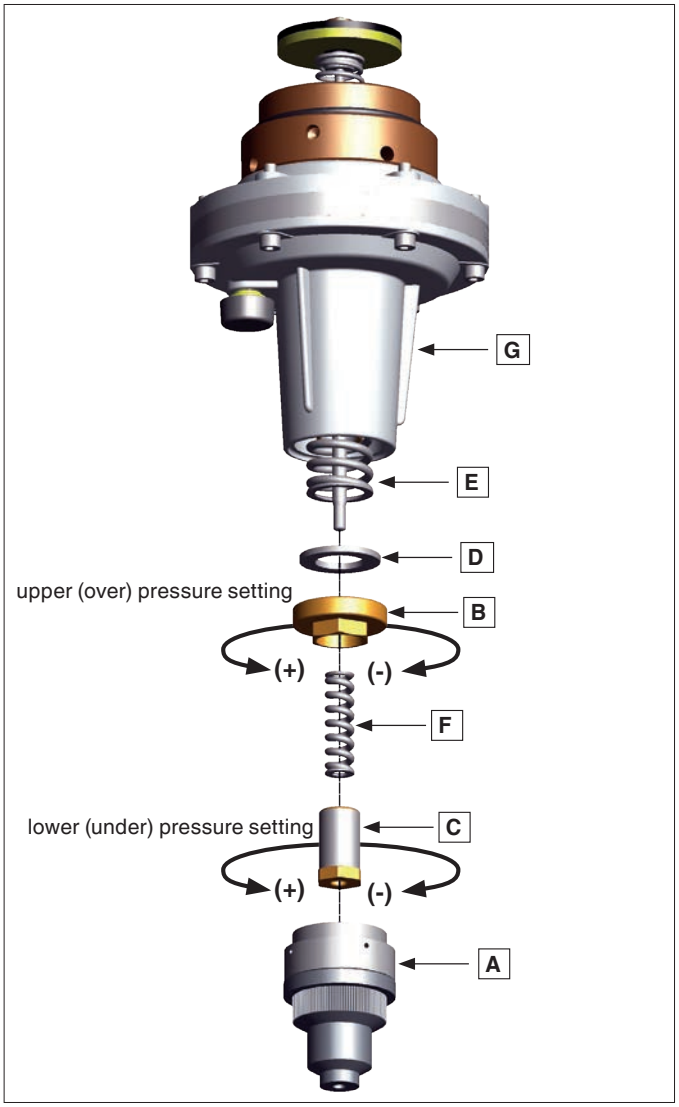
Adjusting the upper (over) response pressure p_{do} setpoint

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

Adjusting the lower (under) response pressure p_{du} setpoint

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

Attention: The setting for lower (under) pressure set-point affects the set value for upper (over) pressure setting. Please set the (under) pressure setpoint, first. If an adjustment to the (under) pressure setpoint is ever made, the upper (over) pressure setting might need to be re-adjusted.



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 down-stream shutoff valve the SAV may not be actuated. The upper (over) pressure response should be determined to avoid nuisance shut down (e.g. shut down of downstream equipment)
$p_d \leq 100$ mbar (40 "W.C.) $p_{do} = p_d + 100$ mbar (40 "W.C.)	
100 mbar (40 "W.C.) < $p_d \leq 300$ mbar (120 "W.C.) $p_{do} > p_d + 150$ mbar (60 "W.C.)	
$p_d > 300$ mbar (120 "W.C.) $p_{do} > p_d \times 1.5$	

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 (80 "W.C.)**
System-specific operating pressure downstream of the regulator p_{perm}	**500 mbar (200 "W.C.)**
Limiting pressure in case of fault	**550 mbar (220 "W.C.)**
Accuracy class	**AC 5**
Response pressure group of the upper (over) shut down pressure SAV	**AG_o 10**
Response pressure group of the lower (under) shut down pressure SAV	**AG_u 10**
Response group of the SBV	**AG 5**

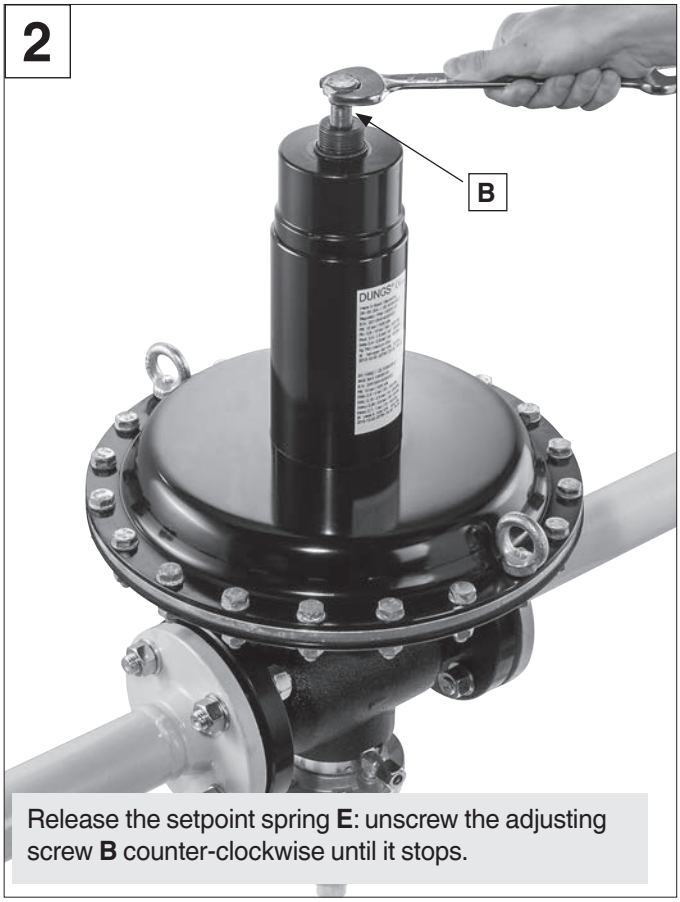
Result			
Device group	**Device data**	**Pressure graduation**	
Safety devices against excessive pressure	Limiting pressure in case of fault: 1.1 * $p_{perm.}$		550 mbar (200 "W.C.)
	AG_o 10		440 mbar (176 "W.C.)
	SAV	p_{do} =	400 mbar (160 "W.C.)
	AG_o 10		360 mbar (144 "W.C.)
	AG 5		315 mbar (126 "W.C.)
	SBV	p_d =	300 mbar (120 "W.C.)
	AG 5		285 mbar (114 "W.C.)
Gas pressure regulator	SG 20		240 mbar (96 "W.C.)
	AC 5		210 mbar (84 "W.C.)
	FRM	p_d =	200 mbar (80 "W.C.)
	AC 5		190 mbar (76 "W.C.)
Safety device against insufficient pressure	AG_u 20		60 mbar (24 "W.C.)
	SAV	p_{du} =	50 mbar (20 "W.C.)
	AG_u 20		40 mbar (16 "W.C.)

11.4 Replacement of regulator springs

1

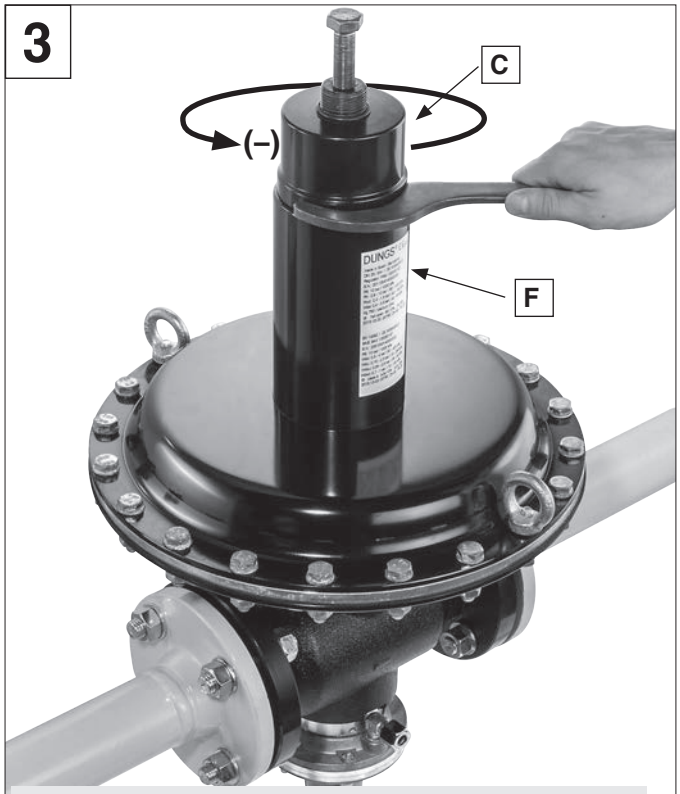
Remove the protective cap **A.**

2



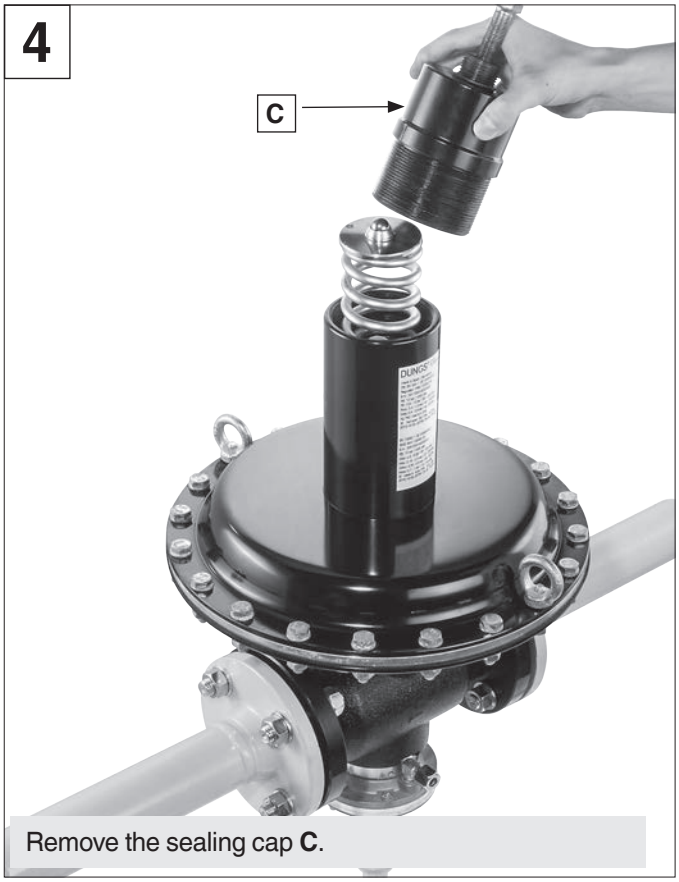
Release the setpoint spring **E**: unscrew the adjusting screw **B** counter-clockwise until it stops.

3

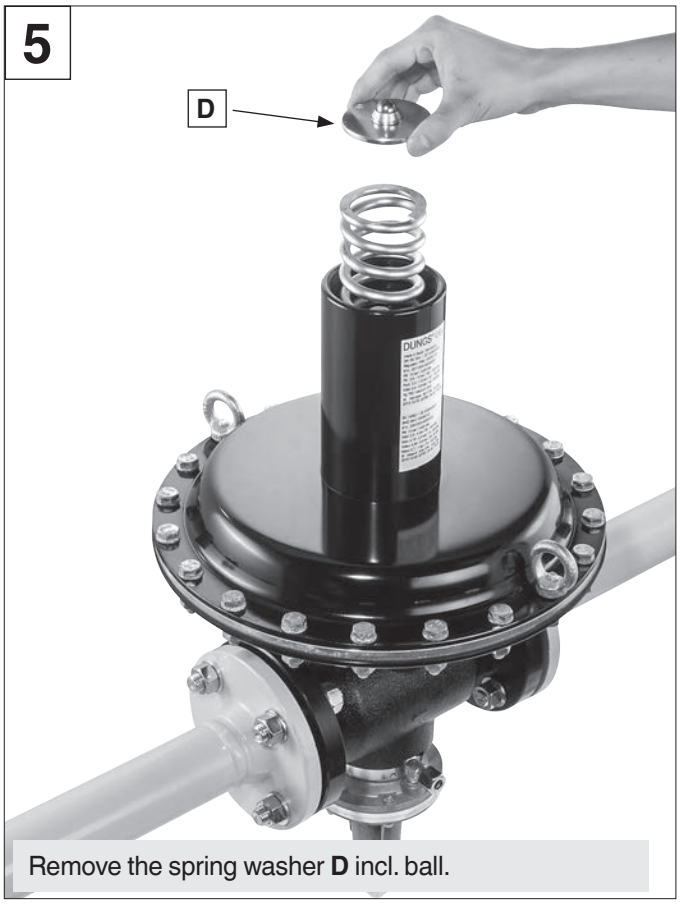


Unscrew the sealing cap **C** from the spring dome **F** using a hinged hook wrench **90-155 mm.**

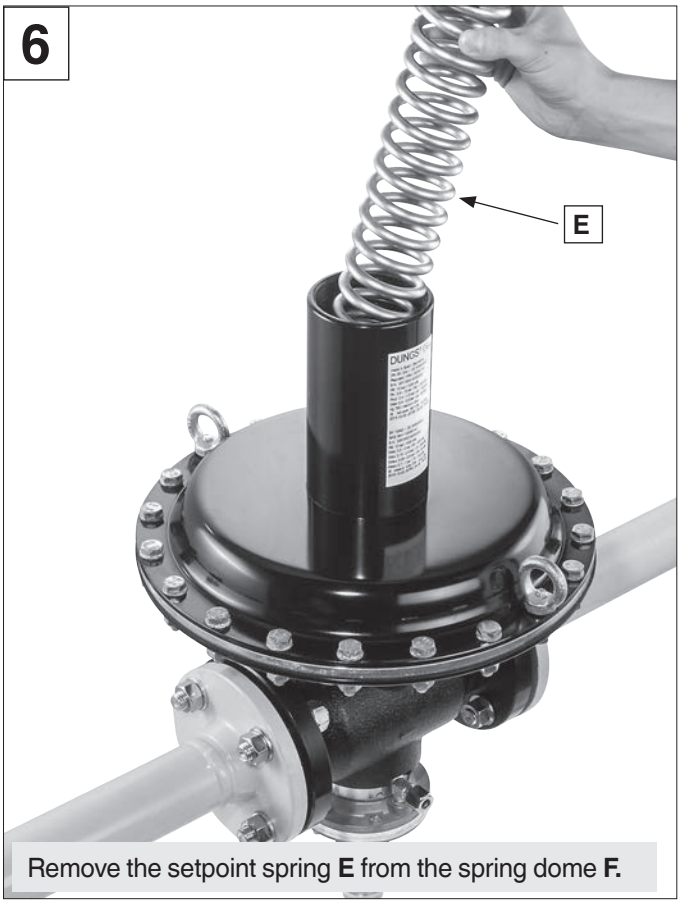
4



Remove the sealing cap **C**.



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



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

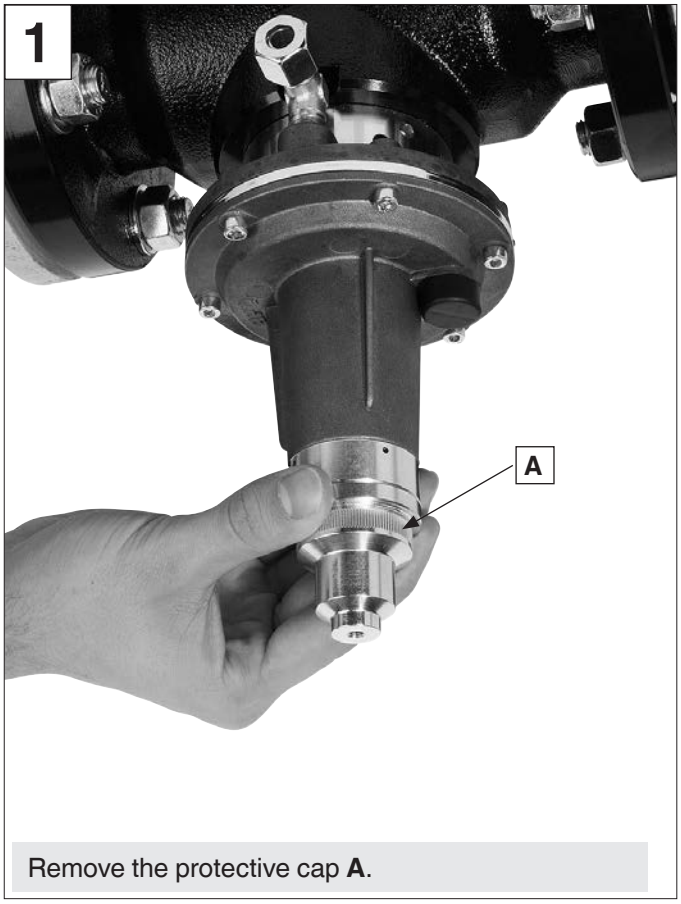
7. Insert a new spring with a suitable adjustment range
8. Reattach the spring washer **D** incl. ball on the spring.
9. Reinsert the sealing cap **C** in the spring dome **F**. Tighten the adjusting screw **B** until the required spring preload is reached. Reinsert the protective cap **A**.
10. Stick on the type plate the label corresponding to new spring range. Take label included on the spring kit and cut the range corresponding to the same type as the type plate on the regulator (ND, MD, HD, UHD).

Example label for spring kit (270345):

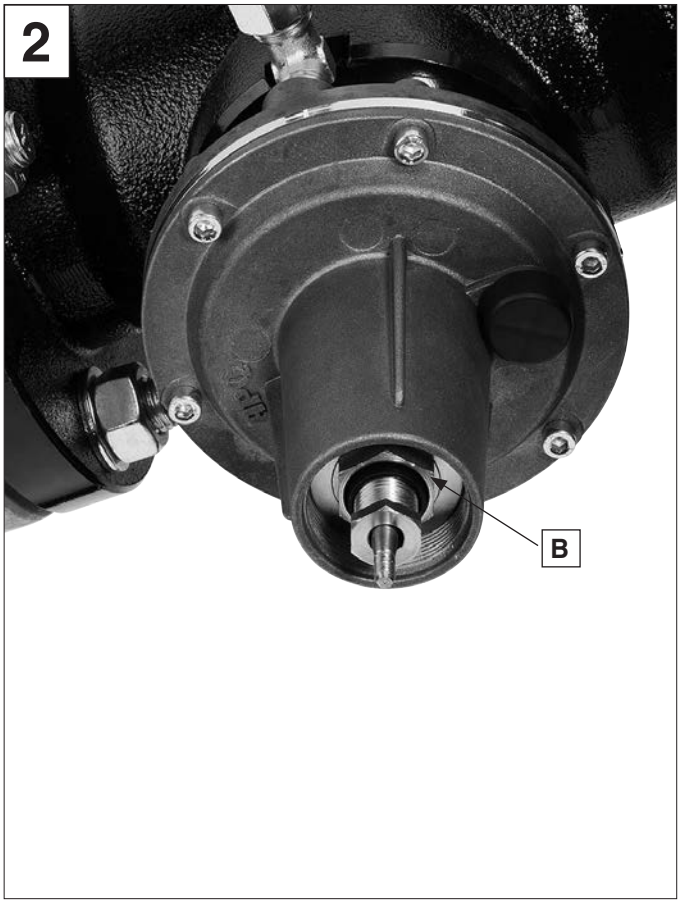
ND W_{ds}: 0,04 - 0,055 bar / 4 - 5,5 kPa
MD W_{ds}: 0,11 - 0,17 bar / 11 - 17 kPa

Never have your head above or near the aluminium cap when removing regulator spring. The spring tension can be high enough to rapidly eject the aluminium cap with a large force.

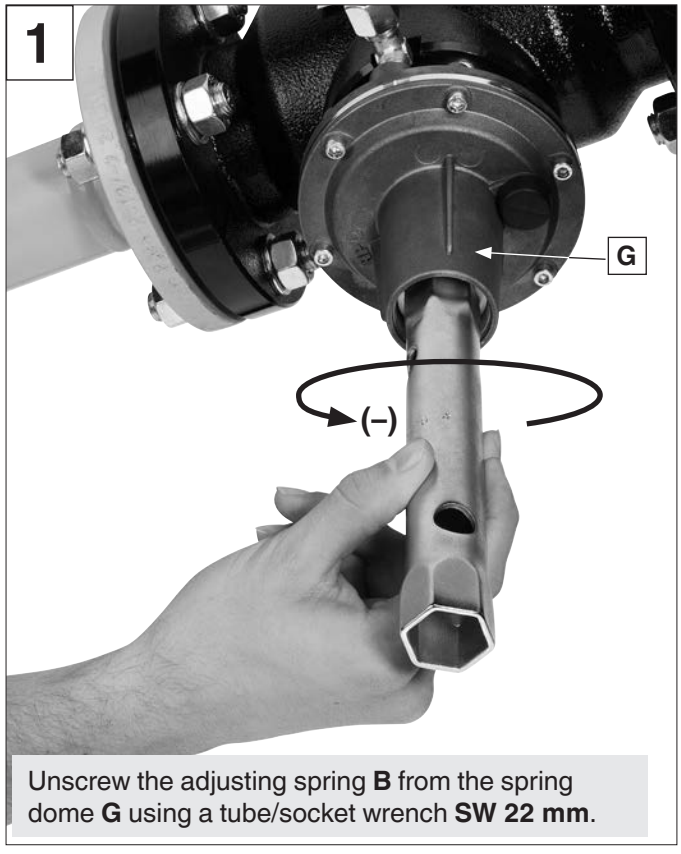
11.5 Replacement of SAV springs



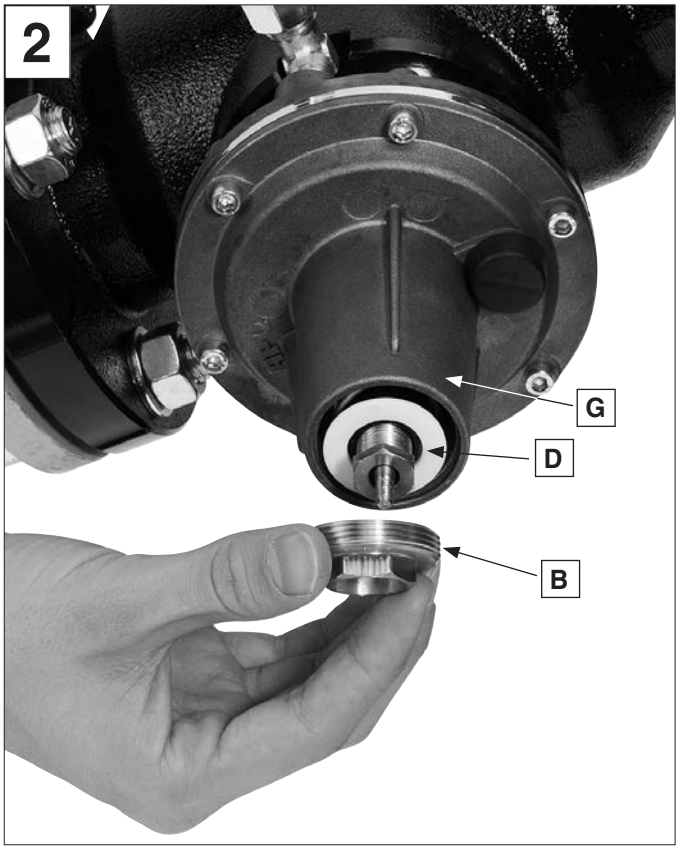
Remove the protective cap **A**.

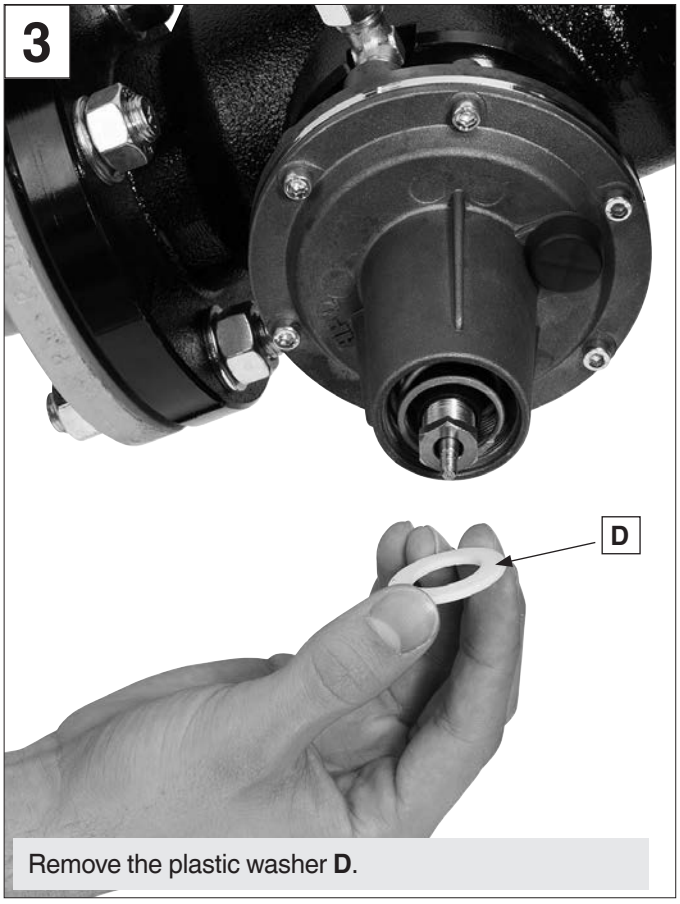


11.5.1 Spring replacement W_{dso}

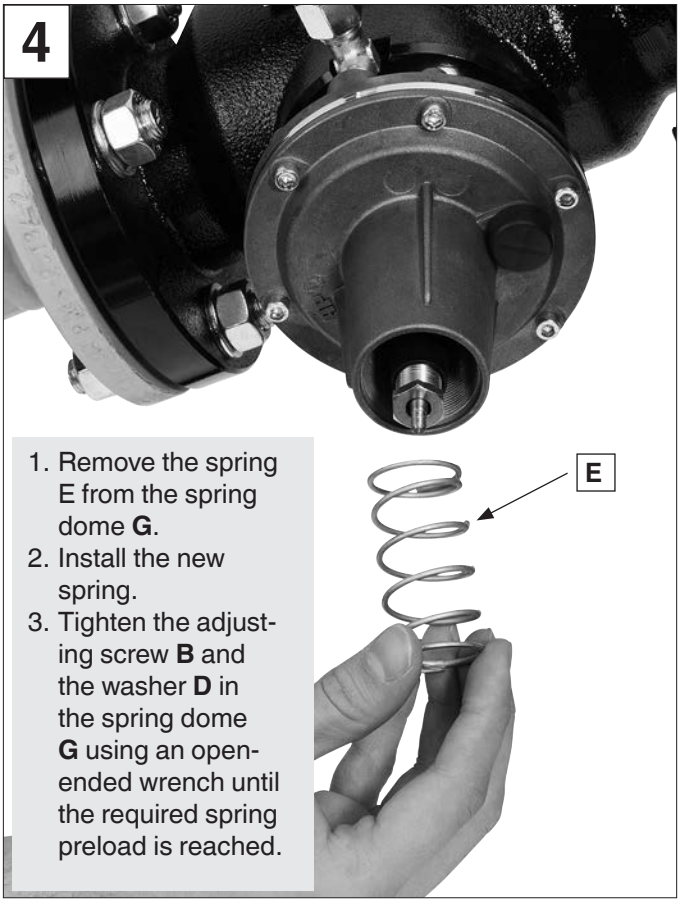


Unscrew the adjusting spring **B** from the spring dome **G** using a tube/socket wrench **SW 22 mm**.



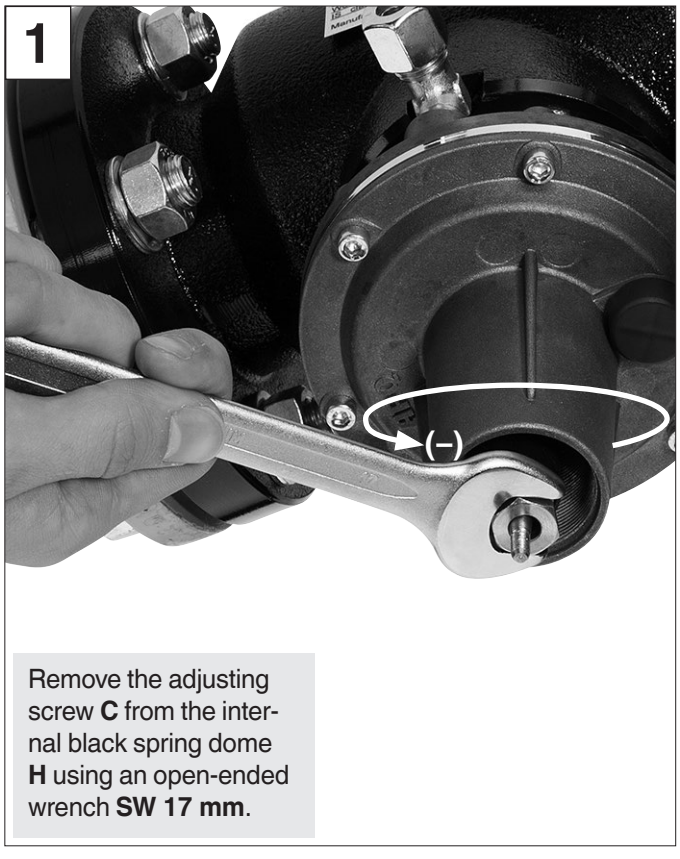


Remove the plastic washer **D**.

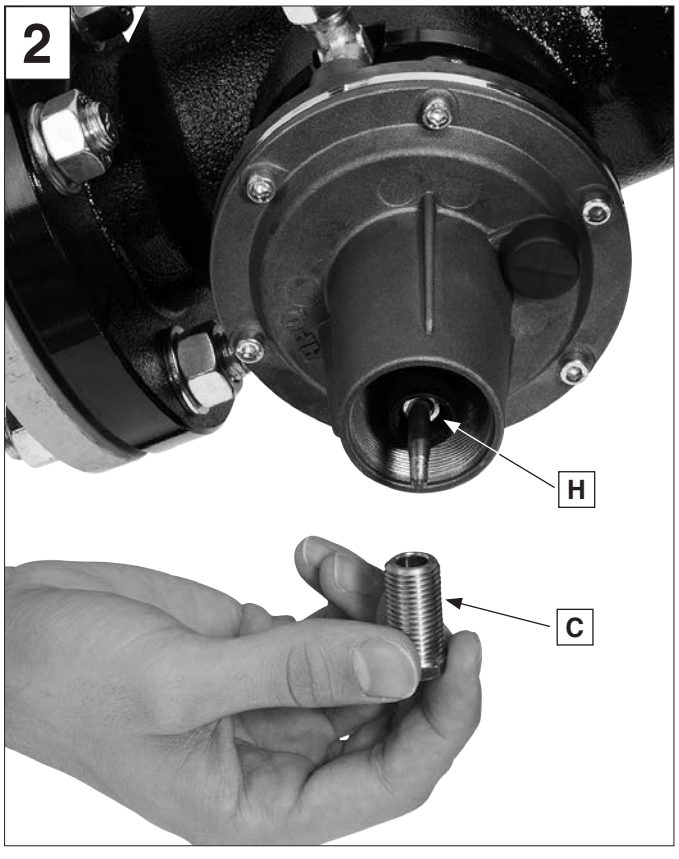


1. Remove the spring E from the spring dome **G**.
2. Install the new spring.
3. Tighten the adjusting screw **B** and the washer **D** in the spring dome **G** using an open-ended wrench until the required spring preload is reached.

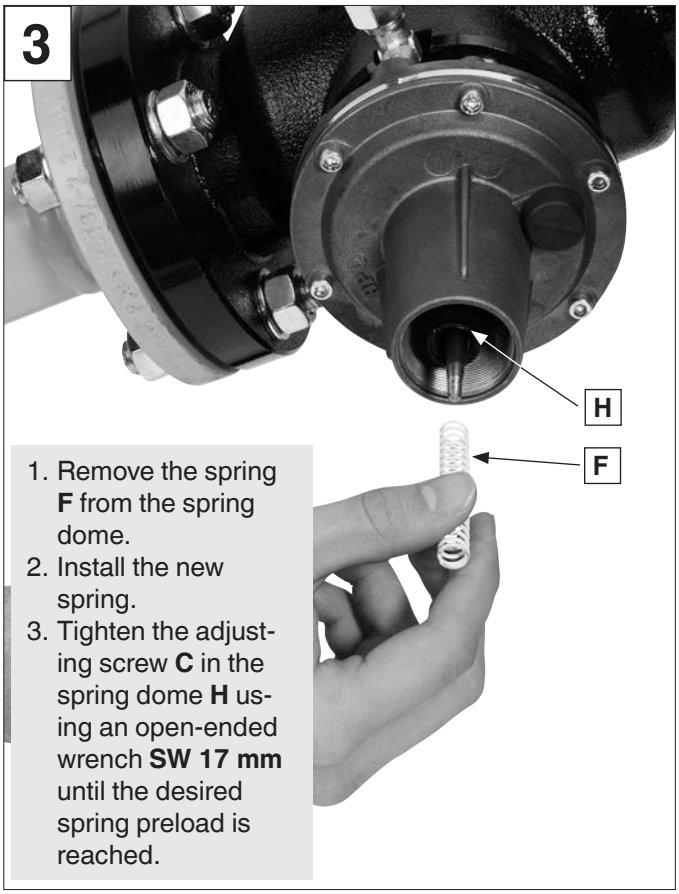
11.5.2 Spring replacement W_{dsu}



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

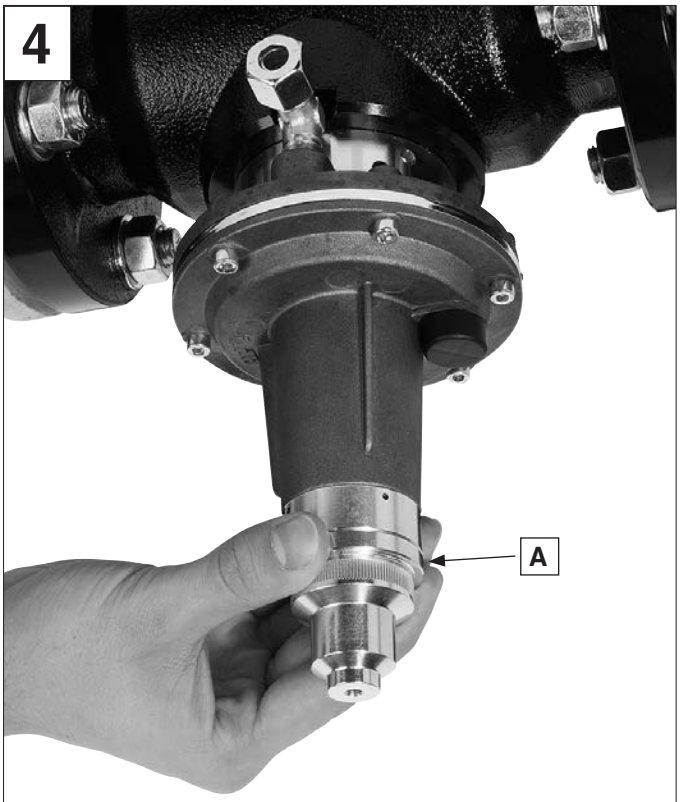


3



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 mm** until the desired spring preload is reached.

4



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

5. Stick on the type plate the label corresponding to new spring range. Take label included on the spring kit and cut the range corresponding to the same type as the type plate on the regulator (ND, MD, HD, UHD).

Example label for spring kit (270183):

ND W_{dso}: 0,09 - 0,24 bar / 9 - 24 kPa
MD W_{dso}: 0,23 - 0,37 bar / 23 - 37 kPa

12. Commissioning, decommissioning and recommissioning FRM or SAV

12.1 General information

Prior to commissioning and recommissioning

- **The performance data on the type plate correspond to the ordering data.**
- **Prevent explosive gas-air mixture: the room atmosphere must be monitored through gas concentration measuring devices for the detection of gas leakages. For the USA and Canada, see NFPA 54, NFPA 56 or B 149.1 for regulations regarding purge of fuel gas.**
- **Only operate the device if all safety devices are fully functional.**
- **Only qualified personnel are allowed to carry out the commissioning.**

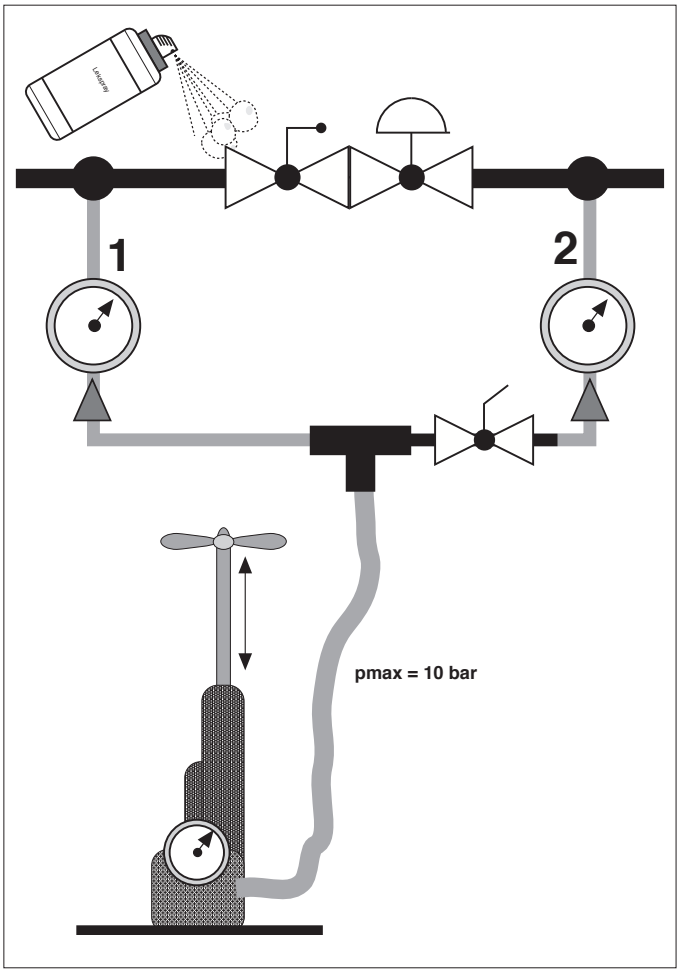
12.2 Initial Pressurization of FRM

1. When first applying pressure to the FRM or SAV, apply pressure slowly to prevent overpressure conditions or damage. This also allows all mechanisms to properly engage.
2. While slowly apply pressure, apply the pressure in "pulses" (open the main valve upstream 5-10% of stroke for about 1-2 seconds and then close it for 10-20 seconds) and repeat until the operating or test pressure is achieved. Large pressure and volumes of pipe require longer waiting times (e.g. 20 s) before applying another pulse.
3. It is recommended to monitor the pressure rise using a pressure gauge in the test section to prevent overpressure conditions.

12.3 Leakage test

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

1. Test gases for the leakage test: Use air or inert gases.
2. Upstream and downstream shutoff valves must be closed.
3. Release all pressure from the test section. Check the presence of gas and safely release to the atmosphere.
4. If test pressure > blow-off pressure SBV: block the line upstream of the SBV.
5. Connect the test section to the test device.
6. Test pressure: 1.1 x system-specific operating pressure Maximum PS of the device (SAV 100... 10 bar/SAV 60... 6 bar). If different pressure ratings of the system must be taken into account. If a relief valve (SBV) is installed in the test section, either the test pressure > SBV relief valve pressure setting or block the line upstream of the SBV and test at 1.1 x system-specific operating pressure maximum PS of the device.
7. Observe the waiting time necessary for the pressure compensation (pressure equilibrium) according to the system-specific volumes. A minimum of one minute is required to reach pressure equilibrium.



External leakage test

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

Internal tightness test for SAV only

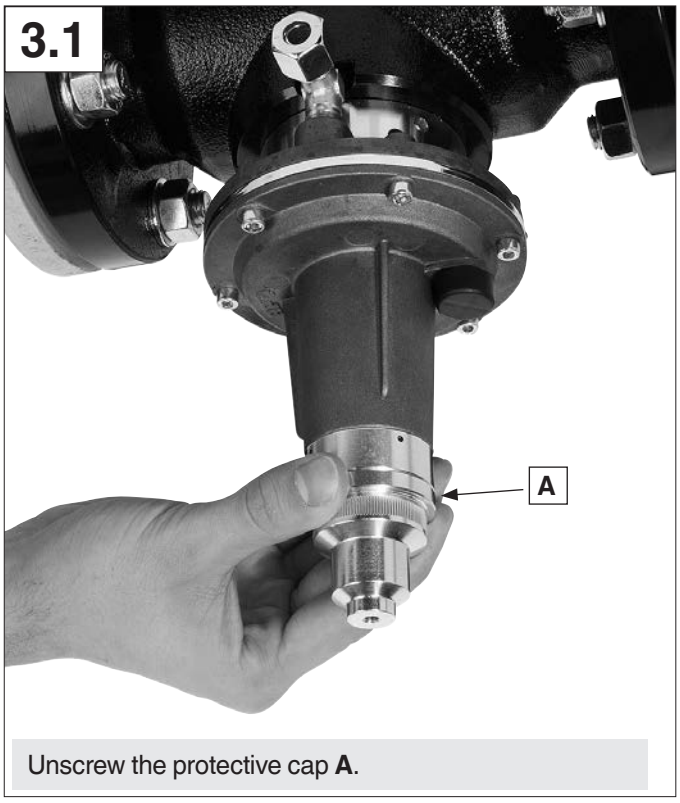
10. Remove the pressure in the test section downstream of the SAV and verify that SAV is closed.
11. Monitor the increase in pressure on the outlet side: pressure gauge accuracy 0.1 mbar. The SAV passes the test if there is no pressure increase for five minutes.
12. Once the leakage test has been carried out, open the shutoff valve upstream of the SBV, if installed.
13. Release pressure in the test section, if test failed.

12.4 SAV resetting and setting of SAV/FRM

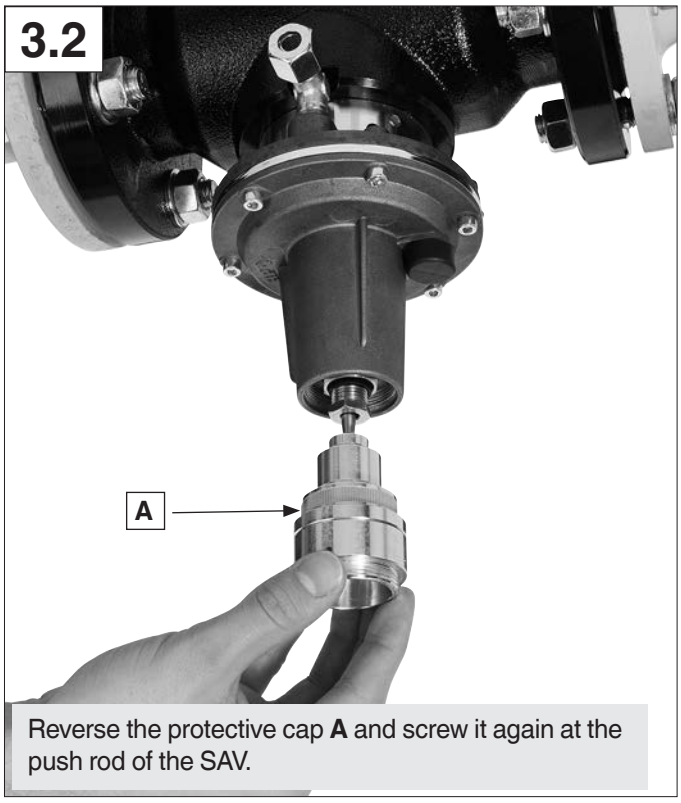
1. Slowly open the shutoff valve on the inlet side per 12.2 "Initial applying pressure during commissioning, recommissioning or testing". The ball valve on the outlet side remains closed.

2. Monitor the pressure rise on the pressure gauge on the inlet side upstream of the device.

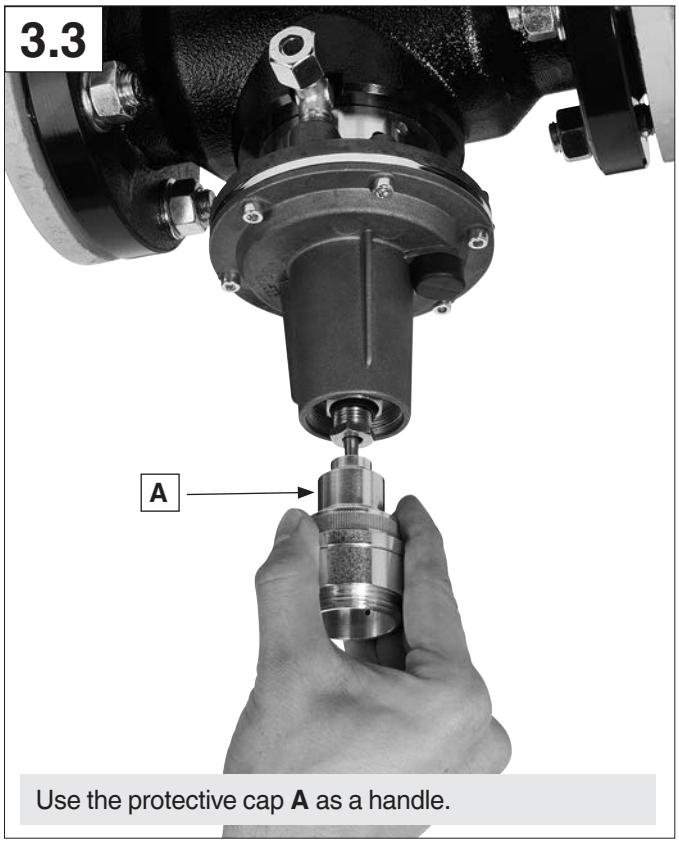
3. SAV resetting:



Unscrew the protective cap **A**.



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



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

3.4 Compensate pressure by pulling the protective cap **A** downwards by approx. 2 mm. This opens the compensation valve on the valve disc.

3.5 Monitor the pressure rise on the outlet side of the pressure gauge.

3.6 Once the operating pressure (setting of the pressure regulator) on the outlet side is reached, the SAV can be reset by pulling the protective cap **A** to its mechanical stop and until it locks in place (resets).

3.7 SAV is now reset.

3.8 Unscrew the protective cap **A** from the push rod and screw it again on the spring dome **G.**

4.0 Venting the test section to atmosphere

4.1 If venting fuel gas to test the setting of the FRM or SAV, use a manual valve connected to a suitable hose to release the fuel gas to a safe location. Or, if a relief valve is installed, it might be possible to use it to vent some or all of the fuel gas for proper testing. Do not use a test burner for venting, and see 12.1 General information regarding risks of venting into spaces.

4.2 Pressurizing Test Section

4.3 When the test section must be completely filled with fuel 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 Initial Checking of the FRM outlet pressure

5.1 Before initially starting of the equipment, an initial check of the FRM outlet pressure setting shall be done.

5.2 To check the outlet pressure setting of the regulator:

5.3 Partially open a manual valve connected to the hose in 4.0 above just enough to generate gas flow, and check the set value (outlet pressure) using a pressure gauge. If necessary, correctly adjust the setting according to section 11.1 Regulator Setting.

5.4 Close the manual valve, remove the hose, insert the sealing cap **A**.

6.0 Checking upper(over) response pressure p_{do}

6.1 SBV installation on the outlet side: block the line upstream of the SBV.

6.2 Create bypass around the FRM (see below).

6.3 Connect a line between the inlet and outlet side of FRM using manually operated test/purge valves.

6.4 With both valves closed, slowly open the upstream valve to charge the bypass line.

6.5 Slowly open the downstream valve in the bypass line and monitor the increase of pressure on the outlet side using a pressure gauge.

6.6 Avoid inadmissible high pressure on the outlet side. Stop applying pressure immediately after the SAV has tripped.

6.7 Once the SAV trips, read the upper (over) response pressure on the pressure gauge on the outlet side.

6.8 If necessary, correct the SAV set points according to the specifications in section 11.2 "SAV setting" and check it again.

7.0 Check of the lower (under) response pressure p_{du} setting.

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 / reset SAV, if SAV is tripped.
See "3. SAV resetting" in section 12.4.

7.5 Check that all test/purge valves are closed.

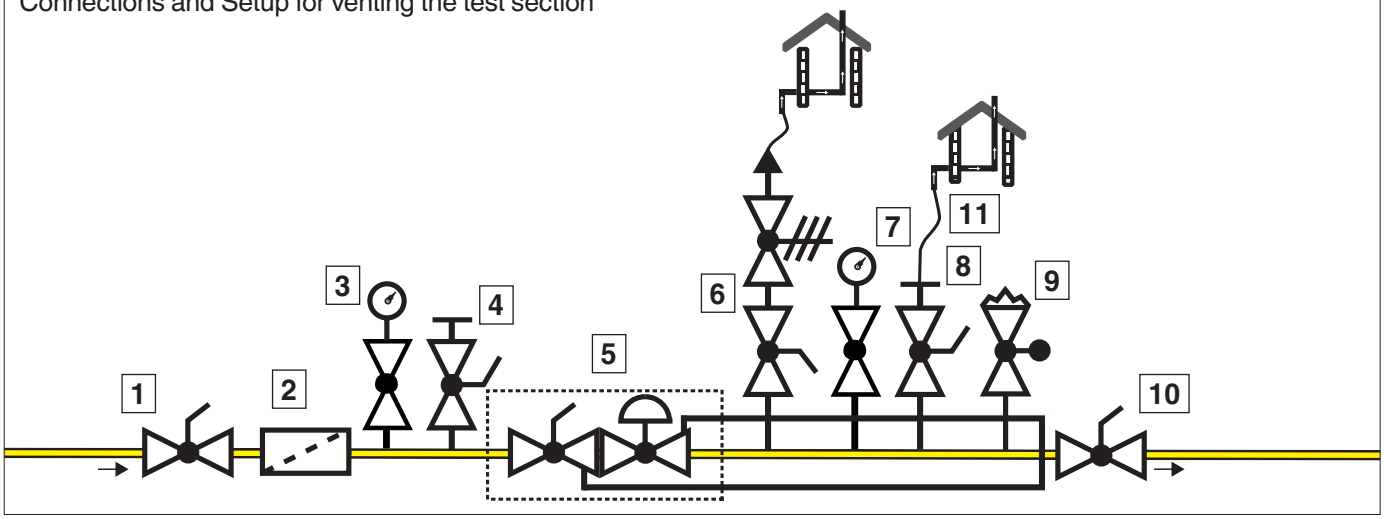
7.6 Create a means to safely release the fuel gas in downstream the SAV into the atmosphere. See figures below and reference "4.0 Venting the test section to atmosphere" in section 12.3.

7.7 Slowly vent the fuel gas per "4.0 Venting the test section to atmosphere". After the SAV trips, read the lower (under) response pressure on the pressure gauge.

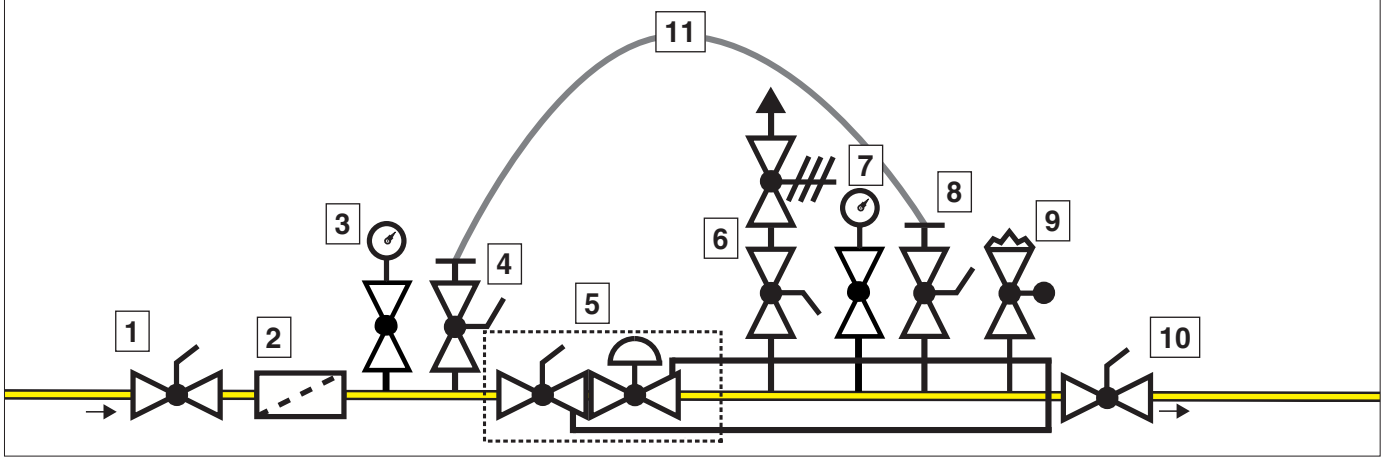
7.8 Close the vent valve, remove the hose, insert the sealing cap.

7.9 Slowly open the shut-off valve on the inlet side.

Connections and Setup for venting the test section



Connections and Setup of a bypass line



Pos.	Designation
1	Shut-off valve, inlet side
2	Filter
3	Pressure gauge with pushbutton
4	Test/Purge valve (manually operated)
5	Regulator with integrated SAV
6	SBV with shutoff valve

Pos.	Designation
7	Pressure gauge with pushbutton
8	Test/Purge valve (manually operated)
9	Test burner
10	Shut-off valve, outlet side
11	Hose

12.5 Recommissioning

1. Close the shutoff valve upstream of the bypass line.
2. Remove the hose.
3. Open the ball valve upstream of SBV, if installed.
4. Reset SAV, see section 12.4.
5. Once SAV has been reset, open the shutoff valve on the outlet side of the SAV.

12.6 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 impulse line is not installed.	Install the impulse line.
	The impulse line is clogged.	Clean the impulse line.
	The impulse line is leaky.	Seal the impulse line.
	The impulse line is broken.	Replace the impulse line.
	The impulse pressure is outside the adjustment range.	Set the lower (under) response pressure and upper (over) response pressure to proper ranges.
	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.
The SAV cannot be activated.	The impulse line is not installed.	Connect/install the pulse line.
	The impulse line is clogged.	Clean the impulse line.
	The impulse line is leaky.	Seal the impulse line.
	The impulse line is broken.	Replace the impulse line.
	The impulse 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 SAV 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 SAV.
	The drive is damaged.	Replace the SAV.
	The O-Ring is damaged.	Replace the O-Ring or the SAV.
The SAV is leaking towards the atmosphere.	The working diaphragm is damaged.	Change the working diaphragm or replace the SAV.
	The sealing ring between the ASE and the housing of the SAV is damaged.	Replace the sealing ring or the SAV.
	The O-Ring in the ASE is damaged.	Replace the O-Ring or the SAV.

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 impulse line is not installed.	Close the impulse line.
	The impulse line is blocked.	Check the impulse line.
	The impulse line is leaky.	Seal the impulse 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 impulse is not installed.	Close the impulse line.
	The pulse impulse is blocked.	Check the impulse line.
	The pulse impulse is leaky.	Seal the impulse 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.
As the flow rate increases, the outlet pressure drops.	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 impulse line.
	The SAV is damaged.	Check the SAV.
Gas escapes at the vent connection.	The working diaphragm is damaged.	Replace the working diaphragm.
	The O-Rings on the compensation shaft are damaged.	Replace the lever system.
Outlet pressure is oscillating in operation.	Required flow is lower than minimum operating flow.	Transitory situation at start-up. Nozzle change for daming factor may help. Nozzle kit 270712.
	Regulator is oversized.	Replace regulator with the right one.
	Ressonance effect with a regulator downstream.	Change nozzle configuration (kit 270712). Change outlet pressure setting.

14. Maintenance

14.1 General information

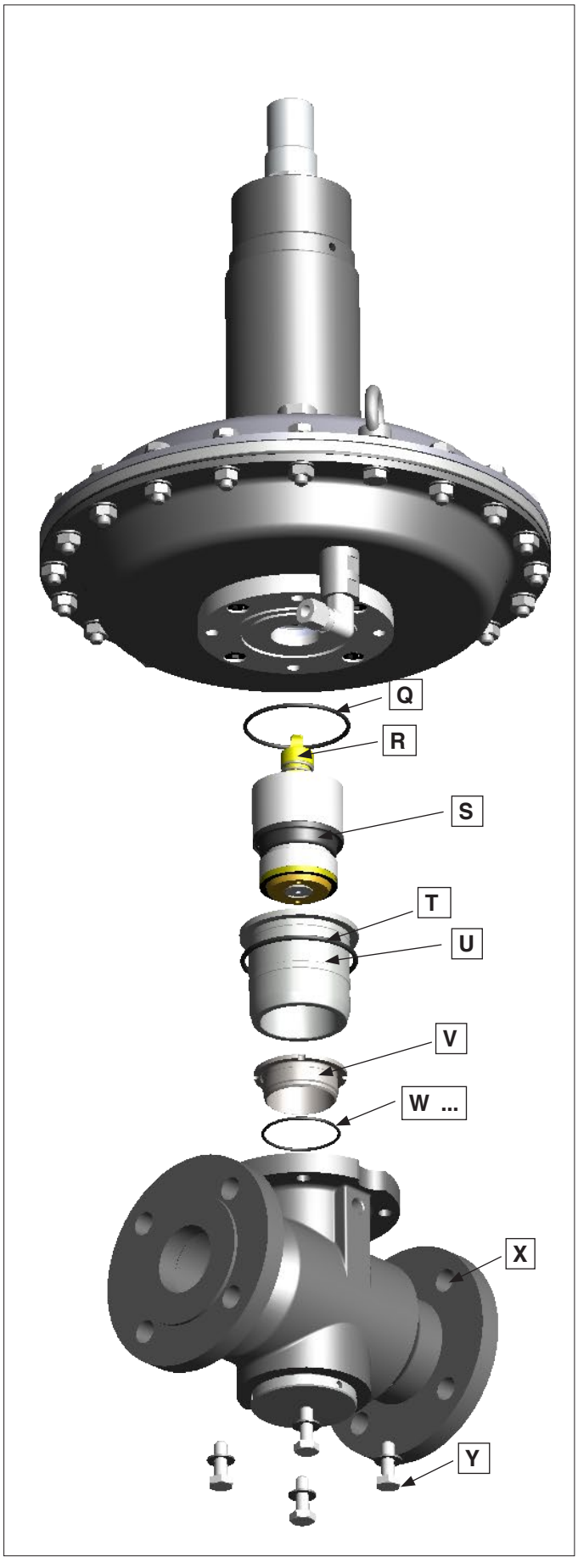
• The Pressure Equipment Directive (PED) requires the regulator to be checked at regular intervals to ensure: safety and correct functioning of the device, high long-term utilisation ratios, resulting in minimum environmental impact.

- **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 rubber parts.**
- **Greases, adhesives, sealing material must be approved.**

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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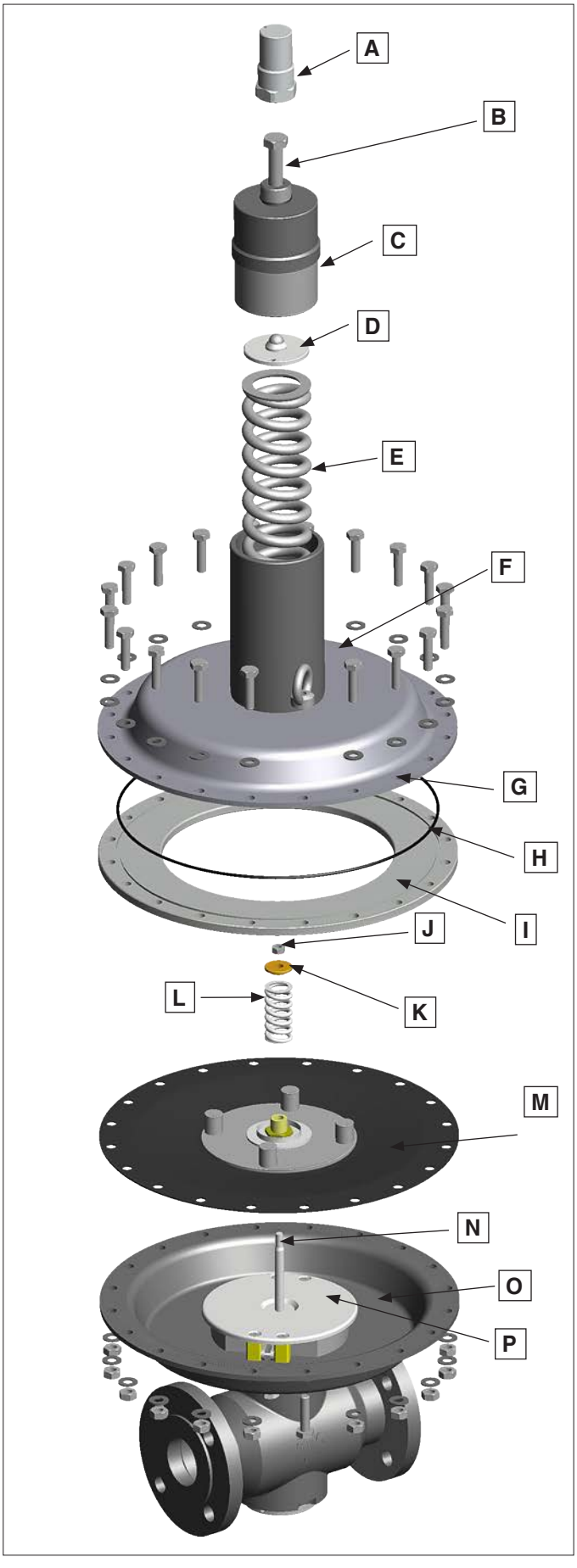
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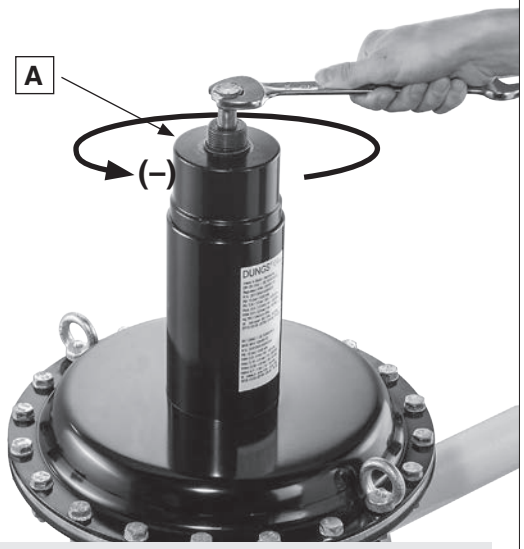
14.2 Maintenance instructions of the regulator

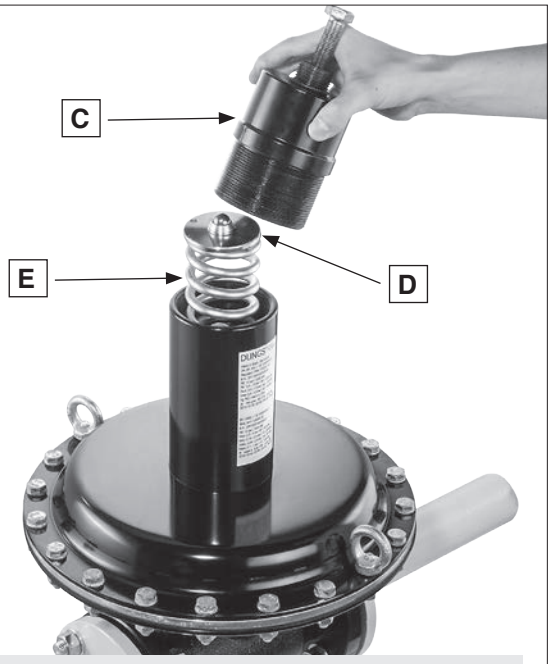
14.2.1 Preparation

1



1. Loosen the impulse line 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 mm**.

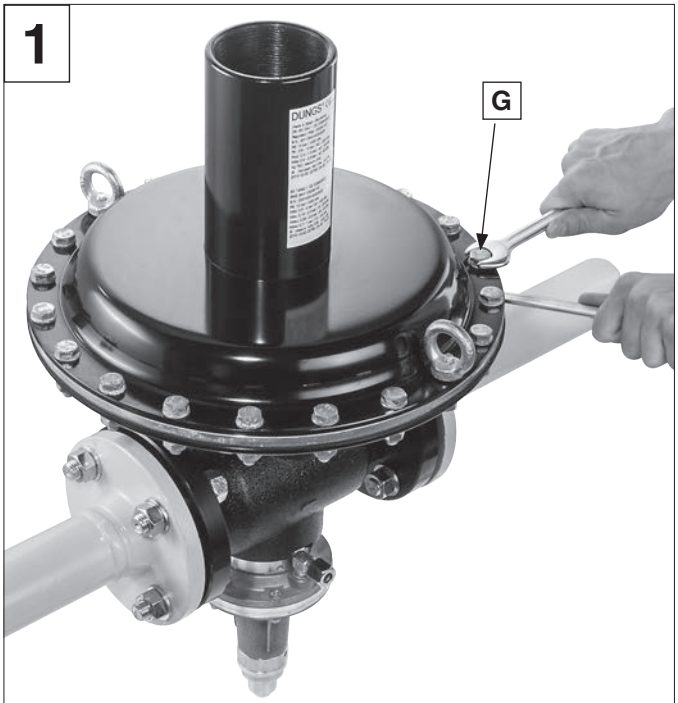
2



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

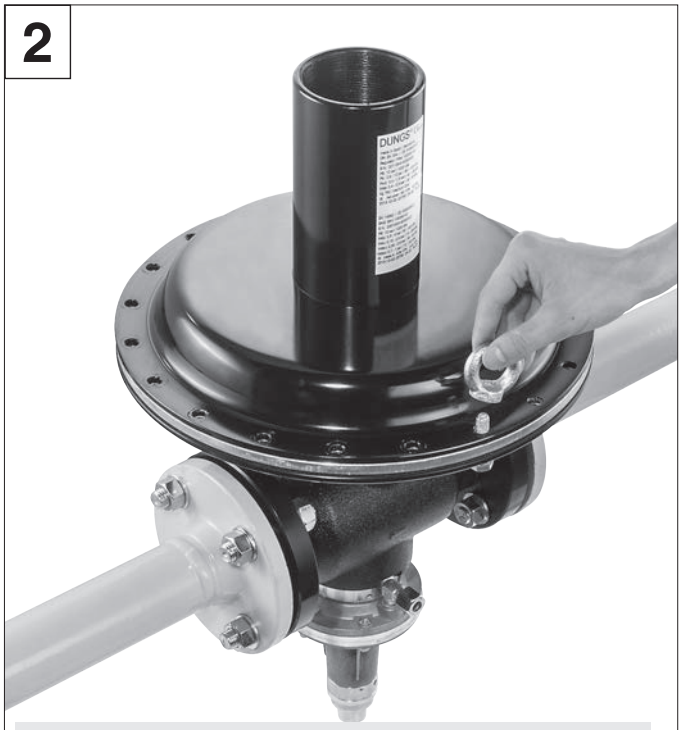
14.2.2 Replacement of the working diaphragm

1



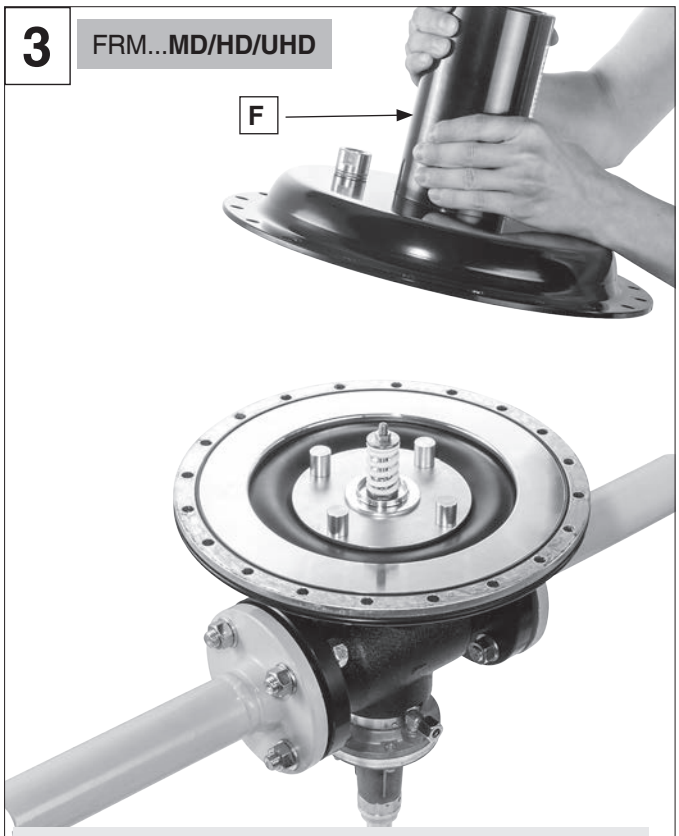
Loosen the screws **G** (M10) using an open-ended wrench **SW 17 mm**.

2



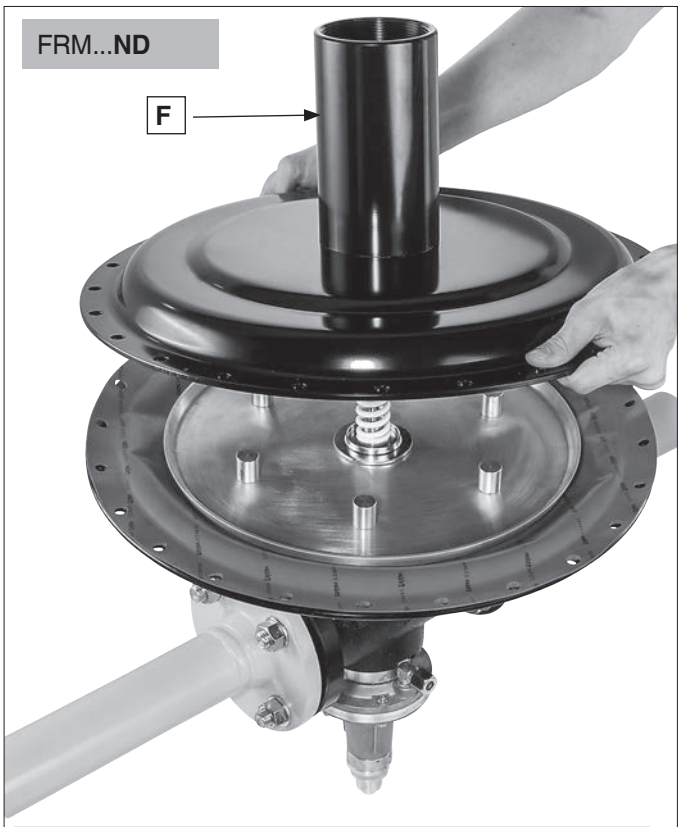
Loosen the loops using an open-ended wrench **SW 17 mm**.

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



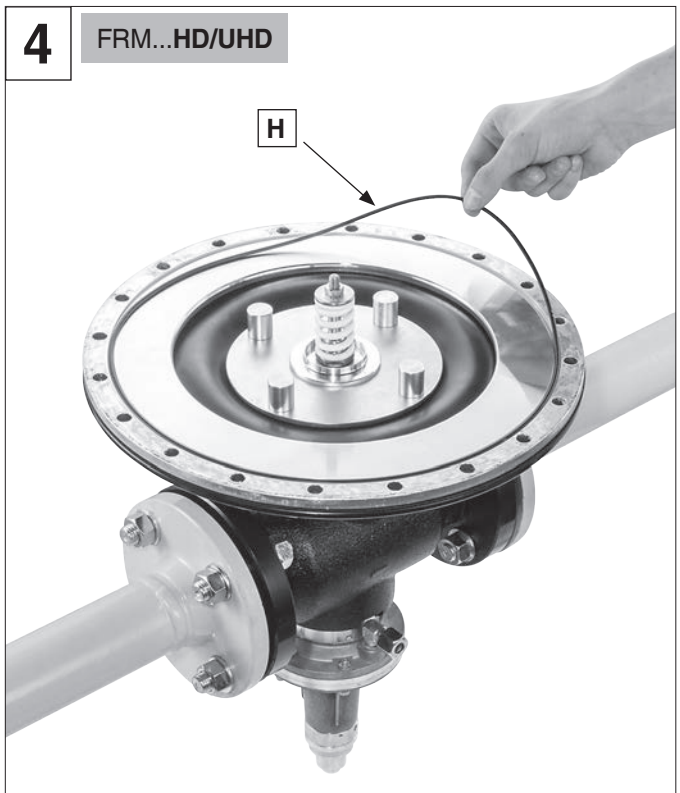
Remove the upper diaphragm shell **F.**

FRM...**ND**



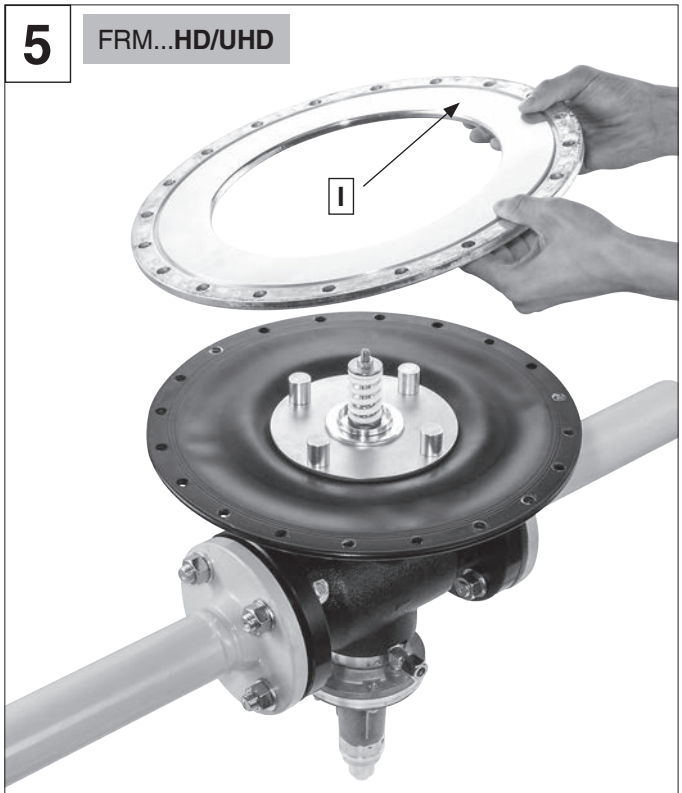
Remove the upper diaphragm shell **F**.

4 FRM...**HD/UHD**



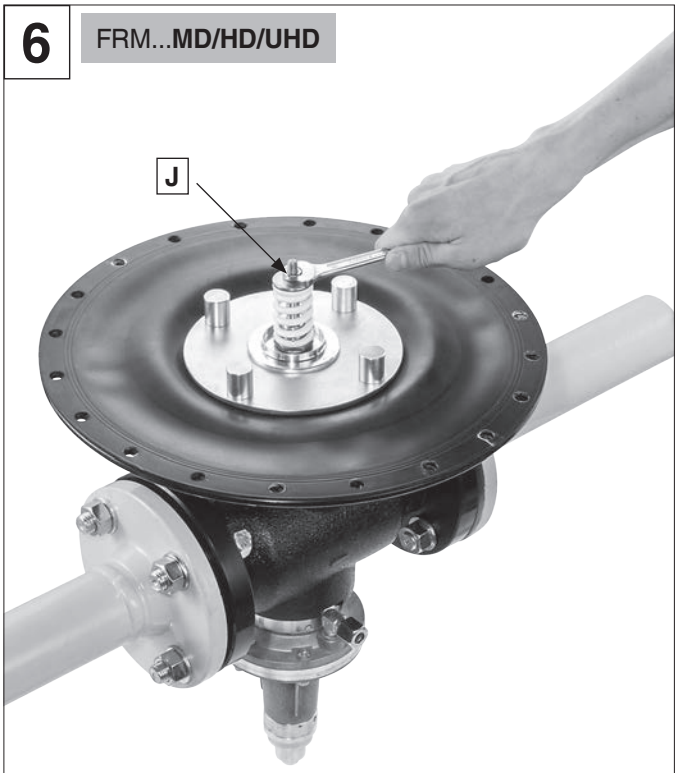
Remove the O-Ring **H** (HD version only).

5 FRM...**HD/UHD**



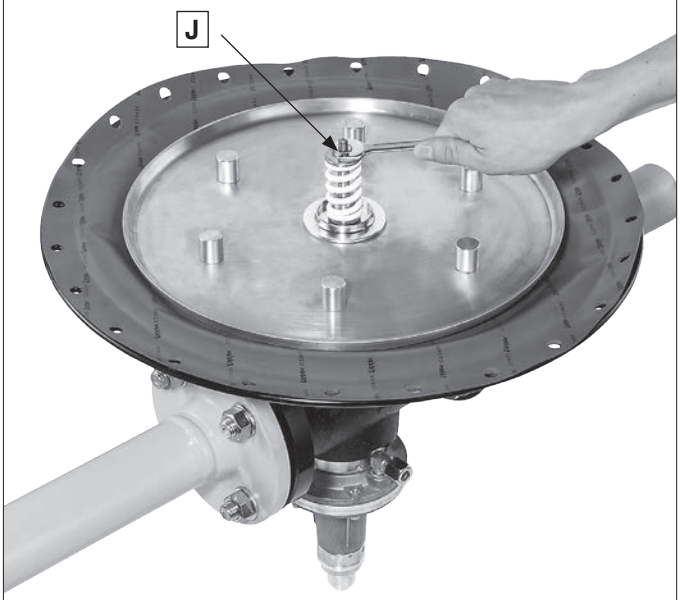
Remove the reducing washer **I** (HD version only).

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



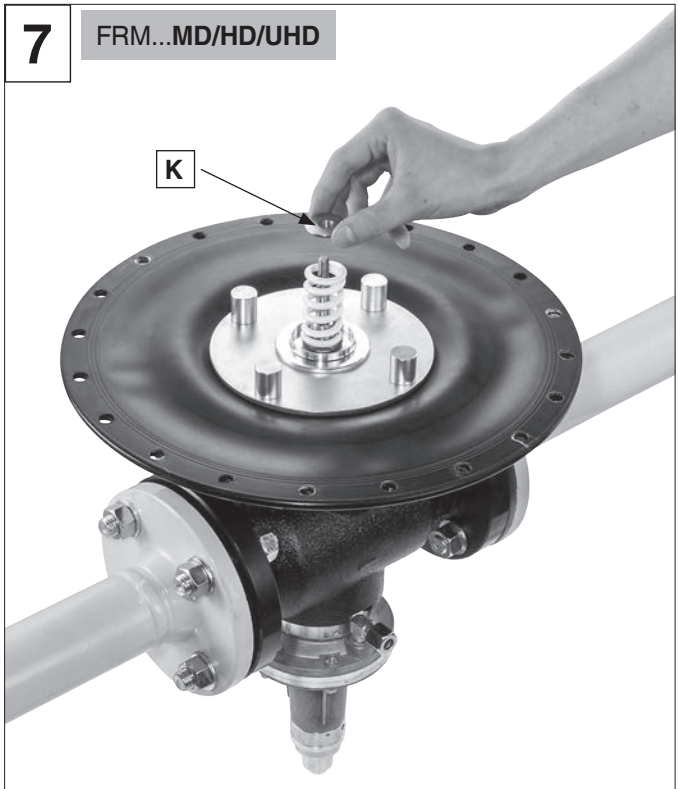
Loosen the nut **J** (M 8) using an open-ended wrench **SW 13 mm**.

FRM...**ND**



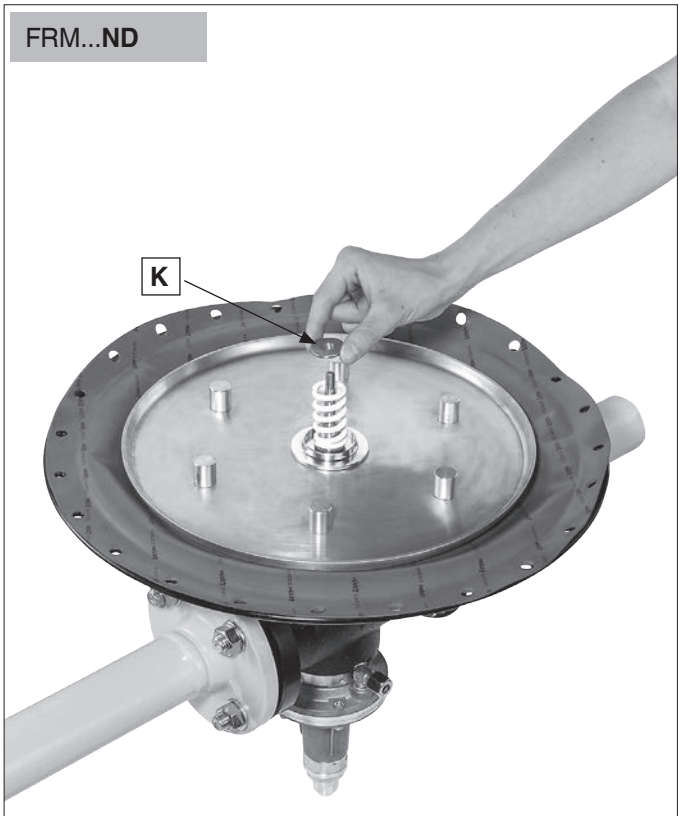
Loosen the nut **J** (M 8) using an open-ended wrench **SW 13 mm**.

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



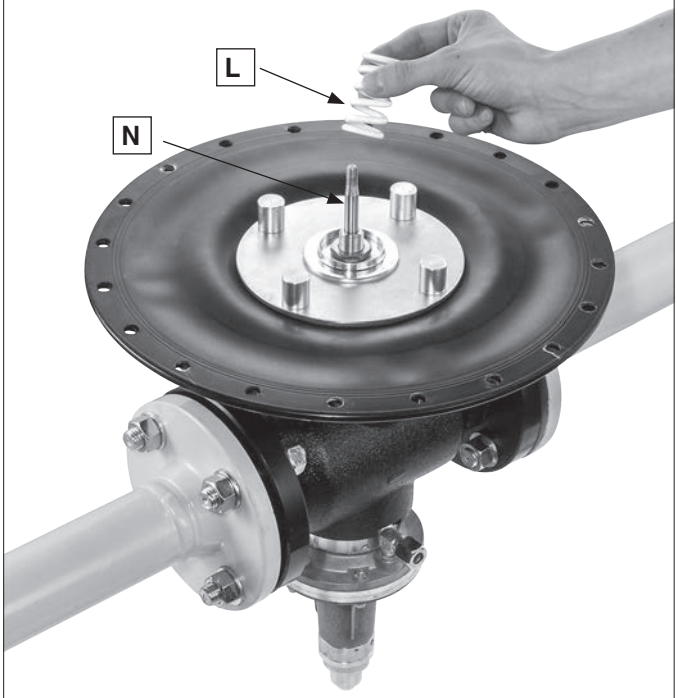
Remove the spring washer **K**.

FRM...**ND**



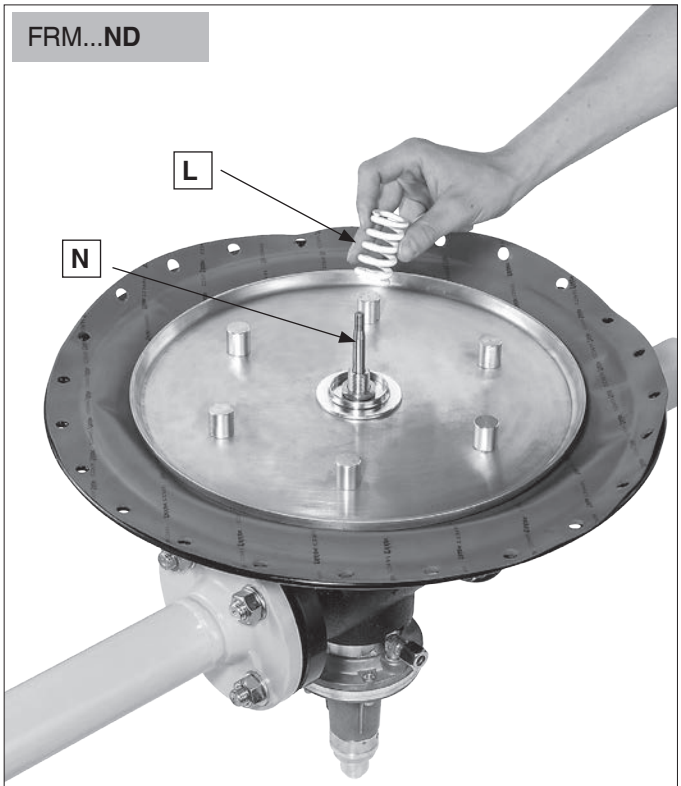
Remove the spring washer **K.**

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



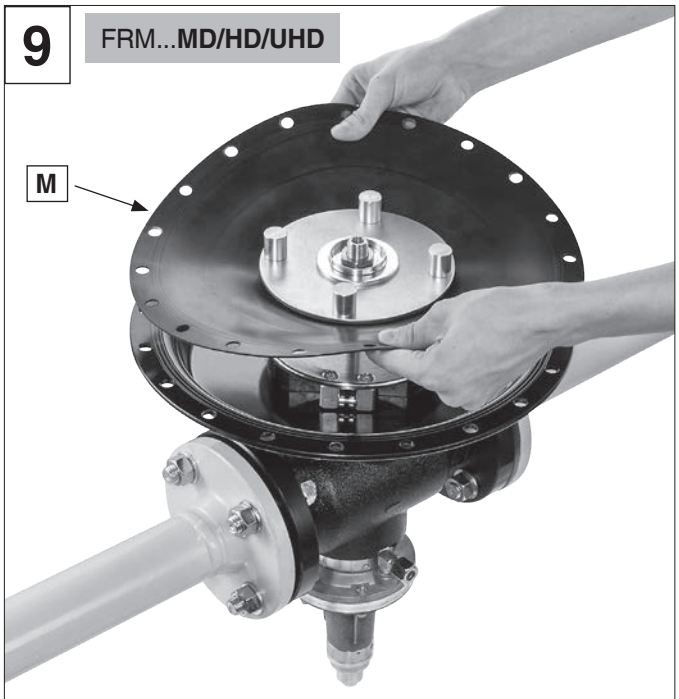
Remove the safety spring **L.**

FRM...**ND**



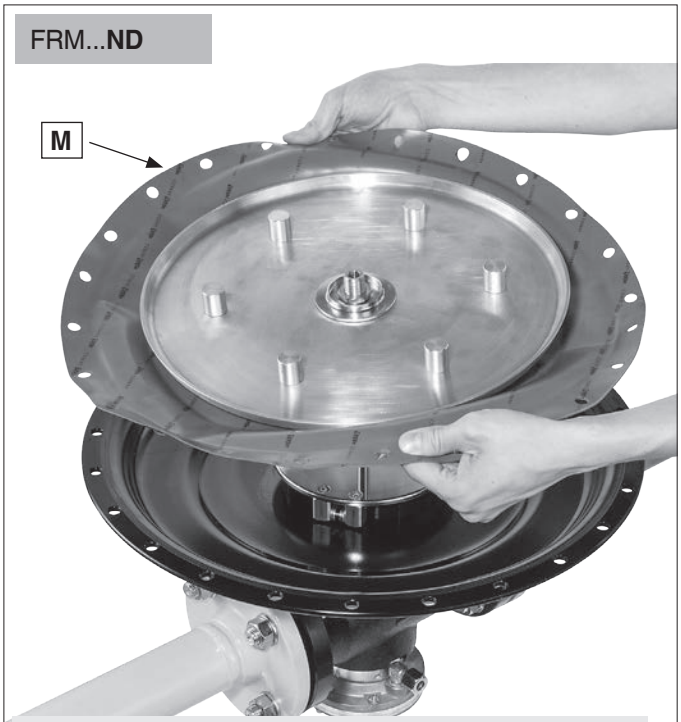
Remove the safety spring **L.**

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



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).

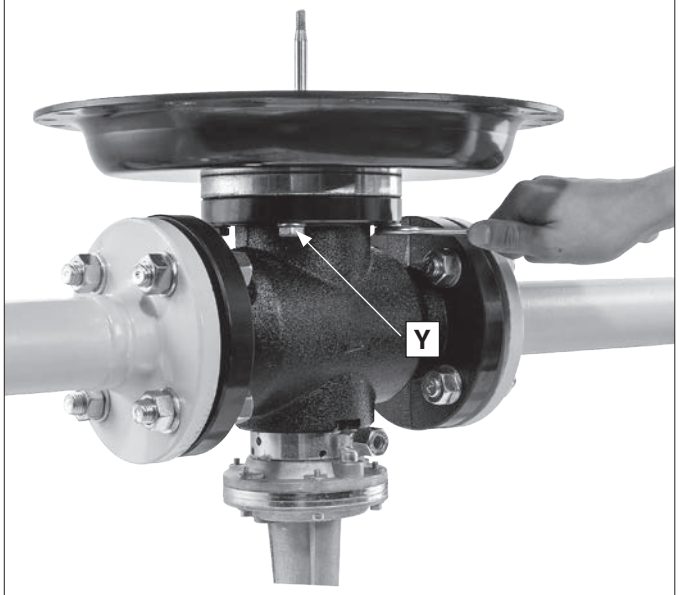
FRM...**ND**



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).

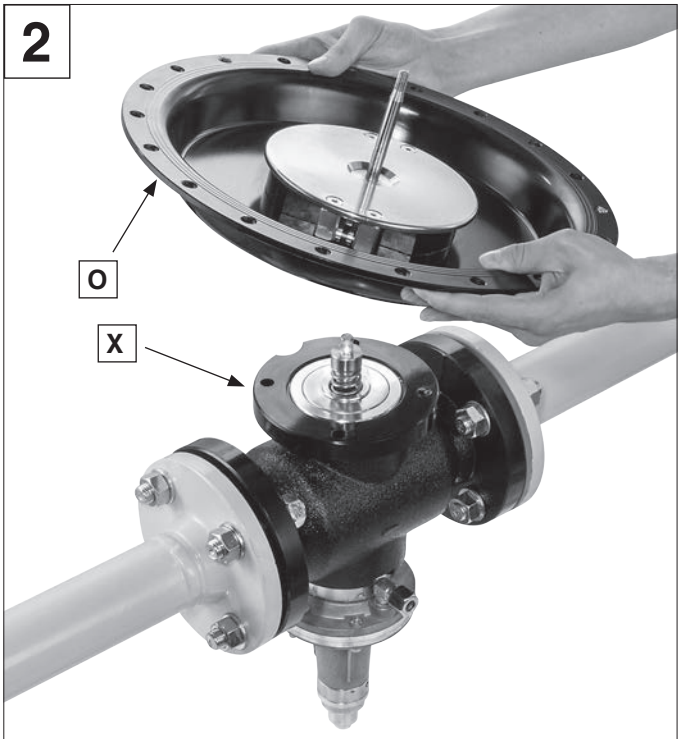
14.2.3 Replacement of the control plate / valve seat

1



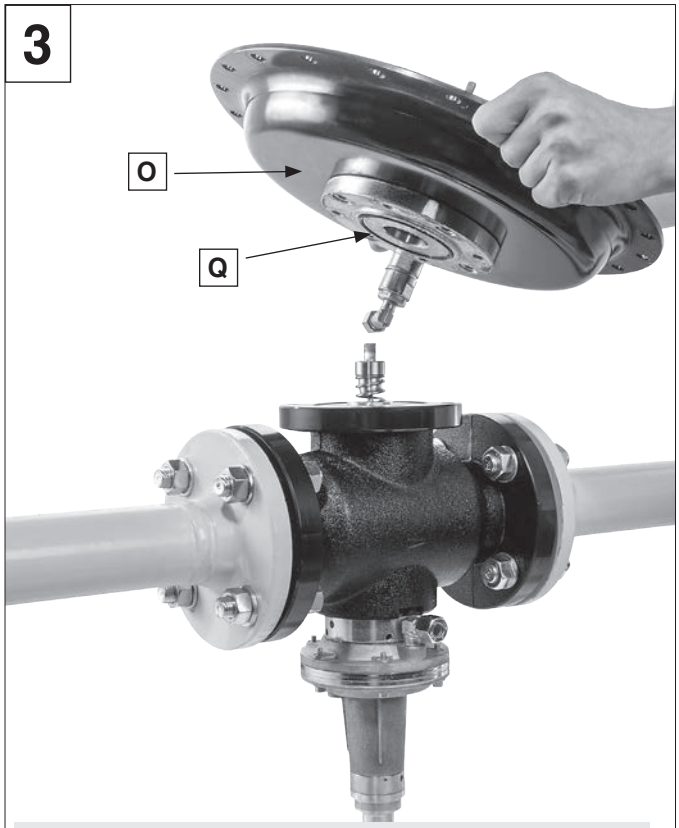
4 Loosen the screws **Y.**

2



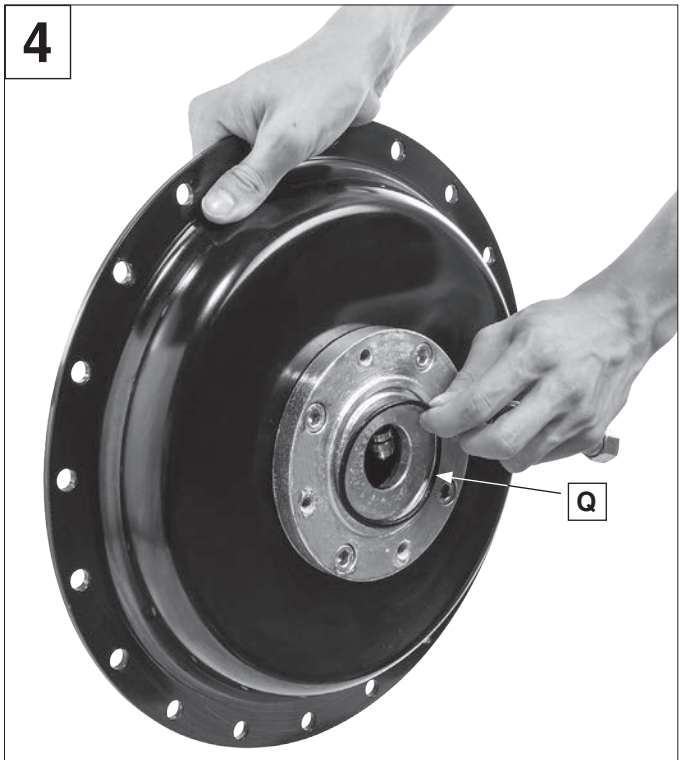
Remove the lower diaphragm shell **O** from the housing **X**. To do this, the diaphragm shell **O** has to be turned carefully.

3



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

4



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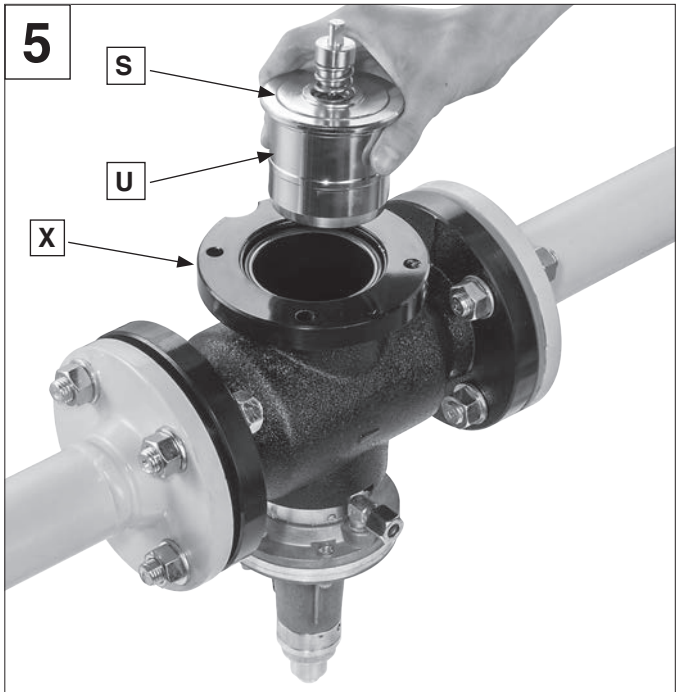
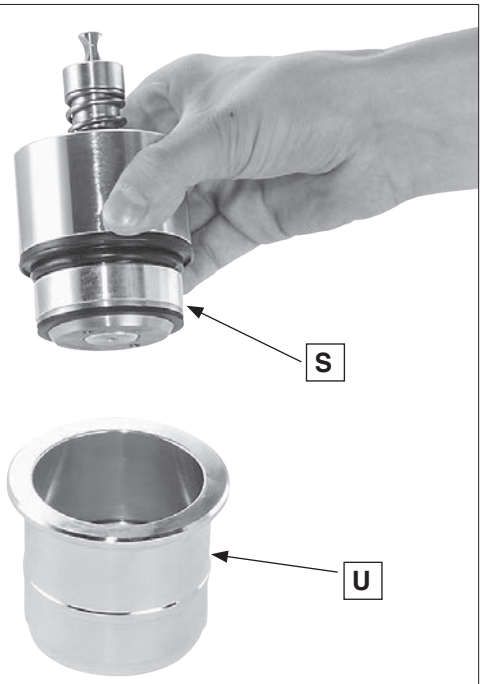
5



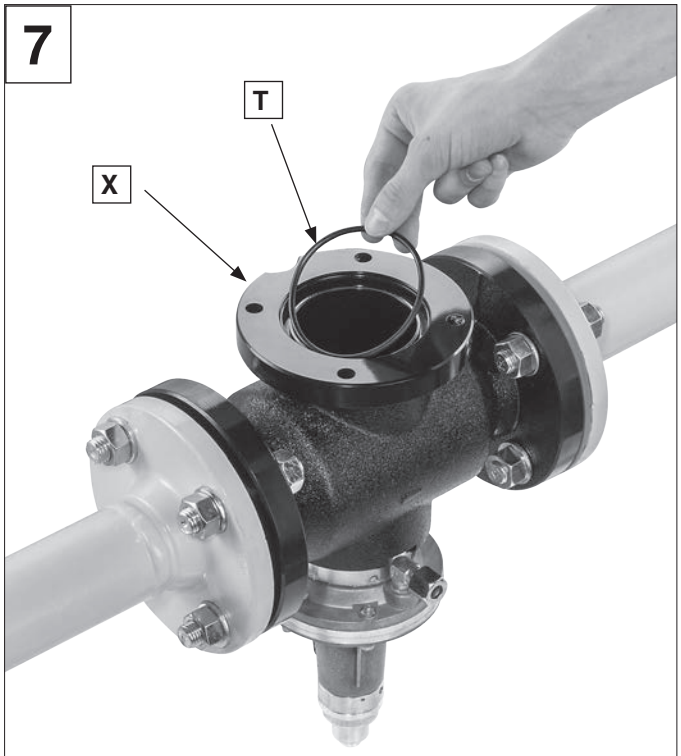
Remove the assembly of the control plate **S** incl. the sleeve **U** from the housing **X**.

6



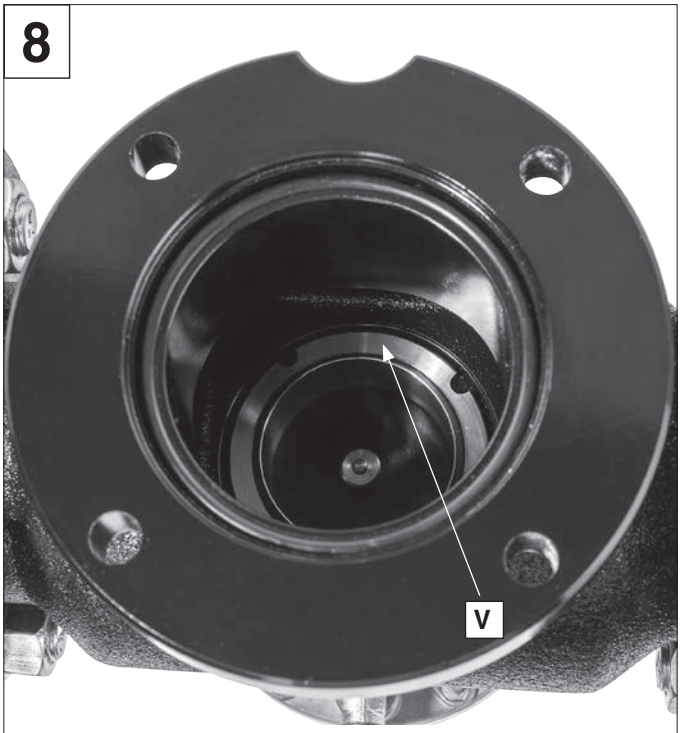
Remove the control plate **S** from the control plate sleeve **U** and check it for damage. If necessary, replace the control plate **S** incl. the sleeve **U**.

7



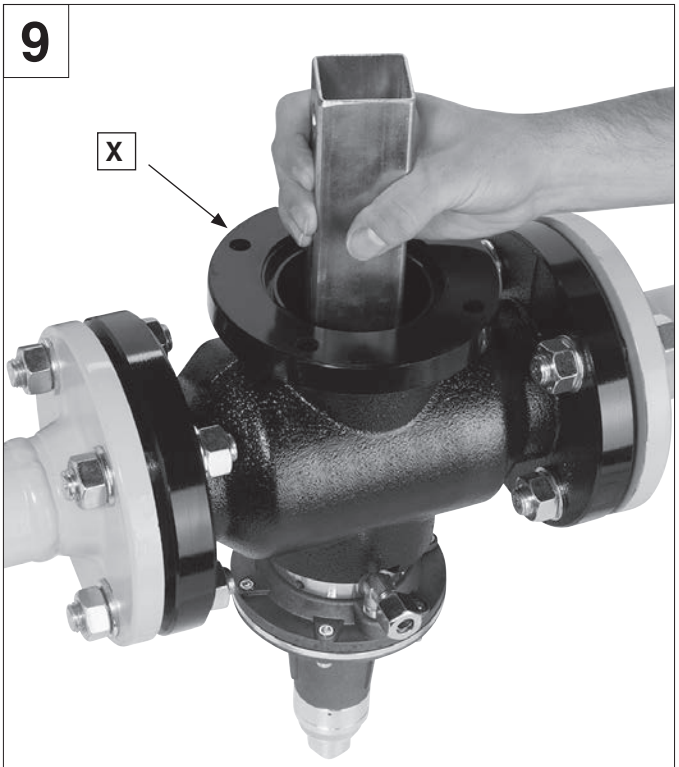
Remove the O-Ring **T** from the housing **X**. Clean the inside of the regulator housing **X**.

8



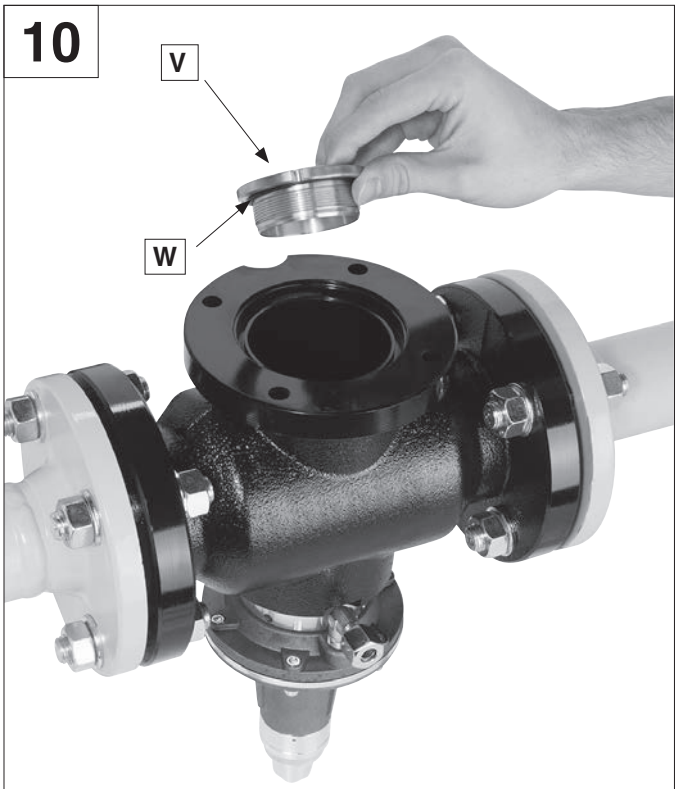
Check the valve seat **V** for dirt or damage.

9



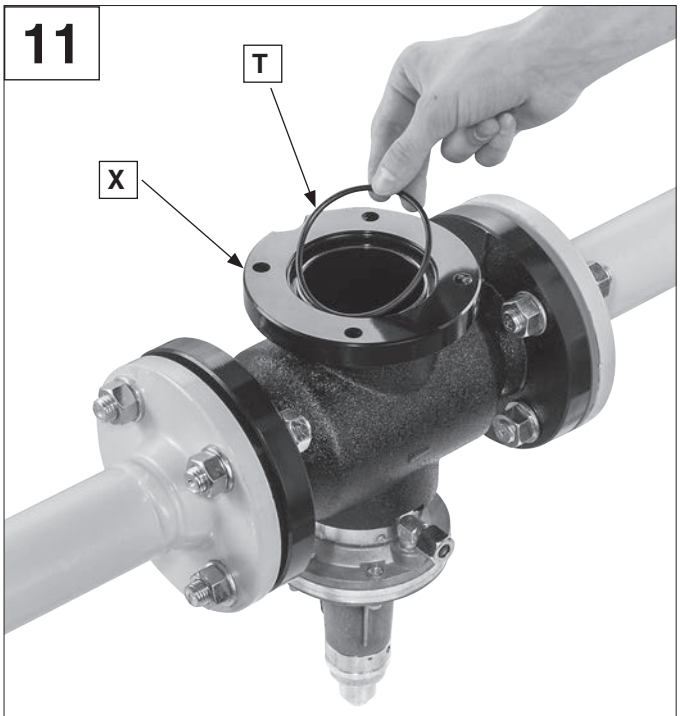
If necessary, replace the valve seat **V**:
screw out the valve seat **V** from the housing **X** by using a socket wrench.

10



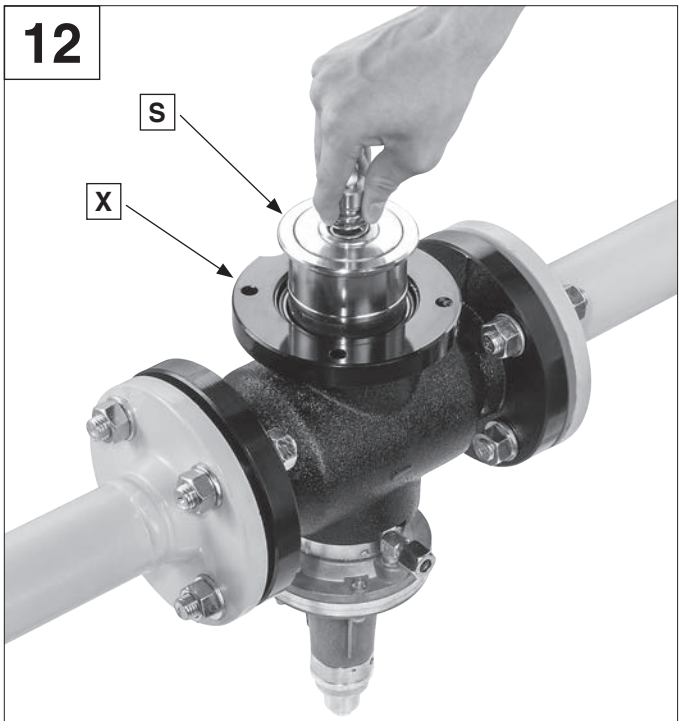
Tighten the new valve seat **V** with the new O-Ring **W** (maintenance set 4) in the housing **X**.

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.

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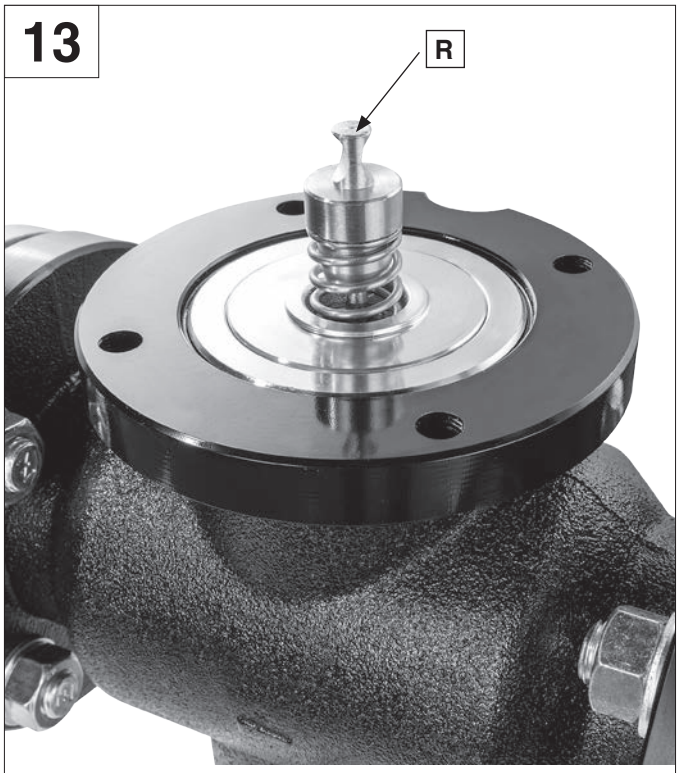
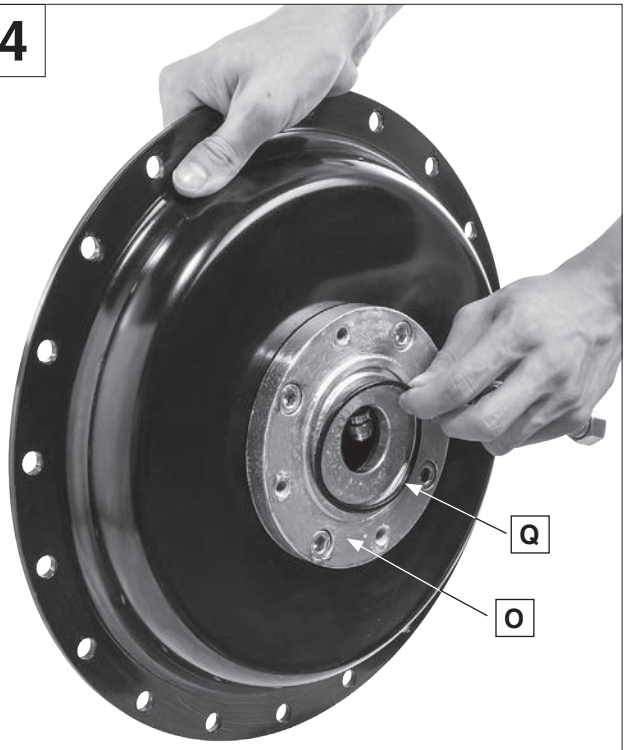
13



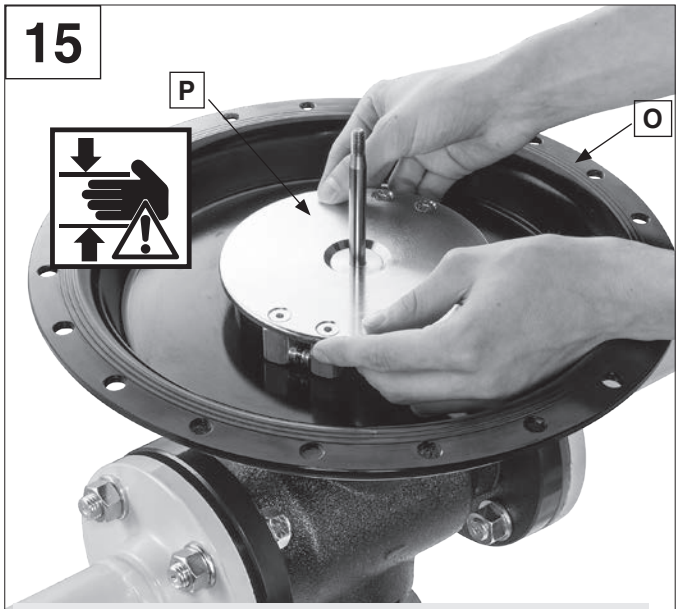
Make sure that the connection pin **R** 45° is oriented opposite to the direction of the flow (non-aligned!)

14



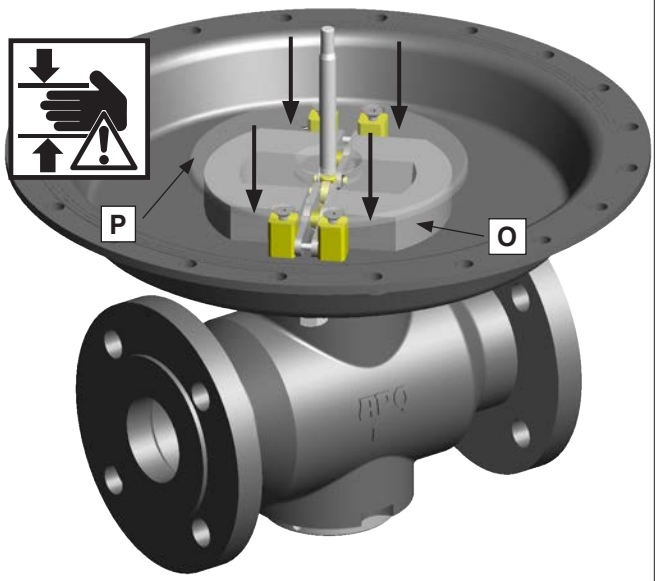
Insert the new O-Ring **Q** (maintenance kit 3, 4 or 5) in the turned groove in the lower diaphragm shell **O** using grease if necessary to hold it in place.

15

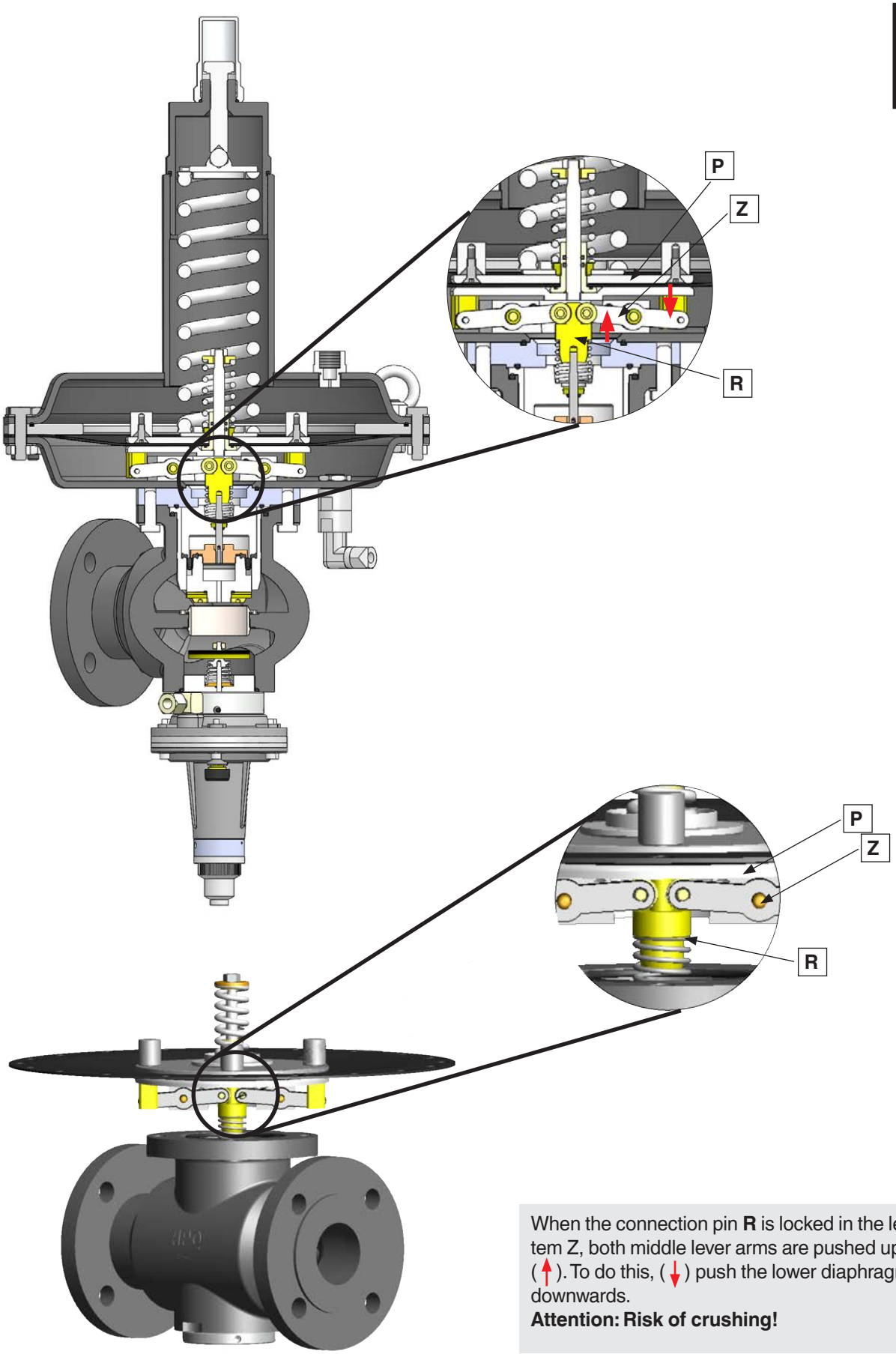


Put the diaphragm shell **O** in position:
Secure the lower diaphragm shell **O** using the lower diaphragm disc **P** (to do this, the diaphragm disc is dragged upwards) and fit the connection pin **R**. Lock the connection pin **R** of the valve disc in the coupling of the lever system in the diaphragm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

16

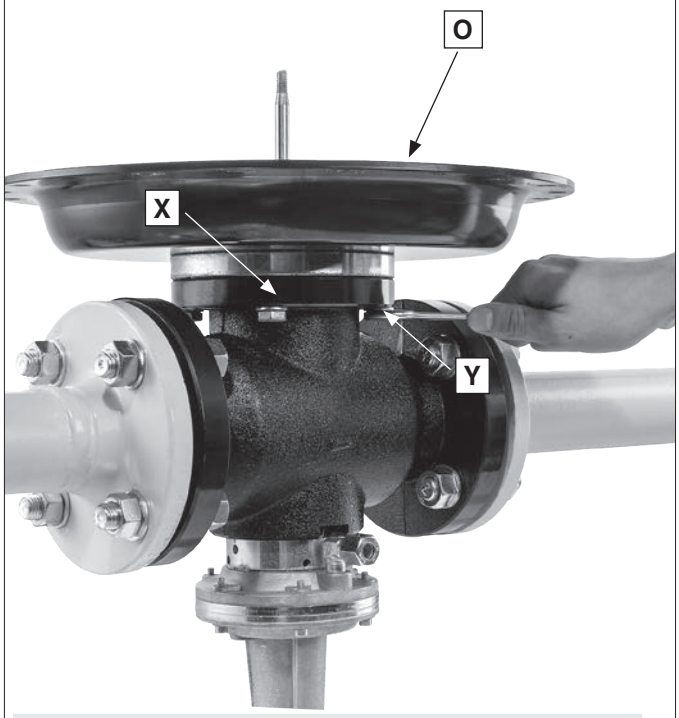


Attention: Risk of crushing!
Place fingers at the marked positions (🡻).
Fingers may be squeezed between the diaphragm disc **P** and the diaphragm shell **O**. Do not slide fingers under the diaphragm disc!!



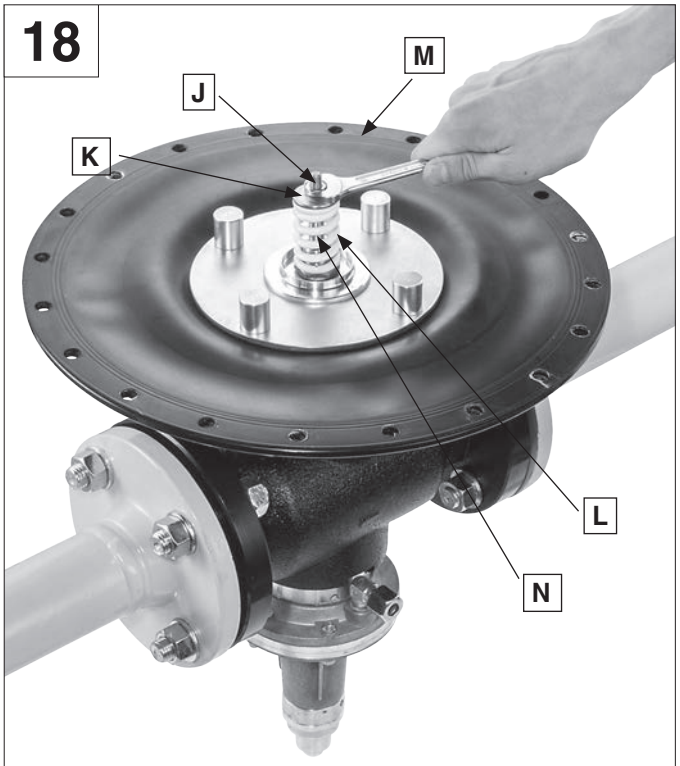
When the connection pin **R** is locked in the lever system Z, both middle lever arms are pushed upwards (↑). To do this, (↓) push the lower diaphragm disc **P** downwards.
Attention: Risk of crushing!

17



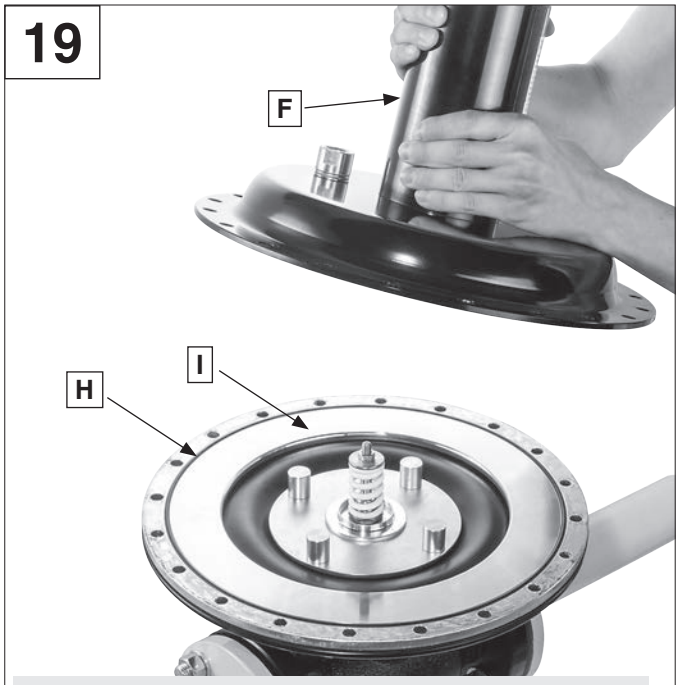
Fix the diaphram housing **O** by tightening the 4 screws **Y**.

18



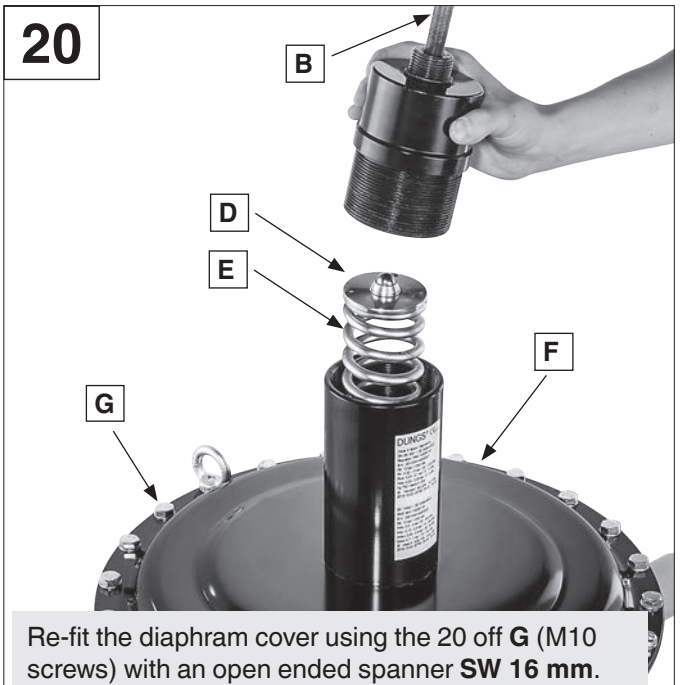
Reinsert the working diaphragm **M** on the guide rod **N**. Put on the safety spring **L** and the spring washer **K**. Screw on the nut **J** (M 8). Tighten to the stop using an open-ended screw **SW 13 mm**.

19



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

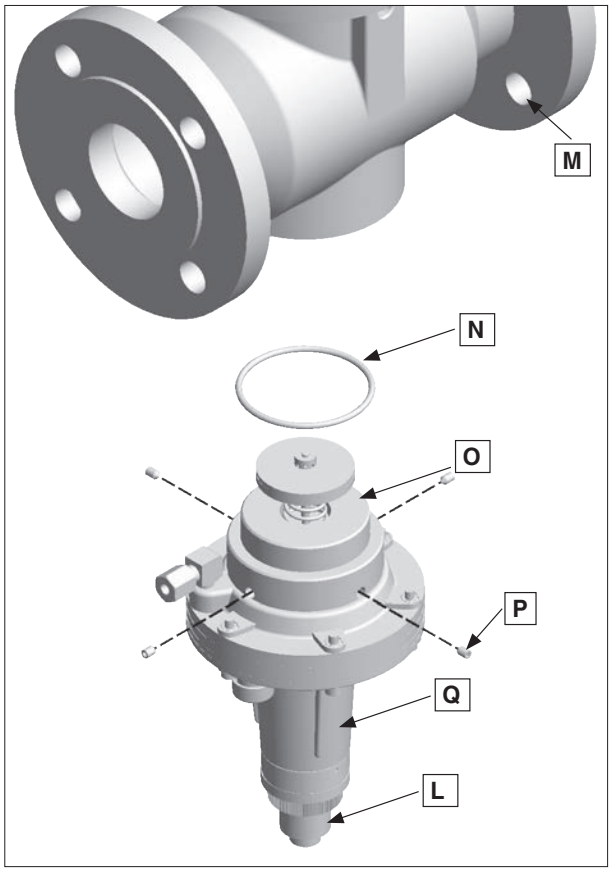
20



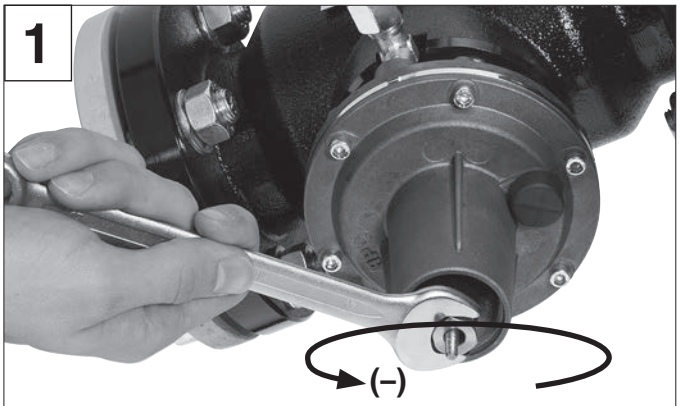
Re-fit the diaphram cover using the 20 off **G** (M10 screws) with an open ended spanner **SW 16 mm**.
Insert the setpoint spring **E** in the spring dome **F**.
In sert the spring washer **D** incl. ball on the spring.
Tighten the sealing cap **C** in the spring dome **F**.
Tighten the adjusting screw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

14.3 Maintenance instructions of the SAV

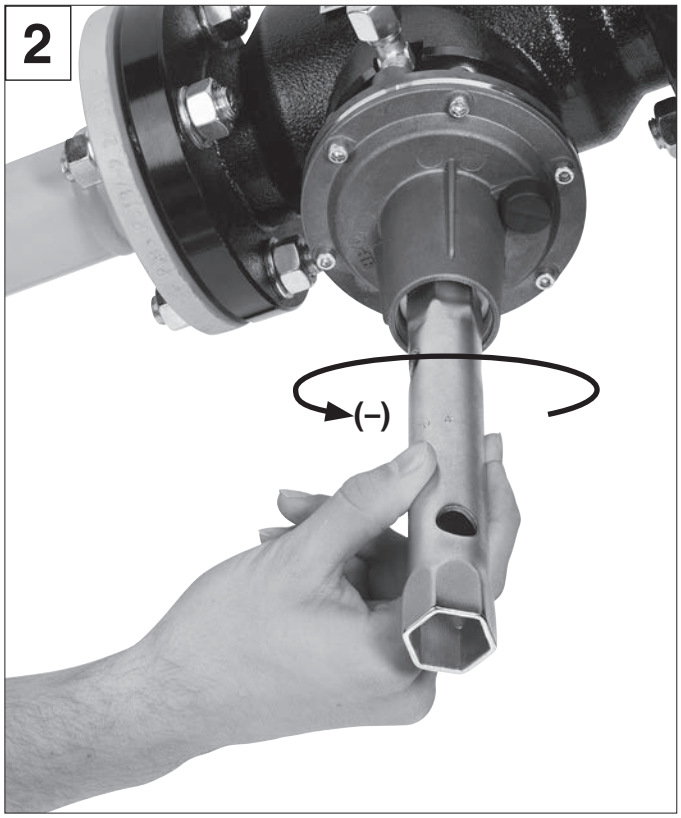
Pos.	Designation
A	Diaphragm shell
B	Push rod
C	O-Ring of the diaphragm shell
D	Lower diaphragm disc
E	Working diaphragm
F	Setpoint spring of the lower shut-down pressure
G	Upper diaphragm disc (HD version only)
H	Allen screw, 6 pieces
I	Spring dome ASE
J	Over pressure adjustment nut
K	Under pressure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



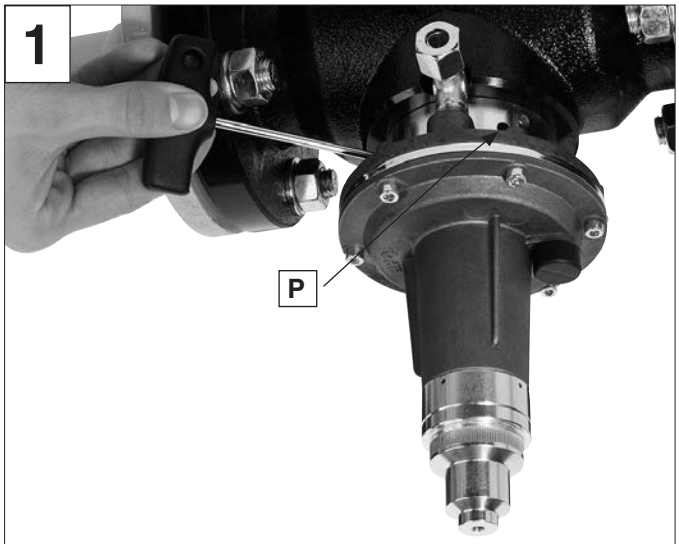
14.3.1 Preparation



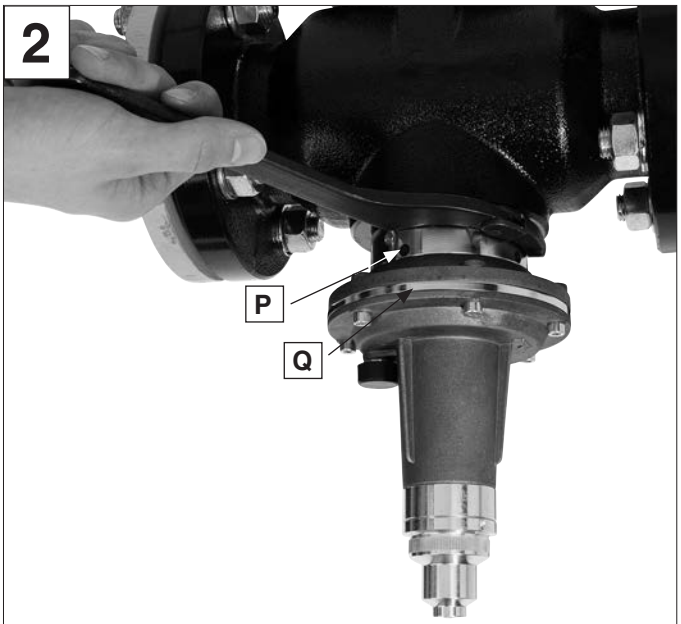
1. Remove the impulse and vent lines.
2. Remove the protective cap **L**.
3. Release the setpoint springs at the adjusting screws **J** and **K**.



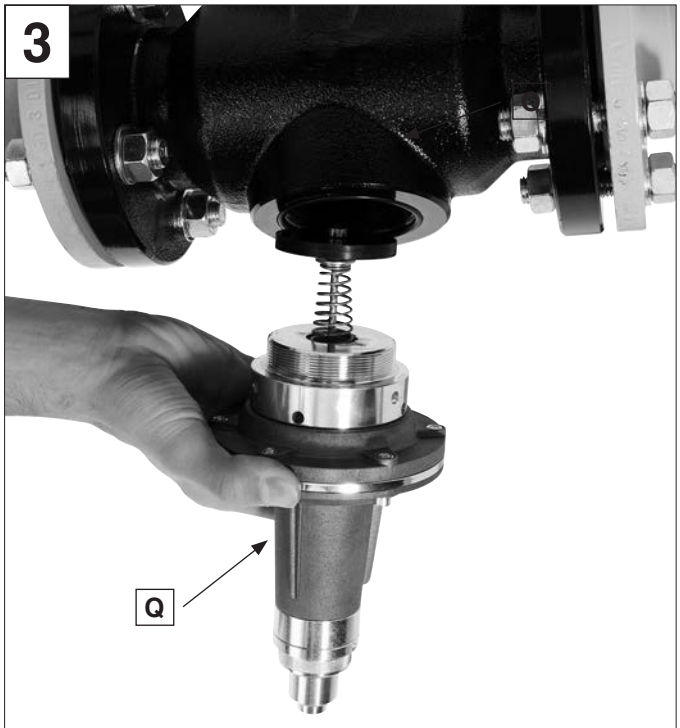
14.3.2 Removing the ASE (SAV mechanism only) from the housing



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



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



Remove the ASE **Q.**

14.3.3 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 mm**.
3	Fix the connecting piece **O** of the ASE **Q** using 4 hexagonal socket grub screws **P** (M5x8).

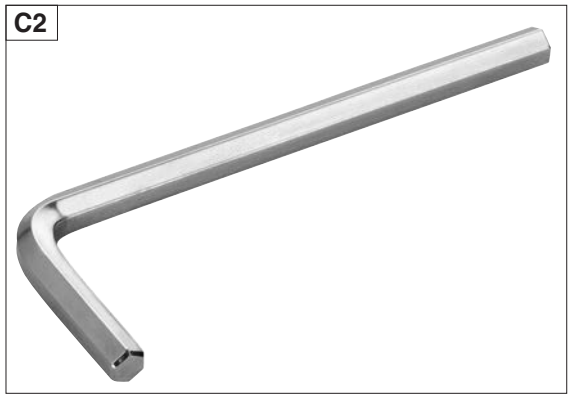
14.4 Required tools

A

B

C1

C2



D

E

Order no. 271170

SAV

Work step		Tool designation	Pressure rating	Wrench size (mm)		
				DN 25	DN 40	DN 50
1	Loosen the pulse lines.	Open-ended spanner (A)	ND/MD/HD	SW 22	SW 22	SW 22
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 4	SW 4

Regulator

Work step		Tool designation	Pressure rating	Wrench size (mm)		
				DN 25	DN 40	DN 50
1	Loosen the pulse lines.	Open-ended spanner (A)	ND/MD/HD	SW 22	SW 22	SW 22
2	Release the setpoint springs.	Open-ended spanner (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 spanner (A)	ND/MD/HD	SW 17	SW 17	SW 17
		Open-ended spanner (A)		SW 13	SW 13	SW 13
4	Replace the control plate.	Open-ended spanner (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 SAV Leakage test

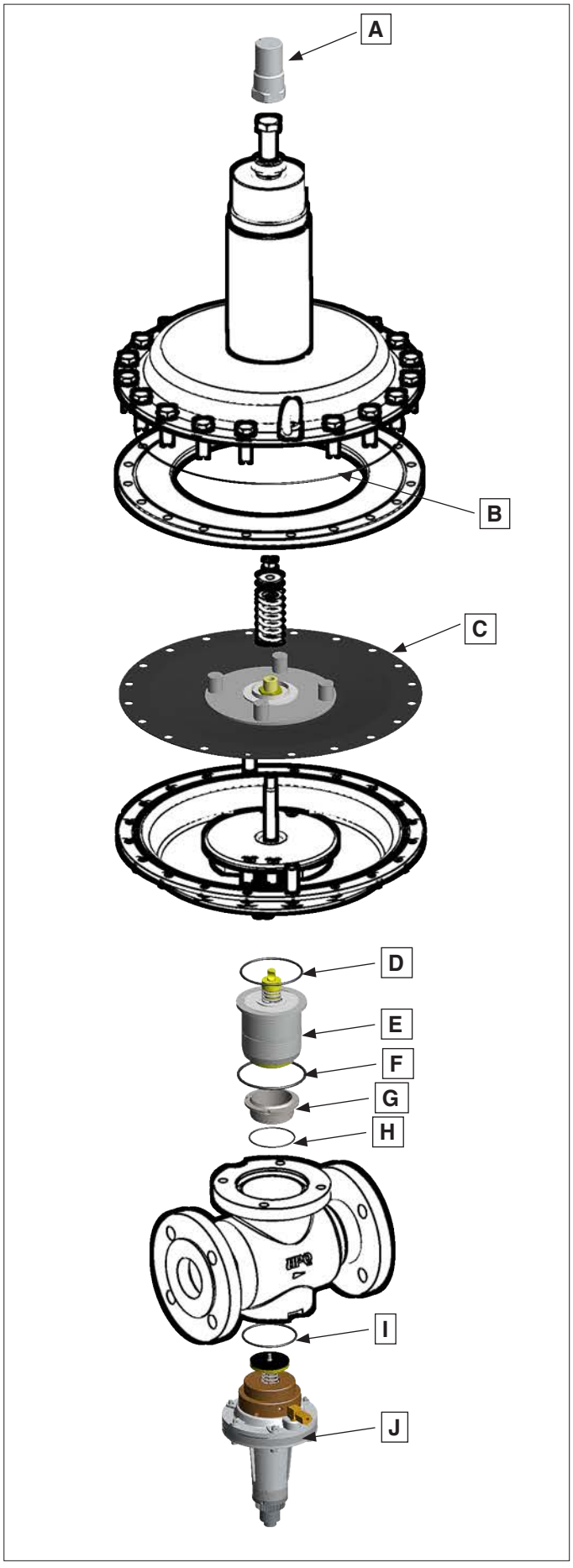
Go to section "12. Commissioning, decommissioning and recommissioning FRM or SAV" for performing functional and leakage testing of SAV.

14.6 Recommended maintenance intervals for SAV and FRM

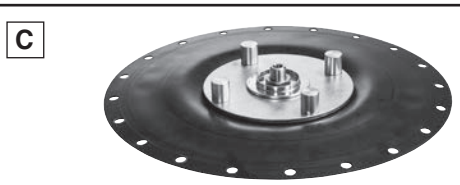
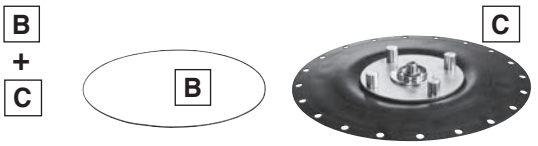
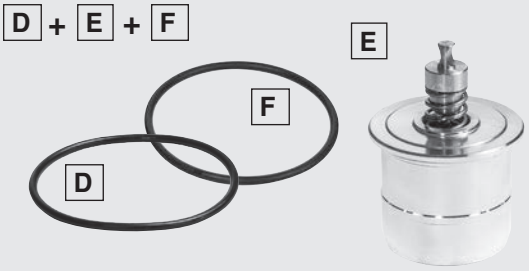
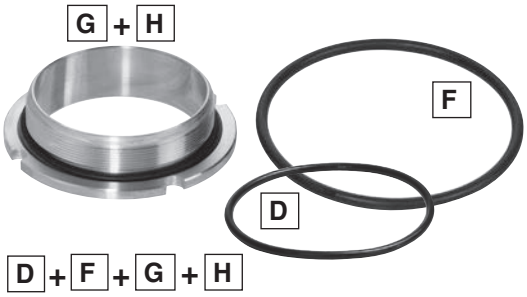
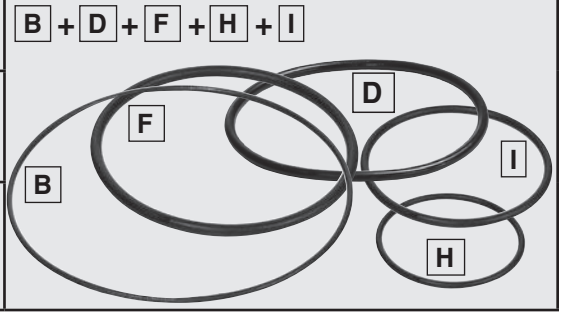
1. The maintenance intervals depend on the system-specific operating and environmental conditions, gas quality, state of the pipelines, etc.
2. The maintenance intervals have to be set by the system operator according to the system requirements.
3. It is recommended to perform a functional test on a monthly base and carry out maintenance works every year including a leakage testing, 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

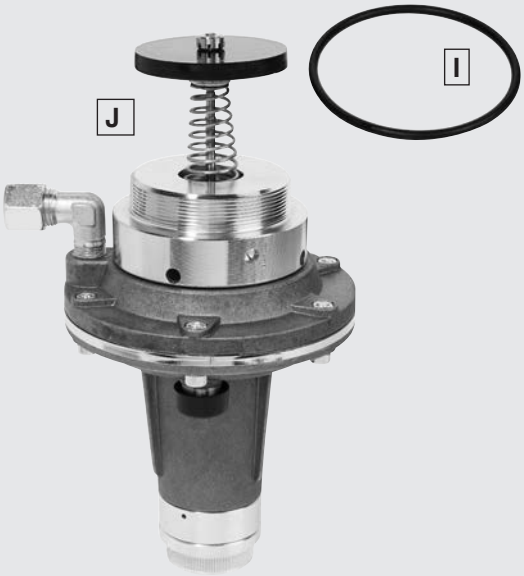
15. Spare parts



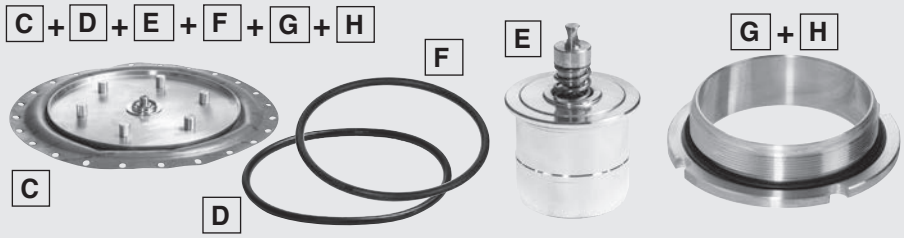
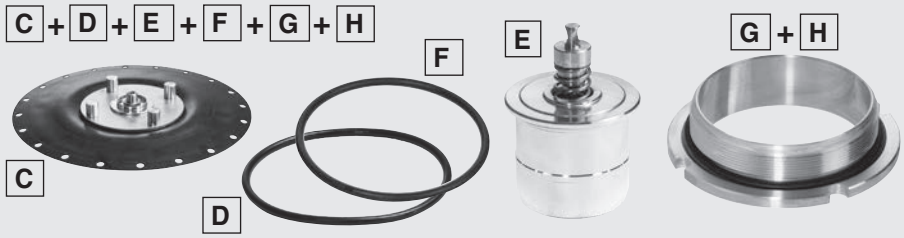
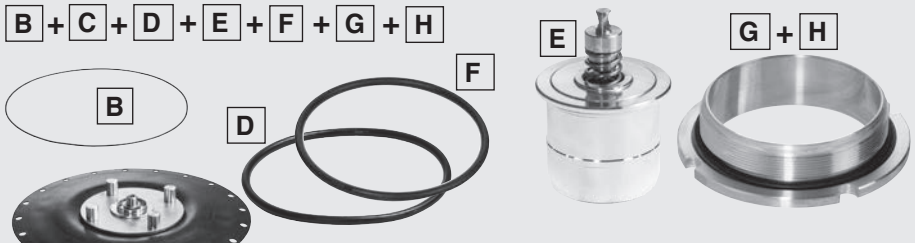
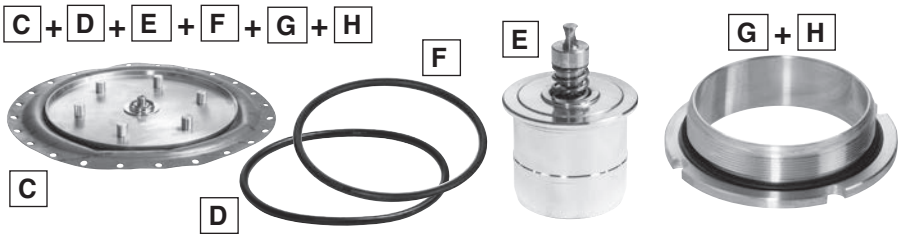
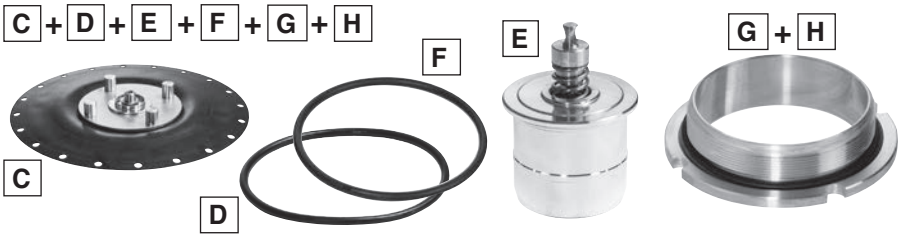
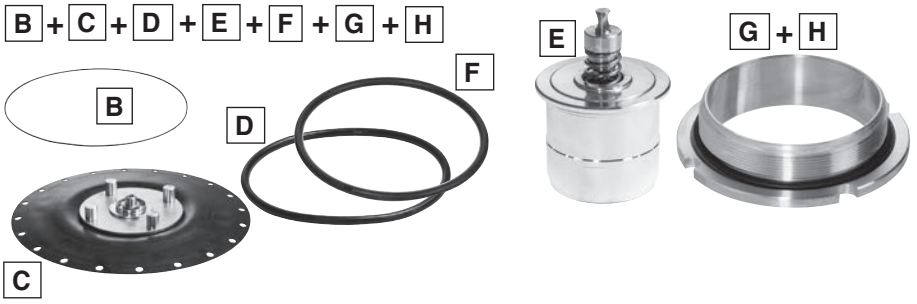
15.1 List of spare parts of the regulator

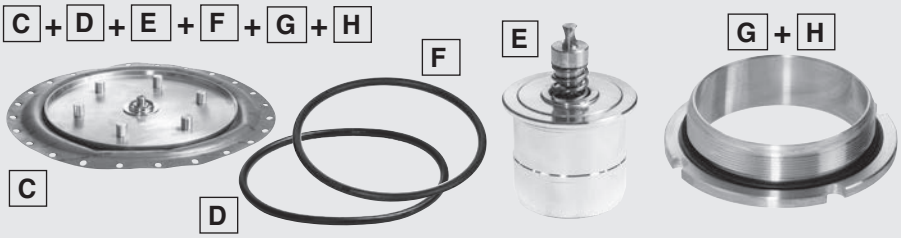
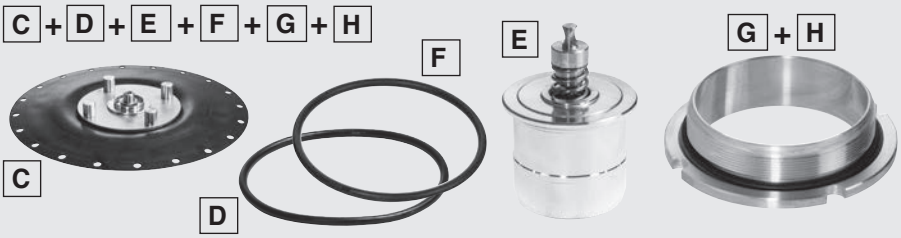
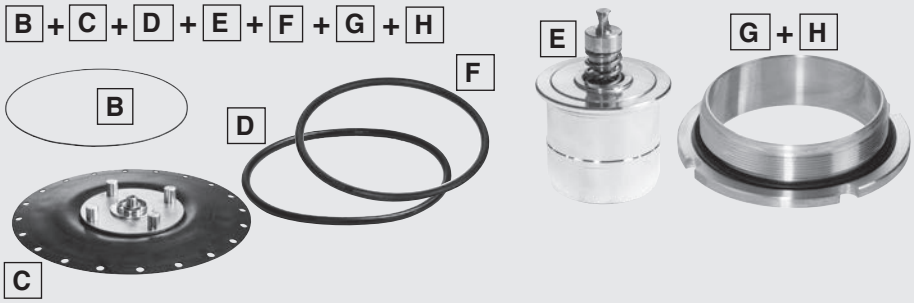
Kit	Spare part	Version	Order number	Spare part / image
1	Protective cap	FRM 100025-100050 FRM 250025-250050	270396	
2	Working diaphragm with O-Ring	FRM 100025-100050 ND	270384	
		FRM 100025-100040 MD	270385	
		FRM 100050 MD	296578	
		FRM 100025-100040 HD FRM 250025-250040 UHD	270386	
		FRM 100050 HD FRM 250050 UHD	297102	
3	Compen-sation unit with O-Rings	FRM 100025 ND/MD/HD FRM 250025 UHD	270387	
		FRM 100040 ND/MD/HD FRM 250040 UHD	270388	
		FRM 100050 ND	270389	
		FRM 100050 MD/HD FRM 250050 UHD	271092	
4	Valve seat with sealing ring and O-Ring	FRM 100025 ND/MD/HD FRM 250025 UHD	270390	
		FRM 100040 ND/MD/HD FRM 250040 UHD	270391	
		FRM 100050 ND/MD/HD FRM 250050 UHD	270392	
5	Kit O-Rings	FRM 100025 ND/MD/HD FRM 250025 UHD	270393	
		FRM 100040 ND/MD/HD FRM 250040 UHD	270394	
		FRM 100050 ND/MD/HD FRM 250050 UHD	270395	

15.2 List of spare parts of SAV

Kit	Spare part	Version	Order number	Spare part / image
1	Protective cap	SAV 100025-100050 ND/MD/HD SAV 250025-250050 UHD	on request	
2	ASE with O-Ring	SAV 100025 ND	270375	
		SAV 100025 MD	270376	
		SAV 100025 HD SAV 250025 UHD	270377	
		SAV 100040 ND	270378	
		SAV 100040 MD	270379	
		SAV 100040 HD SAV 250040 UHD	270380	
		SAV 100050 ND	270381	
		SAV 100050 MD	270382	
		SAV 1000050 HD SAV 2500050 UHD	270383	

15.3 Complete regulator sets

Version	Order number	Contents
FRM 100025 ND	271093	
FRM 100025 MD	271094	
FRM 100025 HD FRM 250025 UHD	271095	
FRM 100040 ND	271096	
FRM 100040 MD	271097	
FRM 100040 HD FRM 250040 UHD	271098	

Version	Order number	Contents
FRM 100050 ND	271099	C + D + E + F + G + H 
FRM 100050 MD	271100	C + D + E + F + G + H 
FRM 100050 HD FRM 250050 UHD	271101	B + C + D + E + F + G + H 

15.4 Accessories

Spare Part	Version	Order number	Contents
Adapter ¼ "G to ¼ "NPT	SAV / ASE	231944	no picture available
Adapter ½ "G to ½ "NPT	FRM	231945	no picture available
Connector ¼ "G to ½ " tubing (USA) for feedback / impulse lines	SAV / ASE	267783	
Connector ½ "G to ½ " tubing (USA) for feedback / impulse lines	FRM	278100	
Nozzle set	8 pc Ø 1,5 - 9 mm	270712	
Venting cap cover	FRM 100025-100050	277942	

15.5 Storage conditions

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

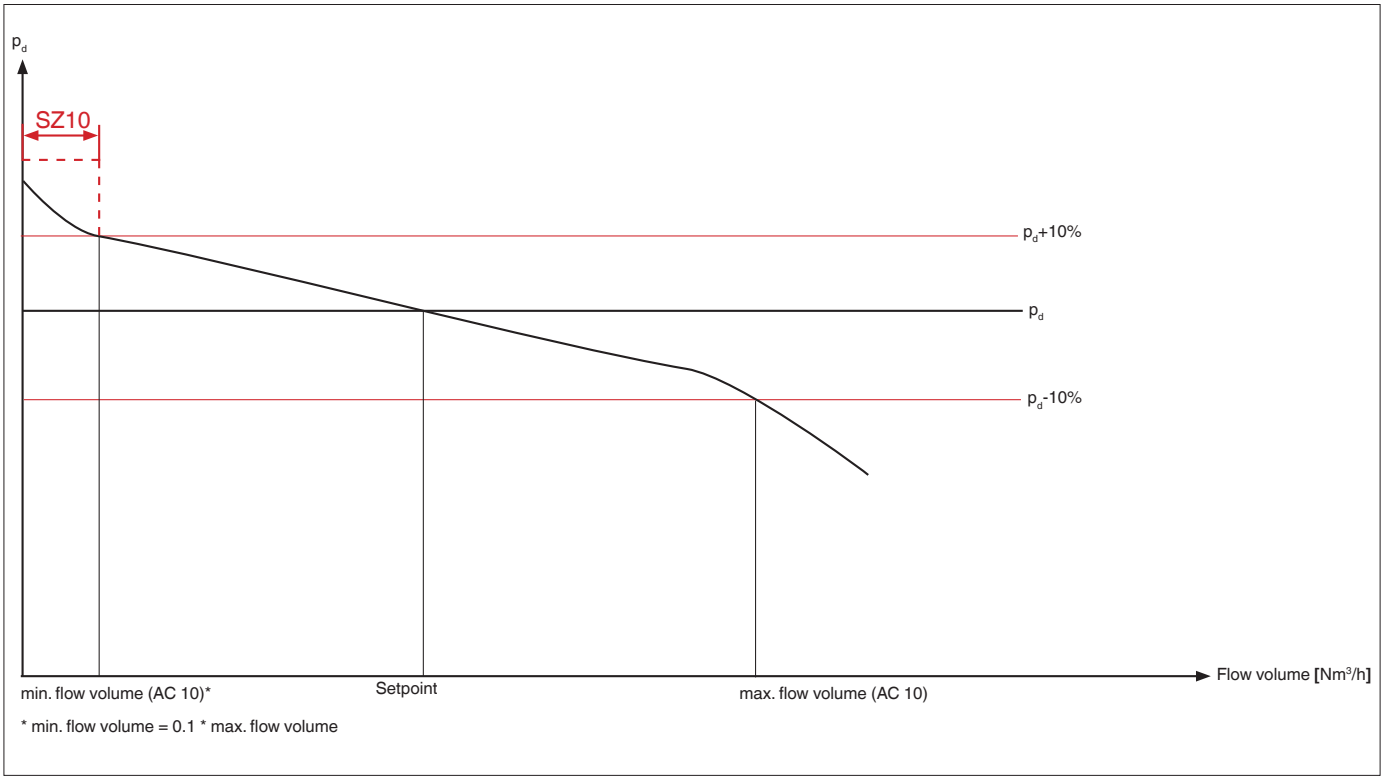
The ageing process mostly depends on the following factors:

- 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 [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	99	120	122	110	110	113											
0,5	164	207	224	220	220	211	199	185	169	149	124	124					
0,75	203	259	283	281	281	276	270	262	254	244	232	232	203				
1	236	301	331	330	330	328	325	321	316	311	304	304	287	219			
1,5	295	377	415	415	415	415	415	415	414	413	411	411	406	379	331	248	
2	354	452	497	497	497	497	497	497	497	497	497	497	497	490	468	430	370
2,5	412	527	580	580	580	580	580	580	580	580	580	580	580	580	573	555	523
3	471	602	662	662	662	662	662	662	662	662	662	662	662	662	662	657	641
3,5	530	676	745	745	745	745	745	745	745	745	745	745	745	745	745	745	740
4	588	751	827	827	827	827	827	827	827	827	827	827	827	827	827	827	827
4,5	647	826	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
5	706	901	992	992	992	992	992	992	992	992	992	992	992	992	992	992	992
6	823	1051	1157	1157	1157	1057	1157	1157	1157	1157	1157	1157	1057	1057	1057	1057	1057
7	940	1201	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322	1322
8	1058	1351	1487	1487	1487	1497	1487	1487	1487	1487	1487	1487	1497	1497	1497	1497	1497
9	1175	1501	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652	1652
10	1292	1651	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817	1817

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

FRM ...		ND				MD						HD				
Outlet pressure p_u [PSI]	Inlet pressure p_d [PSI]	0.400	0.500	1.00	1.50	1.50	2.00	3.00	4.00	5.00	6.00	6.00	10.00	15.00	20.00	22.00
	Inlet pressure p_d ["W.C.]	11.1	13.9	27.7	41.6	41.6	55.4	83.1	110.8	138.5	166.2	166.2	277.1	415.6	554.2	609.6
3.0		3548	3718	4370	3974	3980	4047									
5.0		4604	4853	5967	5759	5752	5684	3504	3011	2575	2113	2113				
10.0		6836	7253	9299	9402	9387	9242	9073	8413	7851	7270	7270				
15.0		8477	8999	11631	11859	11855	11809	11749	11477	11247	10995	10995	8678			
20.0		9913	10529	13629	13929	13928	13916	13901	13816	13720	13599	13599	12332	108491	74877	
30.0		12781	13574	17558	17952	17952	17952	17952	17952	17952	17952	17952	17791	16864	14766	13806
40.0		15624	16598	21492	21976	21976	21976	21976	21976	21976	21976	21976	21976	21802	21025	20619
50.0		18498	19639	25419	26001	26001	26001	26001	26001	26001	26001	26001	26001	25998	25870	25765
60.0		21335	22658	29339	30007	30007	30007	30007	30007	30007	30007	30007	30007	30007	30007	30007
70.0		24208	25705	33269	34026	34026	34026	34026	34026	34026	34026	34026	34026	34026	34026	34026
80.0		27063	28738	37194	38038	37913	36657	37031	38038	38038	38038	36216	36216	36216	36216	36216
90.0		29912	31767	41123	42055	41863	39928	40504	42055	42055	42055	39249	39249	39249	39249	39249
100.0		32761	34795	45052	46073	46047	45791	45867	46073	46073	46073	45701	45701	45701	45701	45701
110		35630	37840	48981	50090	50104	50247	50204	50090	50090	50090	50297	50297	50297	50297	50297
120		38494	40880	52910	54108	54125	54302	54250	54108	54108	54108	54364	54364	54364	54364	54364
130		41343	43908	56839	58125	58126	58135	58133	58125	58125	58125	58138	58138	58138	58138	58138
145		45627	48463	62748	64167	64167	64167	64167	64167	64167	64167	64167	64167	64167	64167	64167

FRM 100040 … DN 40 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	142	172	206	184	160	133											
0,5	237	298	380	367	320	352	383	329	360	284	270	200					
0,75	293	372	479	468	408	461	519	466	541	464	505	373	408				
1	340	434	561	551	480	548	626	571	674	592	661	489	577	473			
1,5	424	542	703	691	603	693	799	737	883	787	896	662	816	819	719	500	
2	509	640	843	829	723	831	957	883	1060	947	1082	800	1000	1057	1016	867	852
2,5	593	758	982	967	843	969	1116	1030	1236	1104	1262	932	1165	1250	1245	1119	1205
3	678	866	1122	1104	963	1107	1275	1176	1411	1261	1441	1065	1331	1428	1438	1324	1476
3,5	762	974	1262	1242	1083	1245	1434	1323	1587	1418	1621	1198	1497	1606	1617	1501	1704
4	847	1082	1402	1379	1203	1383	1593	1469	1763	1576	1801	1330	1663	1784	1796	1667	1905
4,5	931	1189	1542	1517	1323	1521	1752	1616	1939	1733	1980	1463	1829	1962	1975	1834	2095
5	1016	1297	1681	1654	1443	1658	1911	1762	2115	1890	2160	1596	1995	2140	2154	2000	2285
6	1185	1513	1961	1930	1683	1934	2228	2056	2467	2204	2519	1861	2327	2496	2512	2333	2665
7	1353	1729	2241	2205	1922	2210	2546	2349	2818	2518	2878	2127	2658	2852	2870	2665	3045
8	1522	1945	2520	2480	2162	2486	2864	2642	3170	2833	3237	2392	2990	3208	3229	2998	3425
9	1691	2160	2800	2755	2402	2762	3182	2935	3522	3147	3597	2657	3322	3564	3587	3330	3805
10	1860	2376	3080	3030	2642	3037	3499	3228	3874	3461	3956	2923	3654	3920	3945	3663	4185

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

FRM ...		ND				MD						HD				
Outlet pressure p_u [PSI]	Inlet pressure p_d [PSI]	0.400	0.500	1.00	1.50	1.50	2.00	3.00	4.00	5.00	6.00	6.00	10.00	15.00	20.00	22.00
	Inlet pressure p_d ["W.C.]	11.1	13.9	27.7	41.6	41.6	55.4	83.1	110.8	138.5	166.2	166.2	277.1	415.6	554.2	609.6
3.0		5092	5334	7115	6645	5717	5093									
5.0		6634	6989	9751	9616	8380	8416	6234	5878	4975	4600	3408				
10.0		9868	10458	15206	15663	13772	14938	16161	16458	15132	15825	11693				
15.0		12210	12966	19049	19796	17416	19108	20965	22496	21686	23911	17687	18367			
20.0		14255	15141	22306	23205	20448	22509	24801	27078	26470	29633	21899	26161	235524	150960	
30.0		18381	19453	28682	29943	26380	29069	32049	35190	34631	39080	28890	37741	36282	31814	31794
40.0		22490	23887	35173	36644	32283	35577	39227	43058	42372	47827	35336	46606	46903	45438	47490
50.0		26598	28252	41613	43348	38187	42085	46405	50928	50113	56576	41813	55132	55879	55949	59329
60.0		30724	32630	48051	50033	44091	48593	53583	58798	57888	65332	48254	63659	64516	64934	69111
70.0		34837	36994	54468	56730	49992	55084	60748	66674	65631	74072	54731	72186	73150	73633	78363
80.0		38958	41370	60899	63438	55895	61583	67911	74555	73374	82819	61189	80712	81782	82328	87616
90.0		43066	45735	67339	70151	61792	68089	75081	82434	81116	91561	67649	89237	90415	91023	96869
100.0		47157	50087	73780	76847	67673	74590	82258	90297	88856	100302	74125	97758	99045	99710	106121
110		51268	54455	80204	83542	73573	81097	89436	98170	96616	109043	80582	106284	107696	108406	115373
120		55382	58823	86631	90238	79477	87606	96613	106045	104372	117794	87034	114810	116341	117100	124626
130		59497	63189	93066	96934	85381	94114	103791	113921	112115	126559	93486	123337	124971	125786	133878
145		65685	69761	102750	107003	94256	103874	114550	125763	123759	139705	103225	136159	137953	138866	147792

FRM 100050 … DN 50 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	150	182	218	194	169	140											
0,5	250	315	401	388	338	372	405	348	381	300	285	211					
0,75	309	393	506	494	431	486	548	492	571	490	533	394	431				
1	359	458	592	581	507	579	661	602	712	625	698	516	609	499			
1,5	448	572	742	730	636	732	843	778	932	831	645	699	862	864	759	528	
2	537	686	889	875	763	877	1011	932	1119	1000	1142	844	1055	1116	1073	915	945
2,5	626	800	1037	1020	890	1023	1178	1087	1307	1166	1332	984	1230	1320	1314	1181	1336
3	716	914	1185	1166	1016	1168	1346	1242	1490	1331	1522	1124	1405	1508	1518	1397	1636
3,5	805	1028	1332	1311	1143	1314	1514	1396	1676	1497	1711	1264	1581	1696	1707	1585	1889
4	864	1142	1480	1456	1270	1460	1682	1551	1861	1663	1901	1404	1756	1883	1896	1760	2112
4,5	983	1256	1627	1601	1396	1605	1849	1706	2047	1829	2090	1545	1931	2071	2085	1936	2323
5	1072	1369	1775	1746	1523	1751	2017	1861	2233	1995	2280	1685	2106	2259	2274	2111	2533
6	1250	1597	2070	2037	1779	2042	2352	2170	2604	2327	2659	1965	2456	2635	2652	2462	2955
7	1429	1825	2365	2327	2029	2333	2688	2479	2975	2659	3038	2245	2806	3011	3030	2813	3376
8	1607	2053	2661	2618	2283	2624	3023	2789	3347	2990	3418	2525	3156	3386	3408	3165	3797
9	1785	2280	2956	2908	2536	2915	3359	3098	3718	3322	3797	2805	3507	3762	3786	3516	4000
10	1964	2508	3251	3199	2789	3206	3694	3408	4089	3654	4100	3086	3857	4100	4100	3867	4100

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

FRM ...		ND				MD						HD				
Outlet pressure p_u [PSI]	Inlet pressure p_d [PSI]	0.400	0.500	1.00	1.50	1.50	2.00	3.00	4.00	5.00	6.00	6.00	10.00	15.00	20.00	22.00
	Inlet pressure p_d ["W.C.]	11.1	13.9	27.7	41.6	41.6	55.4	83.1	110.8	138.5	166.2	166.2	277.1	415.6	554.2	609.6
3.0		5378	5636	7529	7007	6038	5366									
5.0		7001	7380	10303	10156	8851	8885	6590	6219	5256	4856	3595				
10.0		10408	11035	16061	16539	14546	15762	17057	17380	15981	16703	12349				
15.0		12893	13689	20102	20878	18395	20187	22144	23743	22897	24522	18664	19379			
20.0		15060	15992	23542	24506	21575	23771	26185	28581	27948	23231	23120	27606	248631	159415	
30.0		19394	20598	30335	31601	27841	30680	33839	37151	36571	41247	30483	39841	38311	34456	35262
40.0		23746	25219	37141	38680	34070	37548	41405	45481	44741	50500	37300	49213	49507	49254	52645
50.0		28097	29838	43923	45759	40301	44416	48984	53766	52906	59721	44118	58223	58991	60688	65769
60.0		31662	33847	50720	52820	46539	51292	56563	62073	61089	68960	50945	67199	68109	70442	76624
70.0		36765	39046	57501	59881	52761	58152	64127	70400	69276	78187	57788	76201	77223	79868	86876
80.0		41099	43649	64291	66960	59042	65033	71698	78708	77460	87421	64605	85202	86336	89297	97139
90.0		45441	48261	71078	74038	65293	71902	79266	87010	85643	96649	71423	94204	95449	98731	107407
100.0		49800	52887	77866	81099	71448	78745	86841	95313	93827	105877	78240	103205	104563	108157	117657
110		54137	57496	84670	88181	77680	85609	94408	103636	101995	115126	85058	112192	113680	117592	127908
120		58472	62101	91466	95257	83918	92474	101977	111953	110166	124369	91876	121185	122796	125938	136052
130		62806	66701	98248	102318	90142	99335	109552	120255	118350	133597	98694	130193	131909	132626	140995
145		69358	73655	108456	112972	99501	109654	120929	132757	130657	144790	108981	142713	143664	140806	144790

FRM 250025 UHD… DN 25 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	331				
2	468	370			
2,5	573	523	405		
3	662	641	573		
3,5	745	740	702	467	
4	827	827	810	661	
6	1157	1157	1157	1145	1945
8	1487	1487	1487	1487	1487
10	1817	1817	1817	1817	1817
12	2147	2147	2147	2147	2147
14	2477	2477	2477	2477	2477
16	2807	2807	2807	2807	2807
18	3137	3137	3137	3137	3137
20	3467	3467	3467	3467	3467
25	4292	4292	4292	4292	4292

FRM 250025 UHD… DN 25 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	203				
2	287	340			
2,5	351	480	268		
3	405	588	378		
3,5	456	679	463	339	
4	506	760	535	480	
6	708	1063	764	831	766
8	910	1366	982	1079	1084
10	1112	1669	1200	1318	1332
12	1314	1972	1419	1558	1574
14	1517	2275	1637	1797	1816
16	1719	2578	1855	2037	2058
18	1921	2881	2073	2276	2300
20	2123	3184	2291	2515	2542
25	2628	3941	2836	3114	3147

FRM 250040 UHD… DN 40 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	583				
2	825	852			
2,5	1011	1205	770		
3	1167	1476	1089		
3,5	1312	1704	1334	976	
4	1458	1905	1541	1381	
6	2039	2665	2201	2391	2206
8	2621	3425	2828	3106	3119
10	3203	4185	3456	3795	3836
12	3784	4945	4084	4484	4532
14	4366	5705	4711	5173	5229
16	4947	6465	5339	5863	5926
18	5529	7225	5966	6552	6622
20	6110	7985	6594	7241	7319
25	7564	9885	8163	8964	9060

FRM 250040 UHD… DN 40 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	292				
2	413	489			
2,5	505	691	385		
3	583	847	545		
3,5	656	978	667	488	
4	729	1093	770	690	
6	1020	1530	1100	1196	1103
8	1310	1966	1414	1553	1560
10	1601	2402	1728	1898	1918
12	1892	2838	2042	2242	2266
14	2183	3274	2356	2587	2615
16	2474	3710	2669	2931	2963
18	2764	4147	2983	3276	3311
20	3055	4583	3297	3621	3659
25	3782	5673	4082	4482	4530

FRM 250050 UHD… DN 50 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
p_d [bar] / p_u [bar]	1	1,5	2	3	4
1,5	616				
2	871	1032			
2,5	1067	1460	813		
3	1232	1788	1150		
3,5	1385	2065	1408	1031	
4	1539	2308	1626	1457	
6	2153	3229	2323	2524	2328
8	2767	3900	2986	3279	3293
10	3381	4100	3648	4006	4049
12	3995	4300	4300	4300	4300
14	4609	4900	4900	4900	4900
16	5223	5400	5400	5400	5400
18	5500	5500	5500	5500	5500
20	5590	5590	5590	5590	5590
25	5700	5700	5700	5700	5700

FRM 250050 UHD… DN 50 - max. flow volume [Nm³/h] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
p_d [bar] / p_u [bar]	1	1,5	2	3	4
1,5	308				
2	436	516			
2,5	533	730	407		
3	616	894	575		
3,5	693	1032	704	515	
4	769	1154	813	729	
6	1076	1615	1162	1262	1164
8	1383	2075	1493	1639	1646
10	1690	2536	1824	2003	2025
12	1997	2996	2155	2367	2392
14	2304	3456	2487	2731	2760
16	2611	3917	2818	3094	3128
18	2918	4377	3149	3458	3495
20	3225	4838	3480	3822	3863
25	3993	5700	4309	4731	4782

FRM 250025 UHD… DN 25 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
Outlet pressure p_u [PSI] \ Inlet pressure p_d [PSI]	15.00	25.00	35.00	45.00	58.00
22	11071				
30	16814	8505			
40	21772	19162			
50	25984	25115	20364		
60	30002	29752	27406	22479	
80	38038	37973	37233	37915	
100	46073	46073	45976	47441	61451
120	54108	54108	54108	54108	54108
140	62143	62143	62143	62143	62143
160	70178	70178	70178	70178	70178
180	78213	78213	78213	78213	78213
200	86248	86248	86248	86248	86248
250	106335	106335	106335	106335	106335
300	126423	126423	126423	126423	126423
360	150529	150529	150529	150529	150529

FRM 250025 UHD… DN 25 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
Outlet pressure p_u [PSI] \ Inlet pressure p_d [PSI]	15.0	25.0	35.0	45.0	58.0
22	6799				
30	10598	7589			
40	13758	15585			
50	16442	20238	13836		
60	18988	23936	18766	16162	
80	24075	30508	25569	25745	
100	29161	37002	31598	33142	61451
120	34248	43454	37190	39283	54108
140	39335	49905	42709	45124	62143
160	44421	56365	48247	50971	70178
180	49514	62825	53783	56813	78213
200	54624	69276	59302	62639	86248
250	67344	85406	73115	77239	106335
300	80061	101534	86916	91812	126423
360	95320	120880	103492	109332	150529

FRM 250040 UHD… DN 40 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
Outlet pressure p_u [PSI] \ Inlet pressure p_d [PSI]	15.00	25.00	35.00	45.00	58.00
22	19517				
30	30154	19235			
40	39157	41009			
50	46720	53455	39853		
60	54003	63252	54030	46501	
80	68448	80668	73621	74082	
100	82907	97850	90980	95384	92328
120	97374	114909	107083	113078	113611
140	111842	131975	122987	129924	131070
160	126292	149042	138892	146731	148145
180	140744	166106	154792	163526	165099
200	155211	183162	170683	180322	182070
250	191347	225818	210444	222342	224476
300	227478	268478	250196	264333	266882
360	270853	319666	297899	314730	317751

FRM 250040 UHD… DN 40 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
Outlet pressure p_u [PSI] \ Inlet pressure p_d [PSI]	15.0	25.0	35.0	45.0	58.0
22	9780				
30	15250	10915			
40	19801	22442			
50	23658	29153	19928		
60	27351	34436	26998	23237	
80	34680	43911	36804	37049	
100	41993	53264	45488	47702	46172
120	49302	62551	53543	56543	56821
140	56629	71838	61500	64976	65538
160	63956	81125	69450	73373	74073
180	71283	90412	77400	81766	82553
200	78610	99699	85357	90177	91051
250	96909	122913	105215	111165	112238
300	115212	146138	125105	132178	133426
360	137180	173999	148959	157365	158875

FRM 250050 UHD… DN 50 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 10)

FRM ...	UHD				
Inlet pressure p_d [PSI] / Outlet pressure p_u [PSI]	15.00	25.00	35.00	45.00	58.00
22	20632				
30	32172	23041			
40	41839	47386			
50	49954	61547	42076		
60	57742	72715	57010	49063	
80	73203	92700	77703	78195	
100	88395	110262	96044	100693	97459
120	103284	125252	113054	119376	119945
140	117544	135155	129827	137150	138352
160	131805	144975	143234	146902	147561
180	146263	156203	156203	156203	156203
200	161190	170812	170812	170812	170812
250	190662	192883	192883	192883	192883
300	197941	197941	197941	197941	197941
360	201155	201155	201155	201155	201155

FRM 250050 UHD… DN 50 - max. flow volume [CFH] natural gas of density 0,81 kg/m³ (AC 5)

FRM ...	UHD				
Inlet pressure p_d [PSI] / Outlet pressure p_u [PSI]	15.0	25.0	35.0	45.0	58.0
22	10317				
30	16098	11521			
40	20912	23697			
50	24991	30765	21032		
60	28855	36359	28512	24546	
80	36587	46363	38861	39101	
100	44317	56232	48025	50338	48721
120	52047	66030	56521	59673	59960
140	59779	75838	64912	68573	69188
160	67509	85637	73303	77451	78197
180	75239	95435	81699	86322	87141
200	82969	105241	90105	95195	96100
250	102296	129751	111071	117343	118480
300	121530	153492	132051	139520	140862
360	144158	178247	157239	166109	167714

16.2 Air flow volume tables

FRM 100025... DN25 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	80	97	99	89	89	91											
0,5	133	167	181	178	178	171	161	150	137	120	100	100					
0,75	164	209	229	227	227	223	218	212	205	197	188	188	164				
1	191	243	268	267	267	265	263	259	255	251	246	246	232	177			
1,5	238	305	335	335	335	335	335	335	335	334	332	332	328	306	268	200	0
2	286	365	402	402	402	402	402	402	402	402	402	402	402	396	378	348	299
2,5	333	426	469	469	469	469	469	469	469	469	469	469	469	469	463	449	423
3	381	487	535	535	535	535	535	535	535	535	535	535	535	535	535	531	518
3,5	428	546	602	602	602	602	602	602	602	602	602	602	602	602	602	602	598
4	475	607	668	668	668	668	668	668	668	668	668	668	668	668	668	668	668
4,5	523	668	735	735	735	735	735	735	735	735	735	735	735	735	735	735	735
5	571	728	802	802	802	802	802	802	802	802	802	802	802	802	802	802	802
6	665	849	935	935	935	854	935	935	935	935	935	854	854	854	854	854	854
7	760	971	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068	1068
8	855	1092	1202	1202	1202	1210	1202	1202	1202	1202	1202	1210	1210	1210	1210	1210	1210
9	950	1213	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335	1335
10	1044	1334	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469	1469

FRM 100040... DN40 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	115	139	166	149	129	107											
0,5	192	241	307	297	259	284	310	266	291	230	218	162					
0,75	237	301	387	378	330	373	419	377	437	375	408	301	330				
1	275	351	453	445	388	443	506	461	545	478	534	395	466	382			
1,5	343	438	568	558	487	560	646	596	714	636	724	535	660	662	581	404	0
2	411	517	681	670	584	672	773	714	857	765	874	647	808	854	821	701	689
2,5	479	613	794	782	681	783	902	832	999	892	1020	753	942	1010	1006	904	974
3	548	700	907	892	778	895	1030	950	1140	1019	1165	861	1076	1154	1162	1070	1193
3,5	616	787	1020	1004	875	1006	1159	1069	1283	1146	1310	968	1210	1298	1307	1213	1377
4	685	874	1133	1115	972	1118	1288	1187	1425	1274	1456	1075	1344	1442	1452	1347	1540
4,5	752	961	1246	1226	1069	1229	1416	1306	1567	1401	1600	1182	1478	1586	1596	1482	1693
5	821	1048	1359	1337	1166	1340	1545	1424	1709	1528	1746	1290	1612	1730	1741	1616	1847
6	958	1223	1585	1560	1360	1563	1801	1662	1994	1781	2036	1504	1881	2017	2030	1886	2154
7	1094	1397	1811	1782	1553	1786	2058	1899	2278	2035	2326	1719	2148	2305	2320	2154	2461
8	1230	1572	2037	2004	1747	2009	2315	2135	2562	2290	2616	1933	2417	2593	2610	2423	2768
9	1367	1746	2263	2227	1941	2232	2572	2372	2847	2543	2907	2147	2685	2881	2899	2691	3075
10	1503	1920	2489	2449	2135	2455	2828	2609	3131	2797	3197	2362	2953	3168	3188	2961	3382

FRM 100050... DN50 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	ND				MD							HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,4	0,5	0,75	1	1,25	1,5
0,2	121	147	176	157	137	113											
0,5	202	255	324	314	273	301	327	281	308	242	230	171					
0,75	250	318	409	399	348	393	443	398	461	396	431	318	348				
1	290	370	478	470	410	468	534	487	575	505	564	417	492	403			
1,5	362	462	600	590	514	592	681	629	753	672	521	565	697	698	613	427	0
2	434	554	719	707	617	709	817	753	904	808	923	682	853	902	867	740	764
2,5	506	647	838	824	719	827	952	879	1056	942	1077	795	994	1067	1062	955	1080
3	579	739	958	942	821	944	1088	1004	1204	1076	1230	908	1136	1219	1227	1129	1322
3,5	651	831	1077	1060	924	1062	1224	1128	1355	1210	1383	1022	1278	1371	1380	1281	1527
4	698	923	1196	1177	1026	1180	1359	1254	1504	1344	1536	1135	1419	1522	1532	1422	1707
4,5	794	1015	1315	1294	1128	1297	1494	1379	1654	1478	1689	1249	1561	1674	1685	1565	1878
5	866	1106	1435	1411	1231	1415	1630	1504	1805	1612	1843	1362	1702	1826	1838	1706	2047
6	1010	1291	1673	1646	1438	1650	1901	1754	2105	1881	2149	1588	1985	2130	2143	1990	2388
7	1155	1475	1911	1881	1640	1886	2173	2004	2404	2149	2455	1814	2268	2434	2449	2274	2729
8	1299	1659	2151	2116	1845	2121	2443	2254	2705	2417	2763	2041	2551	2737	2754	2558	3069
9	1443	1843	2389	2350	2050	2356	2715	2504	3005	2685	3069	2267	2834	3041	3060	2842	3410
10	1587	2027	2628	2586	2254	2591	2986	2754	3305	2953	3375	2494	3117	3344	3366	3125	3750

FRM 250025 UHD... DN25 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	UHD				
p_d [bar] / p_u [bar]	1	1,5	2	3	4
1,5	268				
2	378	299			
2,5	463	423	327		
3	535	518	463		
3,5	602	598	567	377	
4	668	668	655	534	
6	935	935	935	925	1572
8	1202	1202	1202	1202	1202
10	1469	1469	1469	1469	1469
12	1735	1735	1735	1735	1735
14	2002	2002	2002	2002	2002
16	2269	2269	2269	2269	2269
18	2535	2535	2535	2535	2535
20	2802	2802	2802	2802	2802
25	3469	3469	3469	3469	3469

FRM 250025 UHD... DN25 - max. air flow volume [Nm³/h] (AC 5)

FRM ...	UHD				
p_d [bar] / p_u [bar]	1	1,5	2	3	4
1,5	164				
2	232	275			
2,5	284	388	217		
3	327	475	306		
3,5	369	549	374	274	
4	409	614	432	388	
6	572	859	617	672	619
8	735	1104	794	872	876
10	899	1349	970	1065	1077
12	1062	1594	1147	1259	1272
14	1226	1839	1323	1452	1468
16	1389	2084	1499	1646	1663
18	1553	2328	1675	1840	1859
20	1716	2573	1852	2033	2055
25	2124	3185	2292	2517	2543

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FRM 250040 UHD... DN40 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	471				
2	667	689			
2,5	817	974	622		
3	943	1193	880		
3,5	1060	1377	1078	789	
4	1178	1540	1245	1116	
6	1648	2154	1779	1932	1783
8	2118	2768	2286	2510	2521
10	2589	3382	2793	3067	3100
12	3058	3997	3301	3624	3663
14	3529	4611	3808	4181	4226
16	3998	5225	4315	4739	4790
18	4469	5839	4822	5295	5352
20	4938	6454	5329	5852	5915
25	6113	7989	6598	7245	7323

FRM 250040 UHD... DN40 - max. air flow volume [Nm³/h] (AC 5)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	236				
2	334	395			
2,5	408	558	311		
3	471	685	440		
3,5	530	790	539	394	
4	589	883	622	558	
6	824	1237	889	967	891
8	1059	1589	1143	1255	1261
10	1294	1941	1397	1534	1550
12	1529	2294	1650	1812	1831
14	1764	2646	1904	2091	2114
16	2000	2999	2157	2369	2395
18	2234	3352	2411	2648	2676
20	2469	3704	2665	2927	2957
25	3057	4585	3299	3622	3661

FRM 250050 UHD... DN50 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	498				
2	704	834			
2,5	862	1180	657		
3	996	1445	929		
3,5	1119	1669	1138	833	
4	1244	1865	1314	1178	
6	1740	2610	1878	2040	1882
8	2236	3354	2413	2650	2661
10	2733	4099	2948	3238	3272
12	3229	4843	3484	3826	3867
14	3725	5587	4019	4414	4461
16	4221	6332	4555	5002	5055
18	4718	7076	5090	5590	5650
20	5213	7820	5626	6178	6244
25	6454	9681	6964	5224	7731

FRM 250050 UHD... DN50 - max. air flow volume [Nm³/h] (AC 5)

FRM ...	UHD				
p_u [bar] \ p_d [bar]	1	1,5	2	3	4
1,5	249				
2	352	417			
2,5	431	590	329		
3	498	723	465		
3,5	560	834	569	416	
4	622	933	657	589	
6	870	1305	939	1020	941
8	1118	1677	1207	1325	1330
10	1366	2050	1474	1619	1637
12	1614	2421	1742	1913	1933
14	1862	2793	2010	2207	2231
16	2110	3166	2278	2501	2528
18	2358	3538	2545	2795	2825
20	2607	3910	2813	3089	3122
25	3227	4840	3483	3824	3865

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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	1 150

*When p_u > 4 bar, do not apply formulars above and consider max. flows defined in tables 16.1 or 16.2.

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 $p_{u, abs.}$ = 2.01325 bar and absolute outlet pressure of $p_{d, abs.}$ = 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

$$\frac{p_{d, abs.}}{p_{u, abs.}} \geq 0{,}53$$

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

Abbreviation	Description
p_d [bar]	Outlet pressure
$p_{d, abs.}$ [bar]	Outlet pressure as absolute pressure (p_d+1,013)
p_u [bar]	Inlet pressure
$p_{u, abs.}$ [bar]	Inlet pressure as absolute pressure (p_u+1,013)

b) supercritical pressure ratio

$$\frac{p_{d, abs.}}{p_{u, abs.}} < 0{,}53$$

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

with
Q_N= power of the regulator under standard conditions

The Pressure Equipment Directive (PED) and the Energy Performance of Buildings Directive (EPBD) require a periodic inspection of heat generators in order to ensure a high degree of efficiency over a long term and, consequently, the least environmental pollution.

It is necessary to replace safety-relevant components after they have reached the end of their useful life:

Sicherheitsrelevante Komponente **Safety relevant component** **Composant relatif à la sécurité** **Componenti rilevanti dal punto di vista della sicurezza**	**Konstruktionsbedingte Lebensdauer** **Designed Lifetime** **Durée de vie prévue** **Durata di vita di progetto**		**Norm** **Standard** **Norme** **Norma**	**Dauerhafte Lagertemperatur** **Durable storage temperature** **Température de stockage permanente** **Temperatura di stoccaggio permanente**
	Zyklenzahl **Operating cycles** **Cycle d'opération** **Numero di cicli di funzionamento di progetto**	**Jahre** **Years** **Année** **Anni**		
Ventilprüfsysteme / Valve proving systems / Systèmes de contrôle de vannes / Sistemi di controllo valvole	250 000	10	EN 1643	0…45 °C 32…113 °F
Gas / Gas / Gaz / Gas Druckwächter / Pressure switch / Manostat / Pressostati	50 000	10	EN 1854	
Luft / Air / Air / Aria Druckwächter / Pressure switch / Manostat / Pressostati	250 000	10	EN 1854	
Gasmangelschalter / Low gas pressure switch / Pressostat gaz basse pression / Pressostati gas di minima pressione	N/A	10	EN 1854	
Feuerungsmanager / Automatic burner control / Dispositif de gestion de chauffage / Gestione bruciatore	250 000	10	EN 298 EN 230	
UV-Flammenfühler[1] Flame detector (UV probes)[1] Capteur de flammes UV[1] Sensore fiamma UV[1]	N/A	10 000 h[3]	---	
Gasdruckregelgeräte[1] Gas pressure regulators[1] Dispositifs de réglage de pression du gaz[1] Regolatori della pressione del gas[1]	N/A	15	EN 88-1 EN 88-2	
Gasventil mit Ventilprüfsystem[2] Gas valve with valve testing system[2] Vanne de gaz avec système de contrôle de vanne[2] Valvola del gas con sistema di controllo valvola[2]	nach erkanntem Fehler after error detection après détection d'erreur dopo segnalazione di errore		EN 1643	
Gasventil ohne Ventilprüfsystem[2] Gas valve without valve testing system[2] Vanne de gaz sans système de contrôle de vanne[2] Valvola del gas senza sistema di controllo valvola[2]	DN ≤ 25 200 000 25 < DN ≤ 80 100 000 80 < DN ≤ 150 50 000	10	EN 161	
Gas-Luft-Verbundsysteme / Gas-air ratio control system / Systèmes combinés gaz/air / Sistemi di miscelazione gas-aria	N/A	10	EN 88-1 EN 12067-2	

[1] Nachlassende Betriebseigenschaften wegen Alterung / Performance decrease due to ageing /
Réduction de performance due au viellissement / Riduzione delle prestazioni dovuta all'invecchiamento
[2] Gasfamilien II, III / Gas families II, III / Familles de gaz II, III / per i gas delle famiglie II, III
[3] Betriebsstunden / Operating hours / Heures de service / Ore di esercizio
N/A nicht anwendbar / not applicable / ne peut pas être utilisé / non può essere usato

Lagerzeiten / Storage times / Périodes de stockage / Tempi di stoccaggio

Lagerzeiten ≤ 1 Jahr verkürzen nicht die konstruktionsbedingte Lebensdauer.
Storage time ≤ 1 year does not reduce the designes lifetime.
Les périodes de stockage ≤ 1 an ne réduisent pas la durée de vie liée à la conception.
I tempi di stoccaggio ≤ 1 anno non riducono la durata di vita legata al design.

DUNGS empfiehlt eine **maximale Lagerzeit von 3 Jahren**.
DUNGS recommends a **maximum storage time of 3 years.**
DUNGS recommande une **durée de stockage maximale de 3 ans**.
DUNGS raccomanda un **tempo massimo di stoccaggio di 3 anni**.

We reserve the right to make modifications in the course of technical development.

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DUNGS®
Combustion Controls

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