GB

DUNGS®
Combustion Controls

Instruction Manual

FRM 100065 - 100080 - 250065 - 250080

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.

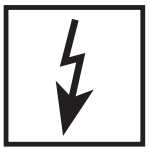
Hang this instruction manual in a readily visible place inside the installation room! Do not carry out any work until you have read the safety instructions of this instruction manual and are qualified to do so.

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.
- 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 100065 - 100080 FRM 250065 - 250080 (SAV 100065 - 100080/ SAV 250065 - 250080*)**	**Medium Pressure Regulator 10 bar / 25 bar (Safety Shut-off Valve 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*)**	
Bescheinigung Attestation Certificat Certificado		**CE-0085DP0301 (CE-0085DP0292*)**	
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, 2024-08-20			

* Gültig für angebautes SAV
Valid for attached SAV
Entre parenthèses valavble pour SAV montré
Tra parentesi valido per SAV mantato

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Combustion Controls

3. Declaration of conformity

Product	**FRM 100065 - 100080** **FRM 250065 - 250080**	**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, 2024-08-20	

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)

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 65 80 NPS 2.5" 3"
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	90-4 000 mbar (9 - 400 kPa) / 12 to 1 600 "W.C. (0.4 - 58 PSI)
Minimum inlet pressure for MD version	440 mbar (44 kPa) / 170 "W.C. (6.4 PSI)
Minimum inlet pressure for HD version	900 mbar (90 kPa) / 360 "W.C. (13 PSI)
Minimum inlet pressure for UHD version	1 500 mbar (150 kPa) / 602 "W.C. (22 PSI)
Materials	Main body housing: cast iron GJS 400-15 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
Type	IS (FRM 100...) / DS (FRM 250...)
Response time	≤ 2s
Adjustment range below W_{du}	35 - 3 000 mbar (3,5 - 3 00 kPa) / 14 - 1 205 "W.C. (0.5 - 43.5 PSI)
Adjustment range above W_{do}	180 - 5 000 mbar (18 - 500 kPa) / 72 - 2 007 "W.C. (2.6 - 72.5 PSI)
Materials	Main body housing: cast iron GJS 400-15 Diaphragm housing: Aluminium Diaphragms: NBR

6.2 Nomenclature

Example **FRM 100080 MD/ SAV MD**	**FRM**	**100**	**080**	**MD**	**SAV**	**MD**
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	065 DN 65 (2½")					
	080 DN 80 (3")					
Pressure range, outlet pressure	MD Medium pressure					
	HD High pressure					
	UHD Ultra high pressure					
Safety device	SAV Integrated shut-off valve					
Pressure range, trip 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	Under pressure monitoring SAV		Over pressure monitoring SAV	
						W_{du}	AG	W_{do}	AG
FRM 100065 MD	DN 65	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.				
FRM 100065 HD	DN 65	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.				
FRM 250065 UHD	DN 65	UHD	AC 5	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.				
FRM 100065 MD / SAV MD	DN 65	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 100065 HD / SAV HD	DN 65	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 250065 UHD / SAV UHD	DN 65	UHD	AC 5	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 100080 MD	DN 80	MD	AC 5/10**	SG 10/20**	90 - 420 mbar 36 - 168 "W.C.				
FRM 100080 HD	DN 80	HD	AC 5	SG 10	400 - 1 500 mbar 160 - 602 "W.C.				
FRM 250080 UHD	DN 80	UHD	AC 5	SG 10	1 000 - 4000 mbar 400 - 1 600 "W.C.				
FRM 100080 MD / SAV MD	DN 80	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 100080 HD / SAV HD	DN 80	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 250080 UHD / SAV UHD	DN 80	UHD	AC 5	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 to EN 334 **p_d = 90-180 mbar: AC 10, SG 20; p_d= 180-420 mbar: AC 5, SG 10

*** AG 30 for Wdu settings 10..39 mbar // AG 20 for Wdu settings 40..59 mbar

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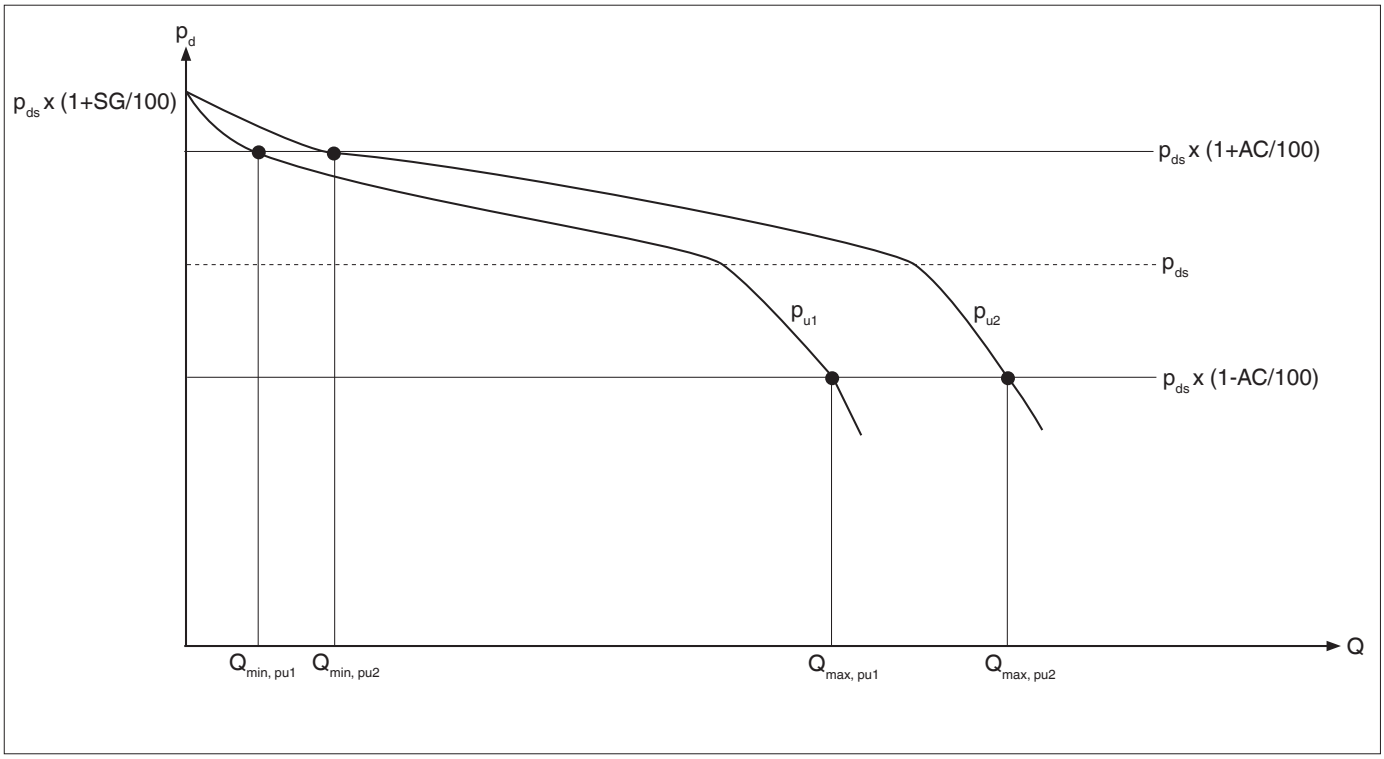
6.4 Accuracy class / lock-up pressure class

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 $Q_{max} \leq 10$ is observed.



Abbreviation	Description
AC	Accuracy class
p_d	Outlet pressure
$p_{u1/2}$	Inlet pressure
p_{ds}	Set nominal value of the outlet pressure
SG	Lock-up pressure class
$Q_{min\ /\ pu½}$	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

Specific set range, outlet pressure W_{ds}							
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range		
					MD	HD	UHD
Blue	270347	8.0	300	65.0	90 - 140 mbar 36 - 56 "W.C		
Black	270348	9.0	300	68.0	120 - 185 mbar 48 - 74 "W.C	400-550 mbar 161 - 221 "W.C	
Purple	270349	10.0	300	69.0	180-280 mbar 72 - 112 "W.C	540-850 mbar 217 - 341"W.C	1 000 - 1 300 mbar 401 - 522 "W.C
Orange	270350	11.0	300	71.0	250-420 mbar 100 - 169 "W.C	800 - 1 150 mbar 321 - 462 "W.C	1 100 - 1 800 mbar 442 - 723 "W.C
Pink	270352	12.0	300	73.0		1 100 - 1 500 mbar 442 - 602 "W.C	1 600 - 2 500 mbar 642 "W.C. - 1 004 "W.C
Red	271132	14.0	300	77.0			2 900 - 4 000 mbar 964 - 1 606 "W.C.

6.6 Selection of SAV springs

Specific set range, underpressure W_{dsu}							
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range		
					MD	HD	UHD
Blue	270356	2.0	55	12.3	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	2.8	55	12.3		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 set range, overpressure W_{dso}							
Spring colour	Order number	Wire Ø [mm]	Length [mm]	Ø [mm]	Setpoint range		
					MD	HD	UHD
Green	270366	2.5	60	30.0	180 - 270 mbar 72 - 117 "W.C.		
Red	270367	2.7	60	30.0	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

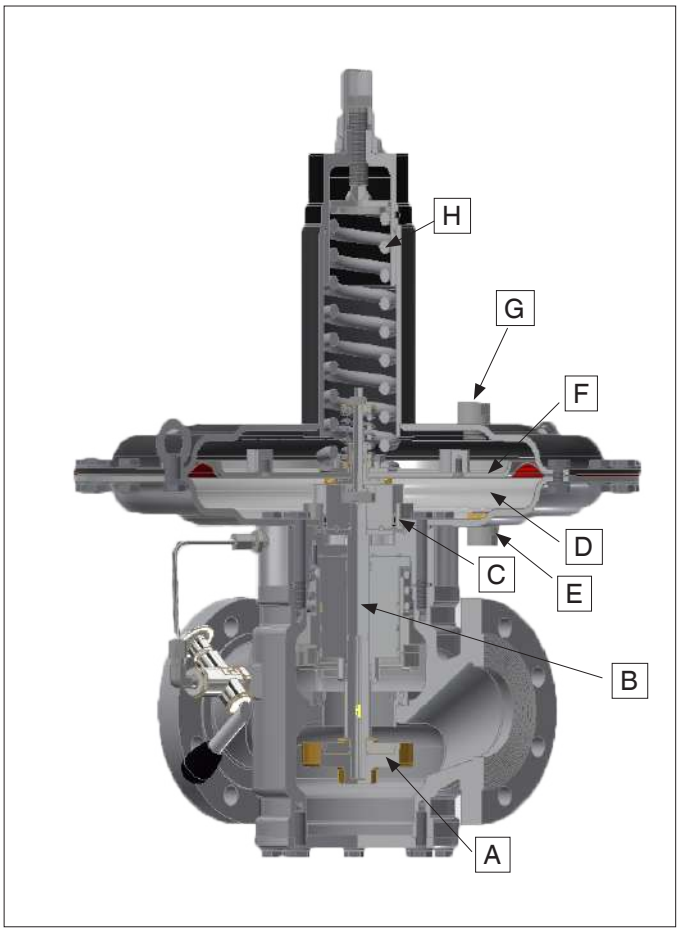
The pressure regulator's function is to keep the outlet pressure largely constant, independent of changes in the inlet pressure and/or in the flow volume. In the depressurised state the regulator is open. The pressure regulator complies with the requirements of EN 334 as direct acting gas pressure regulator.

Main components
A Control plate
B Control plate shaft
C Inlet pressure compensation diaphragm
D Lower diaphragm shell
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 **D**, since no overpressure is applied in the outlet range. The resulting downward movement of the working diaphragm causes the control plate shaft **B** to be pushed downwards. In this way, the control plate **A** is also moved downwards and separated 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 **D** 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 control plate shaft **B** to be pulled upwards. In this way, the control plate **A** is also pushed upwards 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.

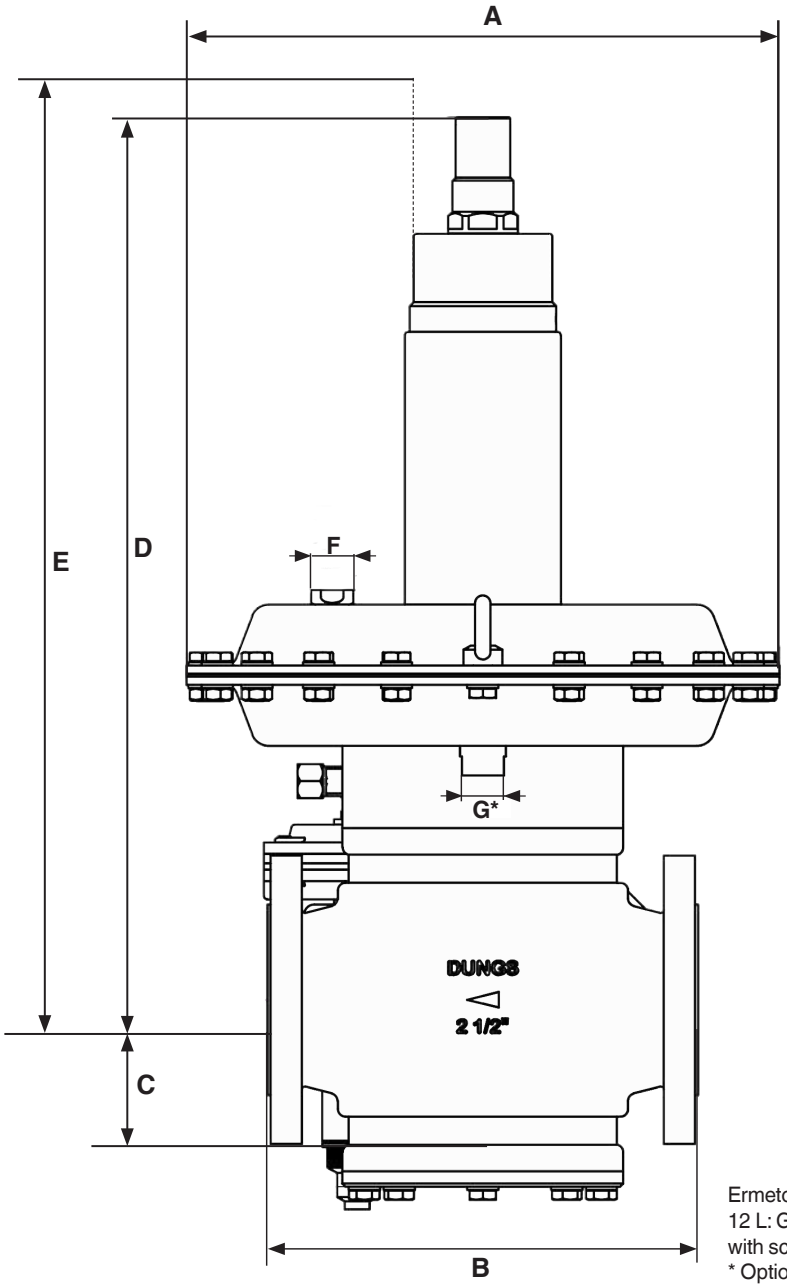
If the outlet pressure drops, the force on the working diaphragm **F** in the lower diaphragm shell **D** decreases also. The working diaphragm **F** is, thus, pushed downwards until the force of the setpoint spring **H** is equal to that of the outlet pressure. The upward movement of the working diaphragm **F** causes the control plate shaft **B** to be pushed downwards. In this way, the control plate **A** is also moved downwards 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 **C**. The inlet pressure is then transferred in the chamber below the inlet pressure compensation diaphragm **C** 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 **C**, 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 top, has the same size as the admission pressure compensation diaphragm **C**, on which the inlet pressure acts from below. Therefore, both forces cancel each other. The inlet pressure balance at the regulator is ensured.

8. Dimensions

FRM...

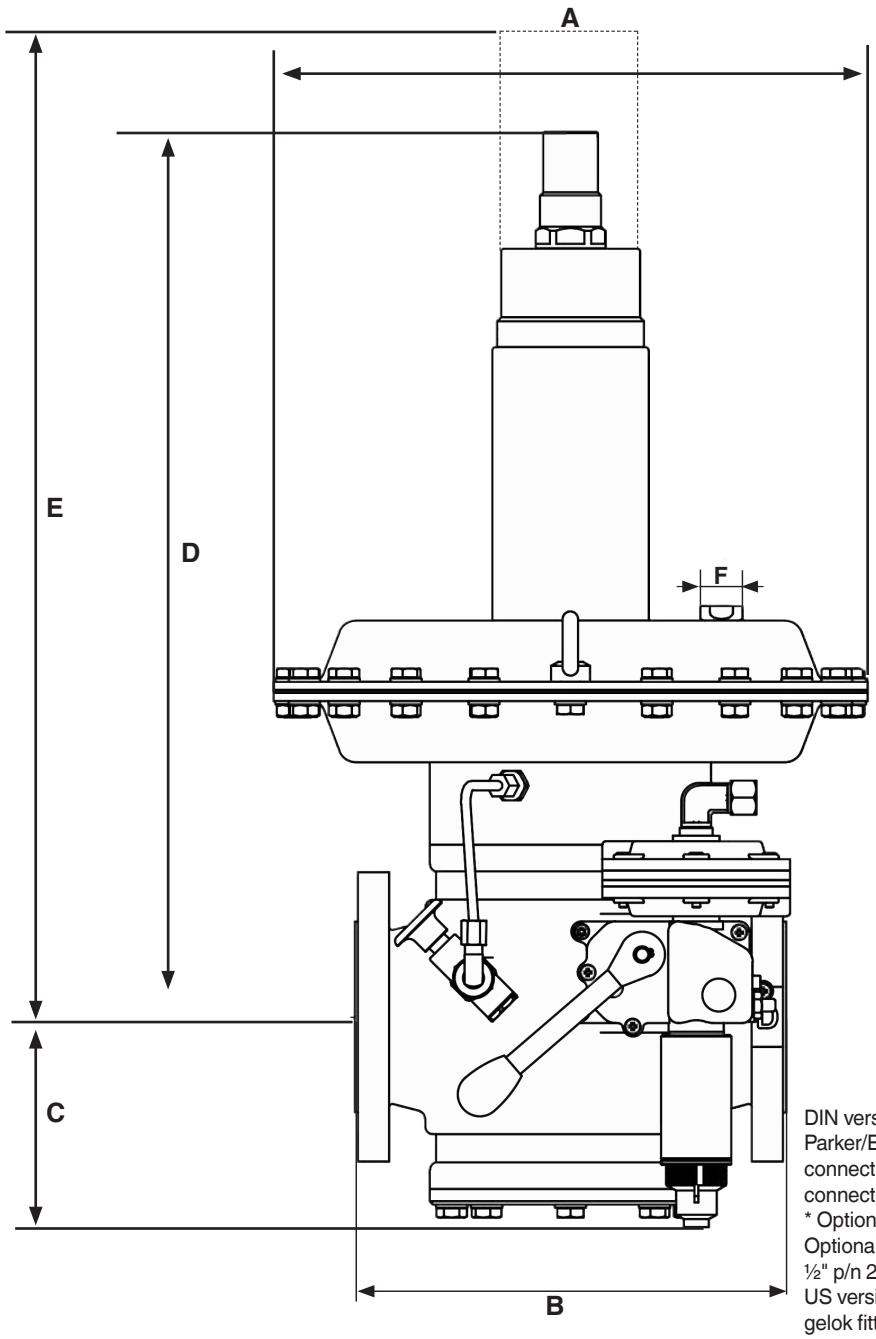


Ermeto screw (commpression) connection
12 L: GE 12 - ¼
with screw connection M 16 for pipes 12 x 1.5.
* Option only US/CDN
Optional with swagelok fitting for ½" tubing.

Type	Order number	$p_{max.}$ [bar / kPa/PSI]	DN	Dimensions [mm]							Weight [kg]
				A	B	C	D	E	F**	G	
FRM 100065 MD	277241	10 / 1 000 / 145	65	500	276	120	567	892	½ "G	⌀ 12	56 (123 lbs)
FRM 100065 HD	277242	10 / 1 000 / 145	65	380	276	120	567	892	½ "G	⌀ 12	50 (110 lbs)
FRM 250065 UHD	277243	25 / 2 500 / 360	65	380	276	120	567	892	½ "G	⌀ 12	52 (114 lbs)
FRM 100080 MD	277244	10 / 1 000 / 145	80	500	298	120	567	892	½ "G	⌀ 12	58 (128 lbs)
FRM 100080 HD	277245	10 / 1 000 / 145	80	380	298	120	567	892	½ "G	⌀ 12	53 (115 lbs)
FRM 250080 UHD	277246	25 / 2 500 / 360	80	380	298	120	567	892	½ "G	⌀ 12	55 (121 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 [mm]							Weight [kg]
				A	B	C	D	E	F**	G	
FRM 100065 MD/SAV MD	273061	10 / 1 000 / 145	65	500	276	135	567	892	½ "G	⌀ 12	71 (156 lbs)
FRM 100065 HD/SAV HD	276113	10 / 1 000 / 145	65	380	276	135	567	892	½ "G	⌀ 12	65 (143 lbs)
FRM 250065 UHD/SAV UHD	276114	25 / 2 500 / 360	65	380	276	135	567	892	½ "G	⌀ 12	67 (148 lbs)
FRM 100080 MD/SAV MD	276115	10 / 1 000 / 145	80	500	298	135	567	892	½ "G	⌀ 12	73 (161 lbs)
FRM 100080 HD/SAV HD	276116	10 / 1 000 / 145	80	380	298	135	567	892	½ "G	⌀ 12	68 (150 lbs)
FRM 250080 UHD/SAV UHD	276117	25 / 2 500 / 360	80	380	298	135	567	892	½ "G	⌀ 12	70 (154 lbs)

**½ "G to ½ "NPT adapter p/n 231945

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.

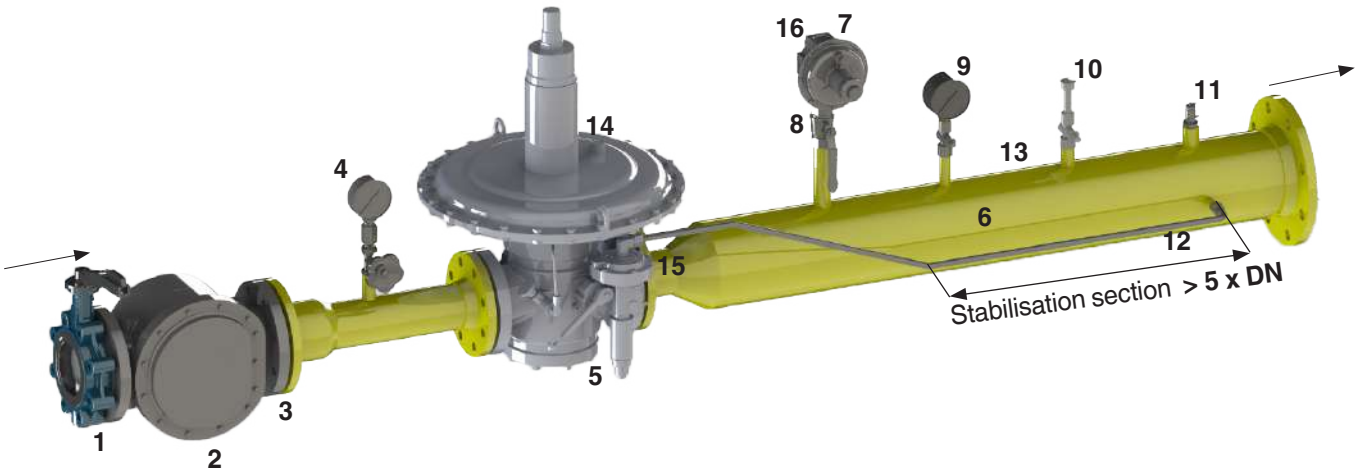
Note during installation!

- 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

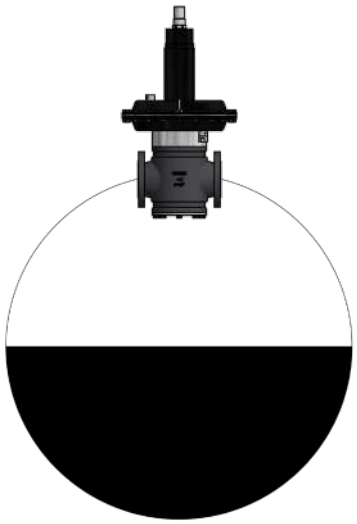
- The installation must be carried according to the installation scheme specified below, unless deviations required by regulations.
- Install the safety shutoff valve in the flow direction (arrow/housing).
- Design a straight stablisation section with the equal diameter.
- Make sure that the impulse 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	Calming 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	Vent line connection regulator
15	Vent line connection SAV
16	Relief line connection 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

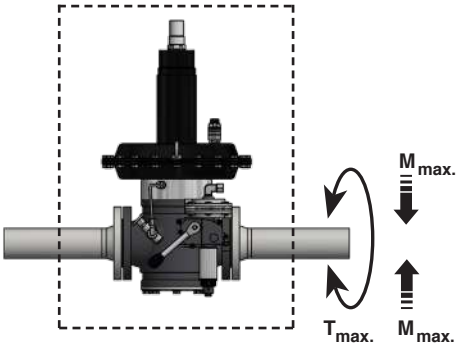
- Considerations depending on the gas type:
  - For Natural Gas and lighter than air combustible gases, the gas will eventually leave the area of discharge.
  - However, for heavier than air combustible or even non-combustible gases, they could accumulate at the point of discharge or even accumulate 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.

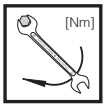
9.4 Torque

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	--	--	--

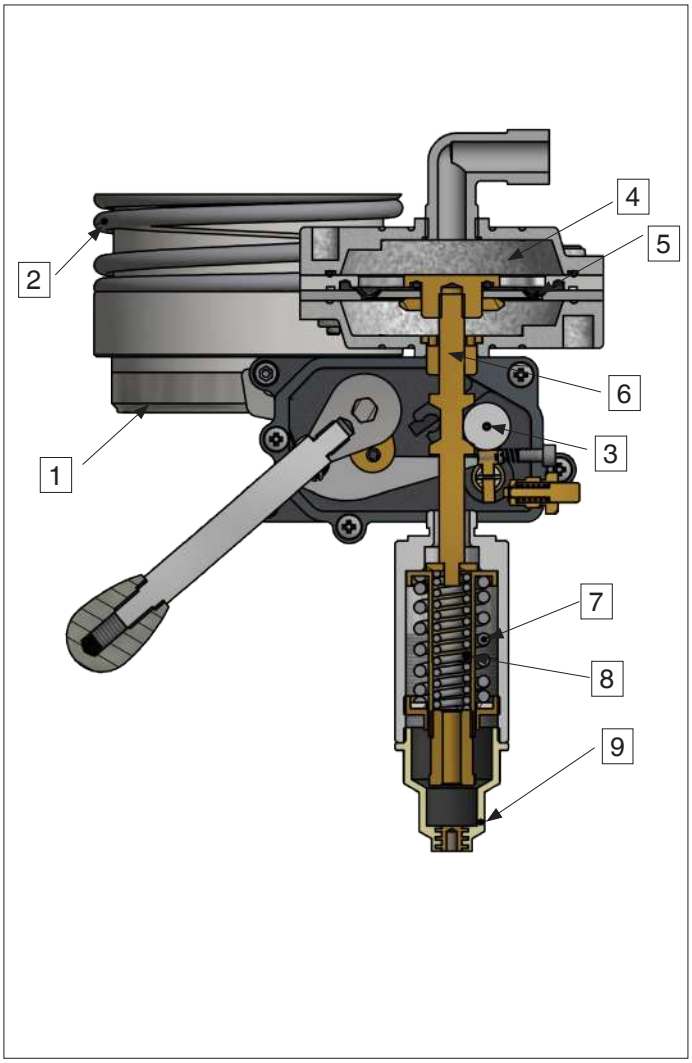


Max. torque system accessories									
M … / G …	M 4	M 5	M 6	M 8	M 10	G ⅛	G ¼	G ½	G ¾
$M_{max.}$ [Nm] t 10 s	2.5 Nm	5 Nm	7 Nm	15 Nm	40 Nm	5 Nm	7 Nm	10 Nm	15 Nm

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. Function integrated SAV

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.
It is classified as a Class A device when both protections for over-pressure and under-pressure monitoring are installed. In case of not having the Under-pressure protection, it is functionally a Class B device. In this conditions SAV stays open even when there is no pressure detected.
Note: When using a SAV functional Class B, it implies the hazard of no detecting a rupture on the diaphragm. With a combination of a failure in the regulator (fail to open), inlet pressure will be on the downstream side too with the corresponding risk to the components downstream.



Main components
1 Shutter case
2 Closing spring
3 Trigger mechanism
4 Chamber with the pressure to be monitored
5 Working diaphragm
6 Push rod
7 Setpoint spring for p_{do}
8 Setpoint spring for p_{du}
9 Protective cap

Function
Chamber **4** is connected to the outlet pressure via a pulse line.
The pressure to be checked acts on the working diaphragm **5**. The force of the setpoint springs **7** and **8** acts as counterforce.
In case of an unbalance of forces (overpressure or underpressure), the SAV is actuated and the gas supply is blocked.

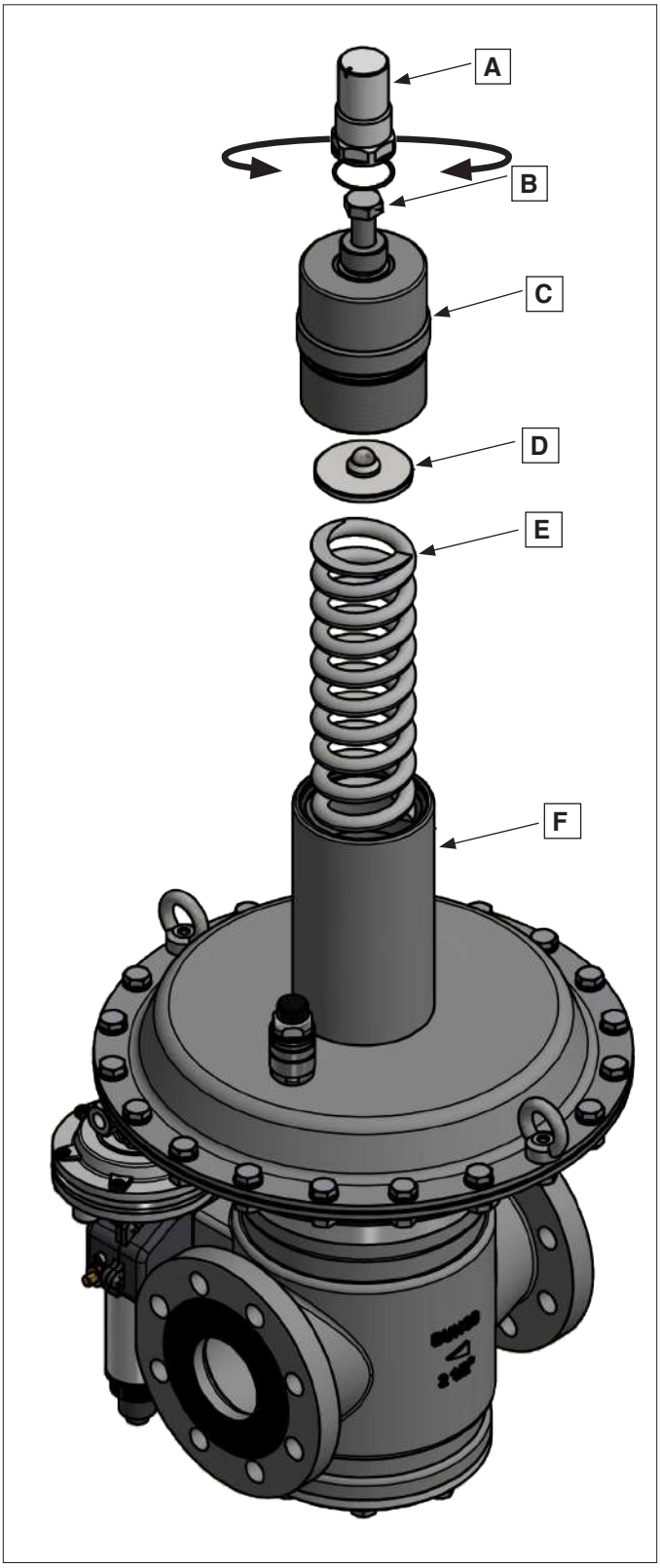
11. Setting

11.1 Regulator setting

Setting of the outlet pressure

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

1. Remove the protective cap **A**.
2. Turn the adjusting screw **B** using an open-ended wrench **SW 24 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

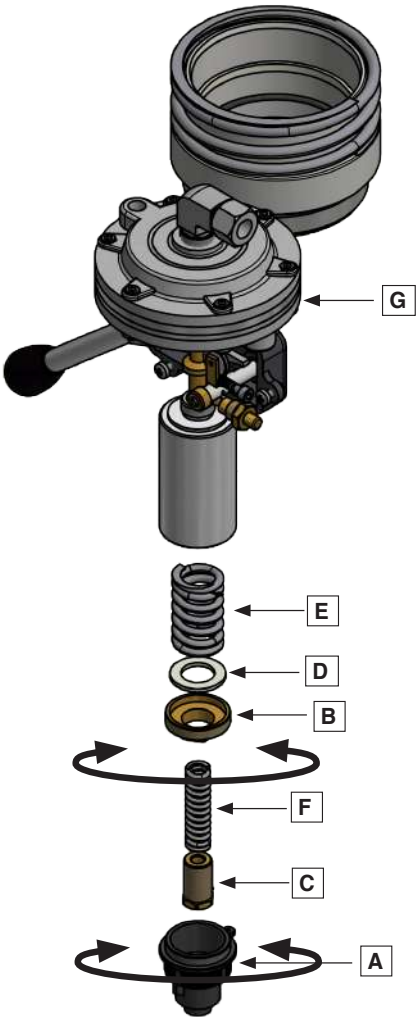
Switch-off setting in case of overpressure p_{do}

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

Triggering setting in case of underpressure p_{du}

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

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



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

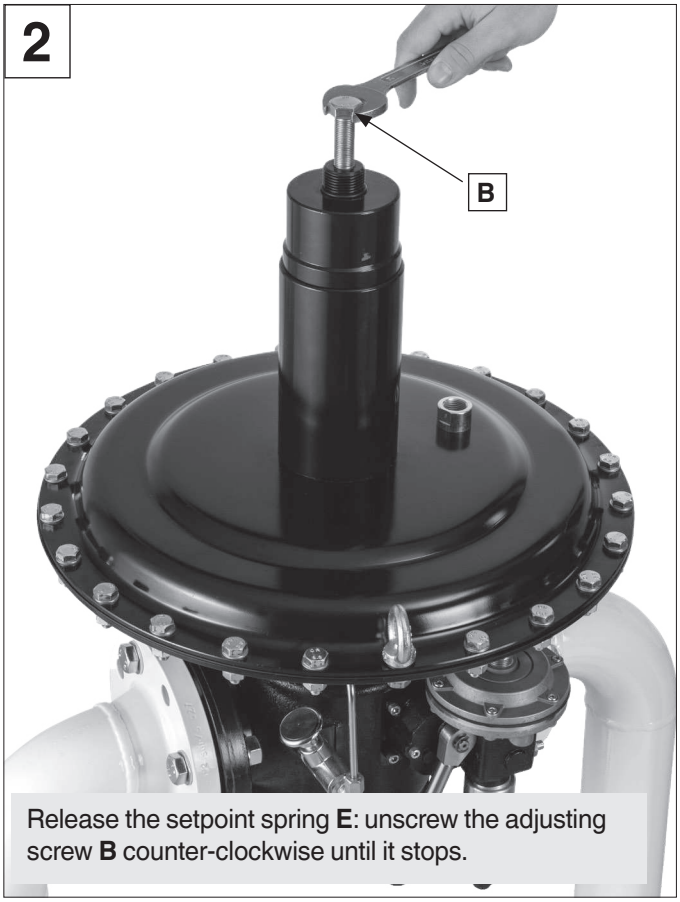
11.3 Calculation example of set values

Determination of the set values by means of a pressure graduation chart	
Selected regulator	**FRM 100065 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 shut down pressure SAV	**AG_o 10**
Response pressure group of the lower shut down pressure SAV	**AG_u 10**
Response group of the SBV	**AG 5**

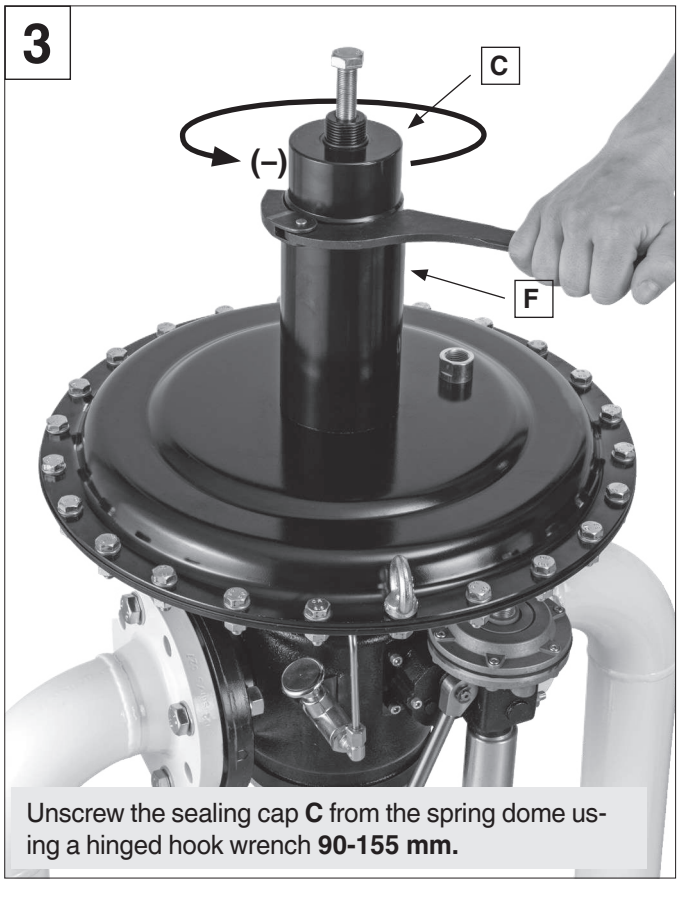
Result			
Device group	**Device data**	**Pressure graduation**	
Safety devices against excessive pressure	Limiting pressure in case of fault: 1.1 * $p_{perm.}$		550 mbar (200 "W.C.)
	AG_o 10		440 mbar (176 "W.C.)
	SAV	p_{do} =	400 mbar (160 "W.C.)
	AG_o 10		360 mbar (144 "W.C.)
	AG 5		315 mbar (126 "W.C.)
	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

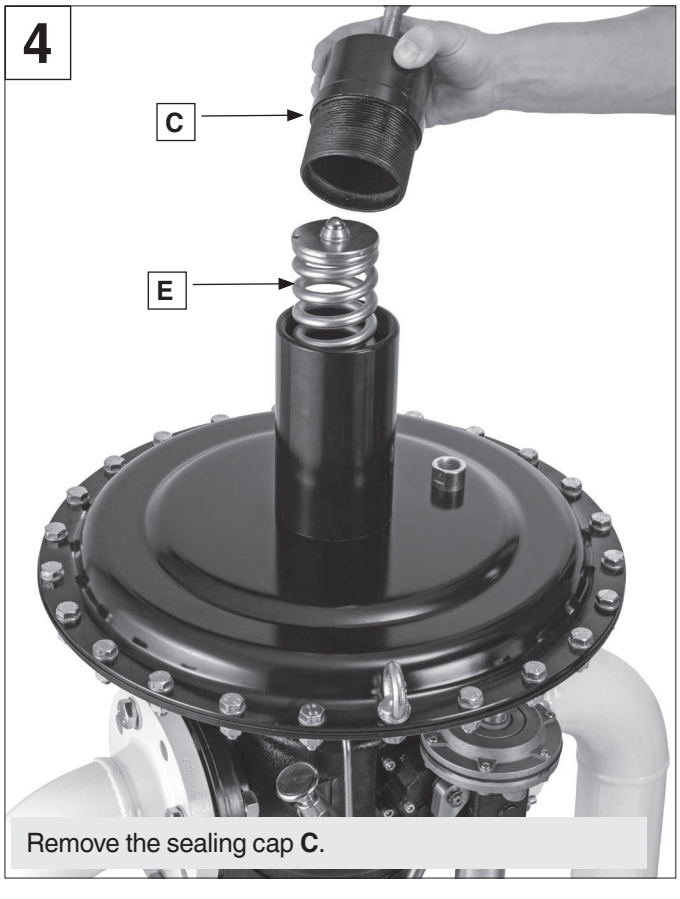
Remove the protective cap **A.**



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



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



Remove the sealing cap **C**.

5

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

6

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

11.5 Replacement of SAV springs

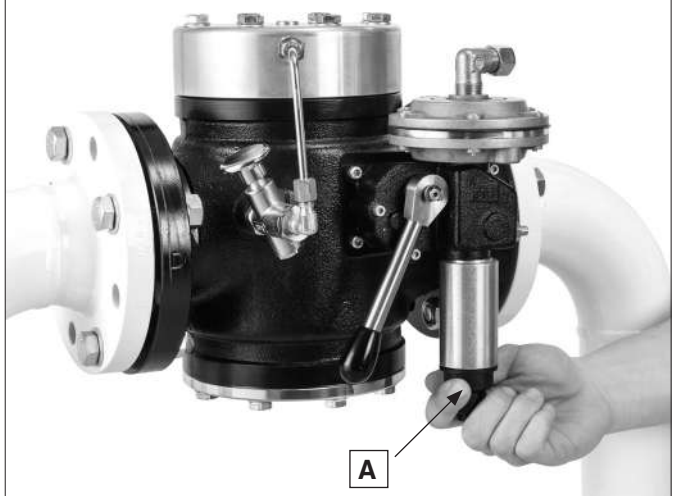
7. Insert a new spring with a suitable adjustment range
8. Reattach the spring washer **D** incl. ball on the spring.
9. Reinsert the sealing cap **C** in the spring dome **F**. Tighten the adjusting screw **B** until the required spring preload is reached. Reinsert the protective cap **A**.
10. Stick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

1

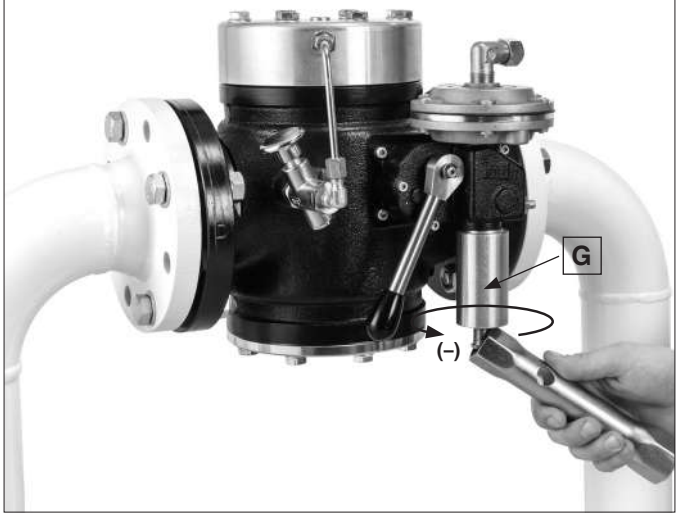


Remove the protective cap **A**.

11.5.1 Spring replacement W_{dso}

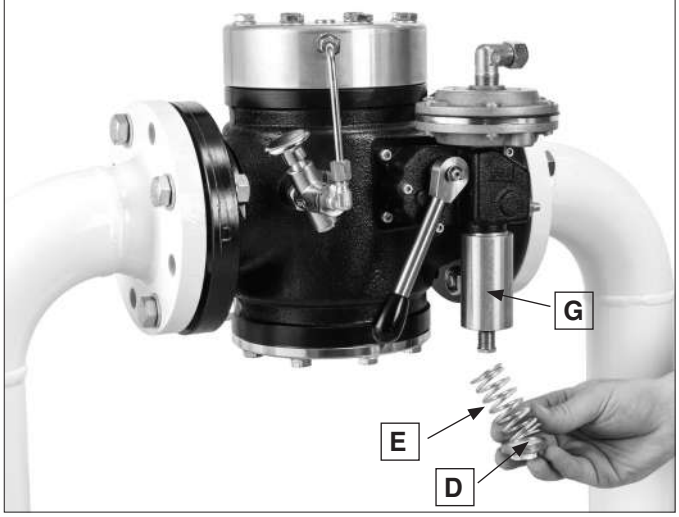
1

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



2

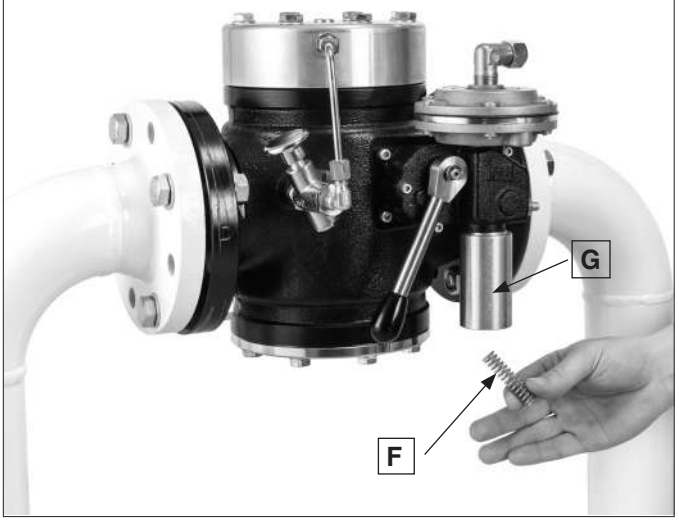
1. Remove the spring **E** from the spring dome **G**.
2. Install the new spring.
3. Tighten the adjusting screw **B** and plastic washer **D** in the spring dome **G** using a tube/socket wrench **SW 22 mm** until the desired spring preload is reached.
4. Reinsert the protective cap **A.**



11.5.2 Spring replacement W_{dsu}

1

1. Remove the spring **F** from the spring dome **G**.
2. Install the new spring.
3. Tighten the adjusting screw **C** in the spring dome **G** using a tube/socket wrench **SW 17 mm** until the desired spring preload is reached.
4. Reinsert the protective cap **A.**



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 (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.**

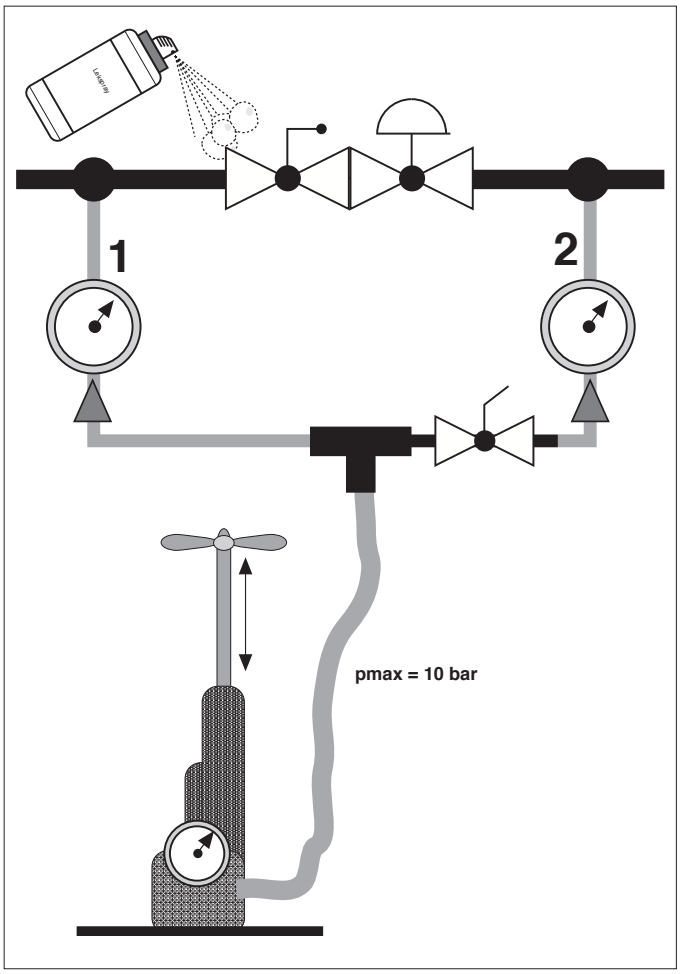
12.2 Initial Pressurization of FRM

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 Commissioning / unlocking/ control of the set values

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 resettimg:

3.1

Press the bypass button valve. Check increase in downstream pressure until setpoint pressure is achieved. Then stop pressing bypass buton valve.

3.2

Operate hand lever to open the valve.

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.

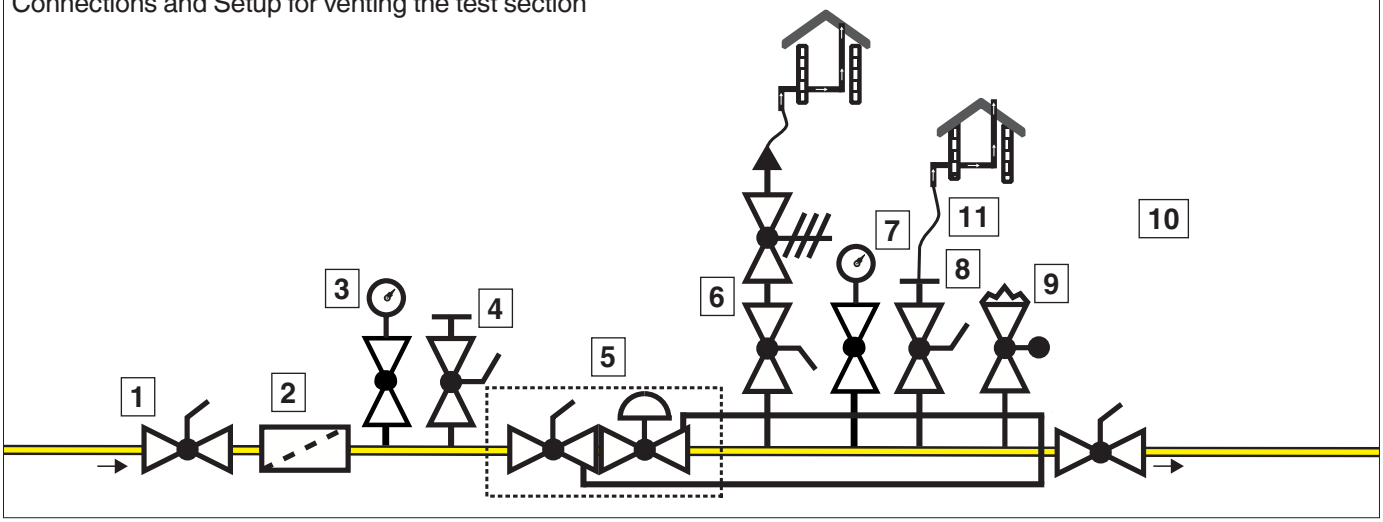
7.7 Slowly vent the fuel gas per “4.0 Venting the test section to atmosphere”. After the SAV trips, read the lower (under) response pressure on the pressure gauge.

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

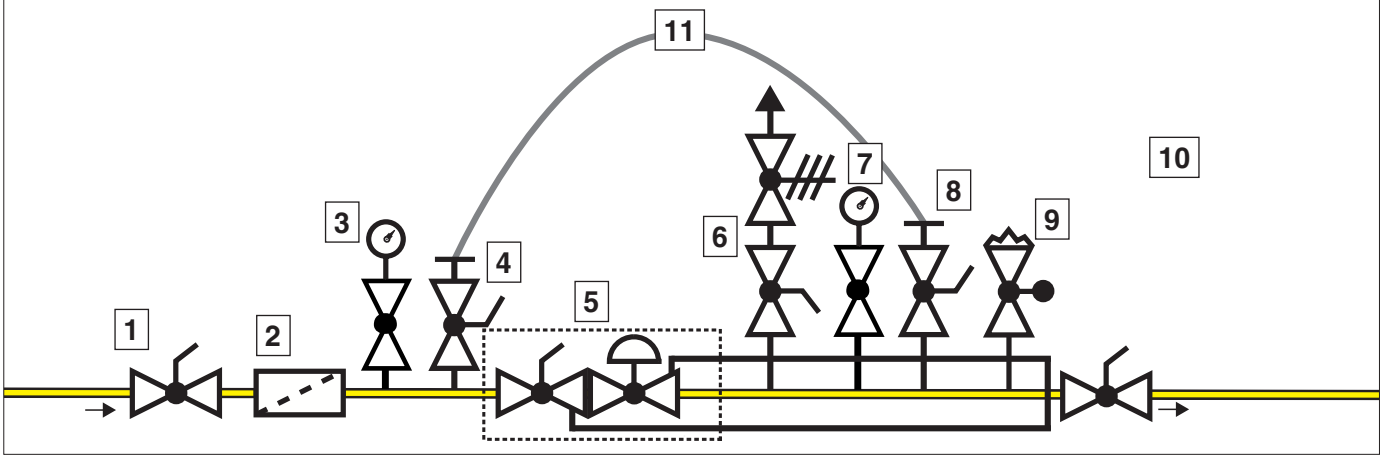
7.9 Slowly open the shut-off valve on the inlet side.

Never fix or tighten the resetting lever. The resetting lever must be able to swing down freely at all times. Obstruction can lead to malfunction or critical conditions. The resetting lever can be removed if it cannot be ensured that it is not hindered in its movement.

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	Venting ball valve
5	Regulator with integrated SAV
6	SBV with shutoff valve

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

12.5 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

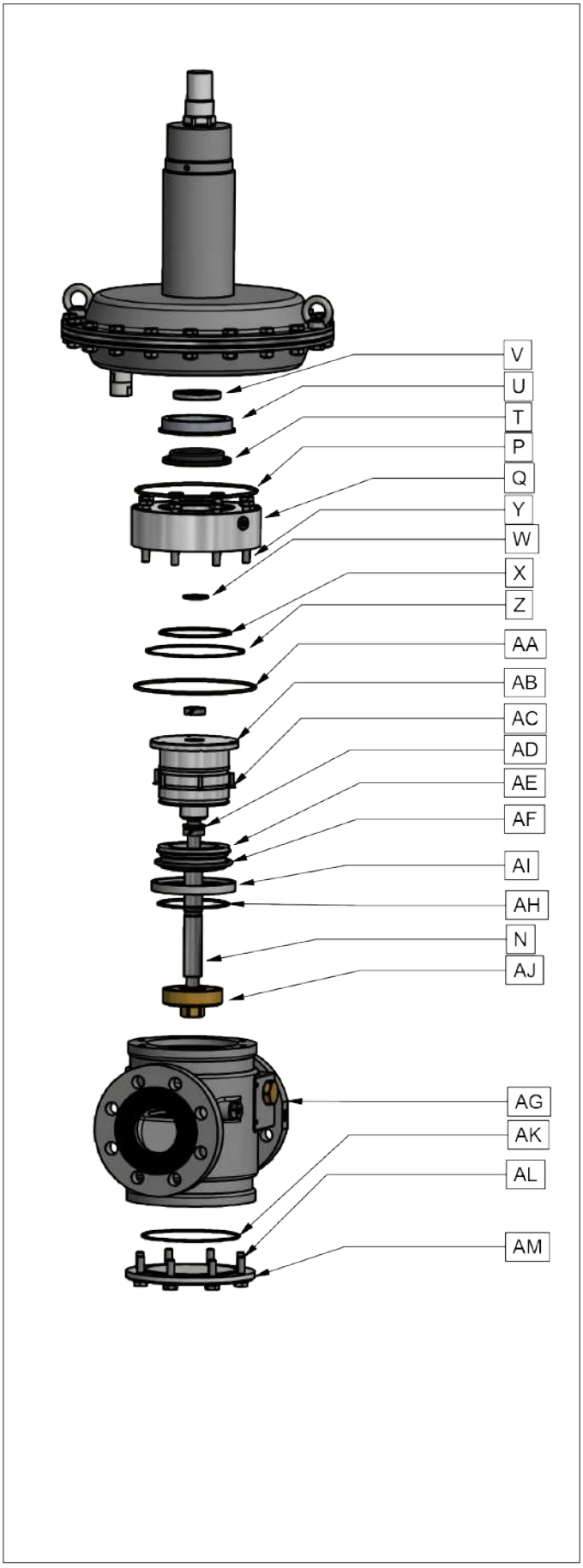
• The Pressure Equipment Directive (PED) requires the regulator to be checked at regular intervals to ensure: safety and correct functioning of the device, high long-term utilisation ratios, resulting in minimum environmental impact.

- **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
A1	O-Ring
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 (UHD version)
I	Reducing washer (UHD version)
J	Locking nut
K	Spring washer
L	Locking spring
M	Working diaphragm
N	Guide rod
O	Lower diaphragm shell
P	Intermediate housing
Q	O-Ring
R	Hexagon nut
S	Compensation guide support
T	Compensation membrane
U	Upper Compensation membrane
V	Under Compensation fixing disc
W	O-Ring
X	O-Ring
Y	Hexagon screws
Z	O-Ring
AA	O-Ring
AB	Shaft guide
AC	Screws
AD	O-Ring
AE	Valve seat orifice
AF	O-Ring
AI	Housing
AH	O-Ring
AJ	Valve sear disc
AG	Control plate
AK	O-Ring
AL	Hexagon screws
AM	Bottom cover


V
U
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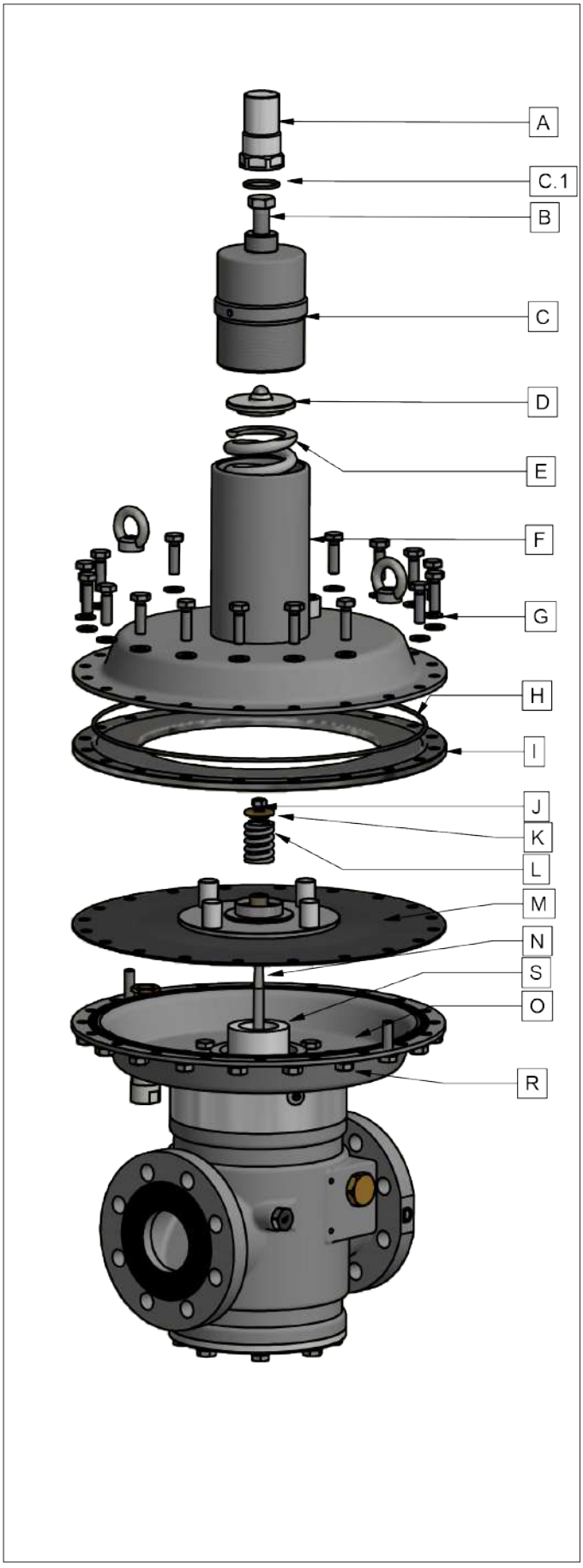
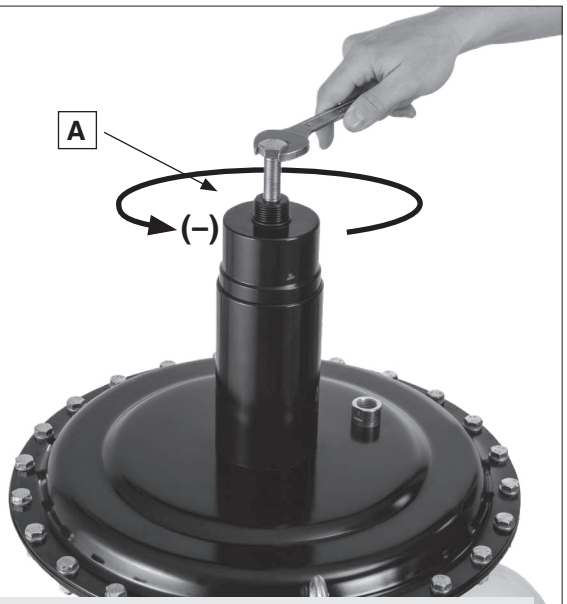

A
C.1
B
C
D
E
F
G
H
I
J
K
L
M
N
S
O
R

14.2 Maintenance instructions of the regulator

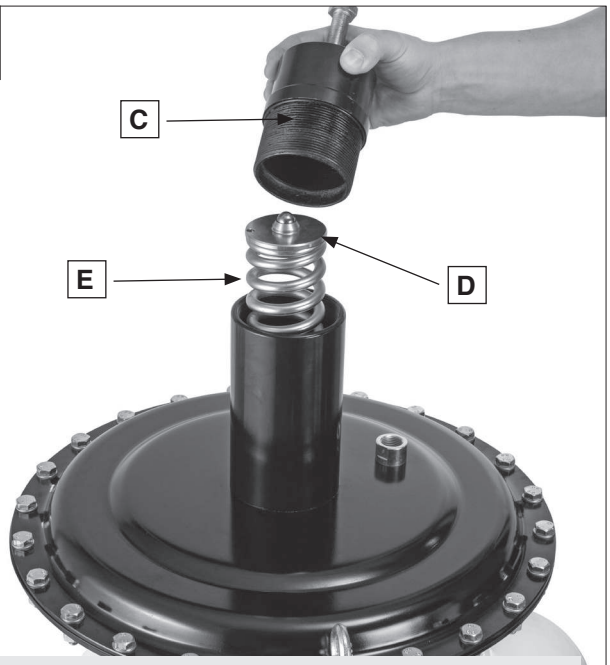
14.2.1 Preparation

1



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

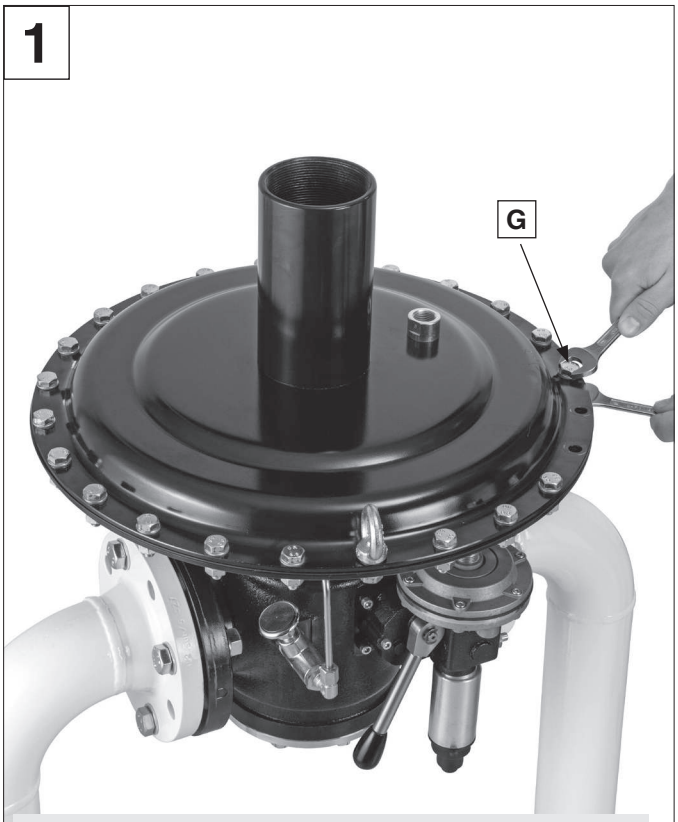
2



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**.

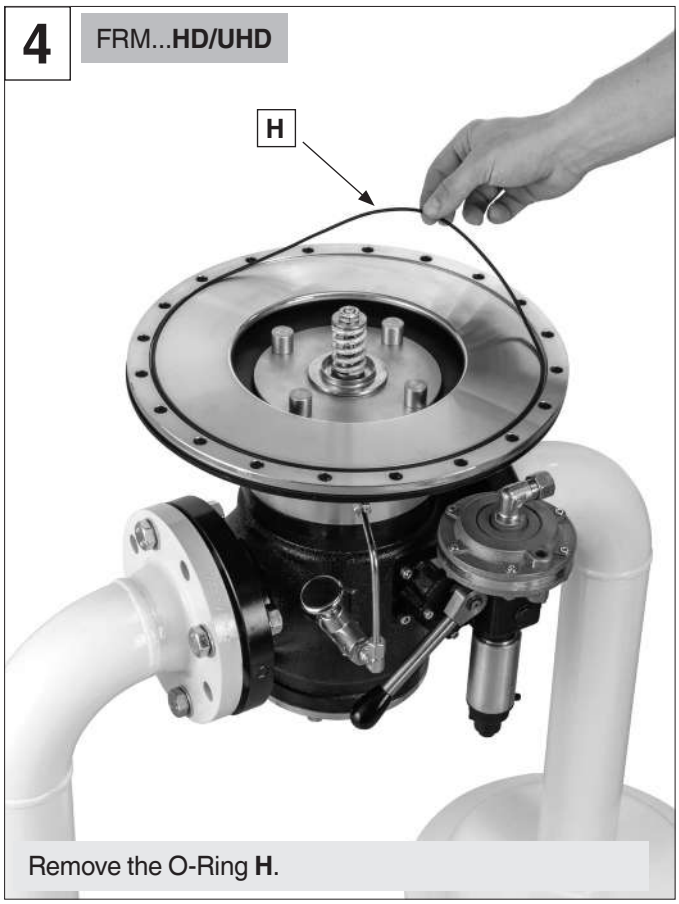
3 FRM...**HD/UHD**

Remove the upper diaphragm shell **F.**

FRM...**MD**

Remove the upper diaphragm shell **F**.

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



Remove the O-Ring **H**.

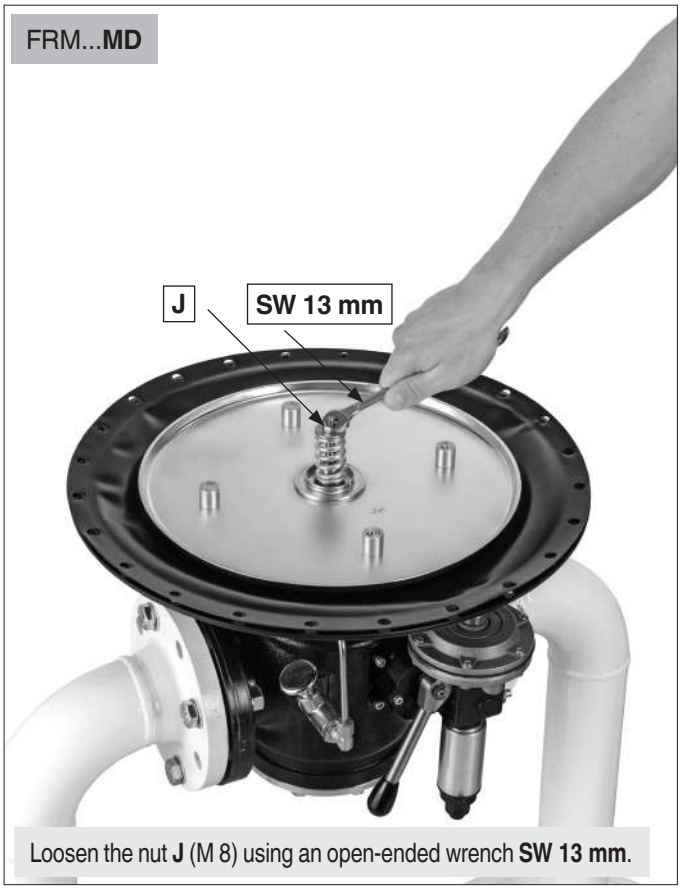
5 FRM...**HD/UHD**

Remove the reducing washer **I**.

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

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

FRM...**MD**



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

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

Remove the spring washer **K**.

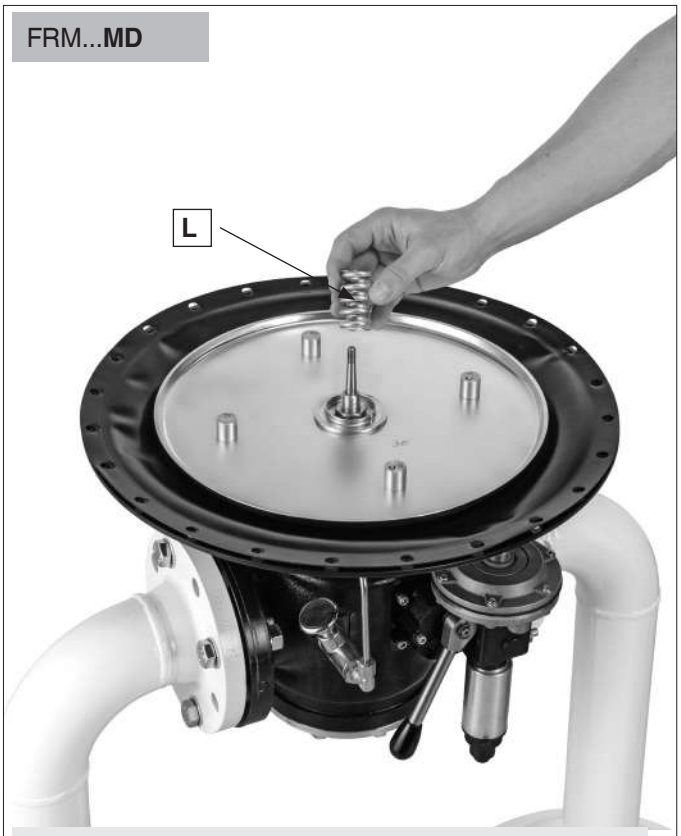
FRM...**MD**

Remove the spring washer **K.**

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

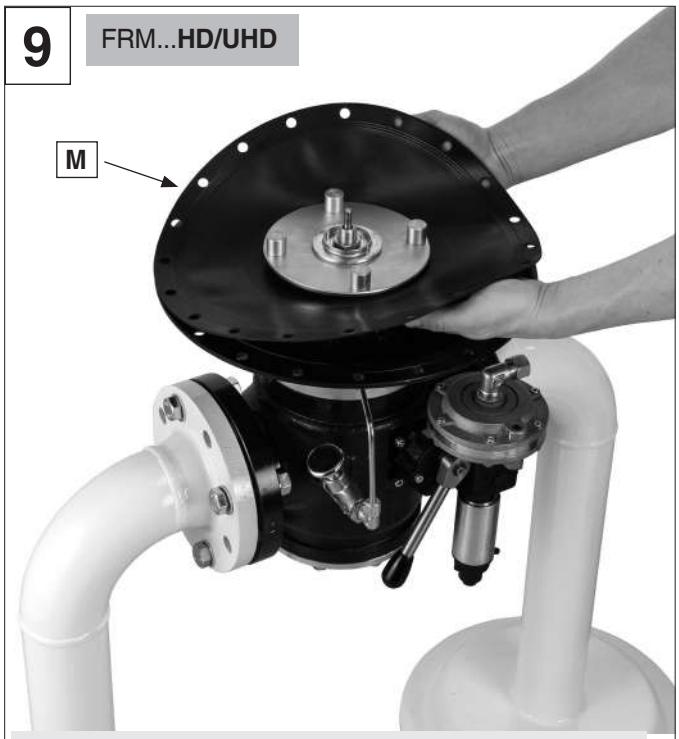
Remove the safety spring **L.**

FRM...**MD**



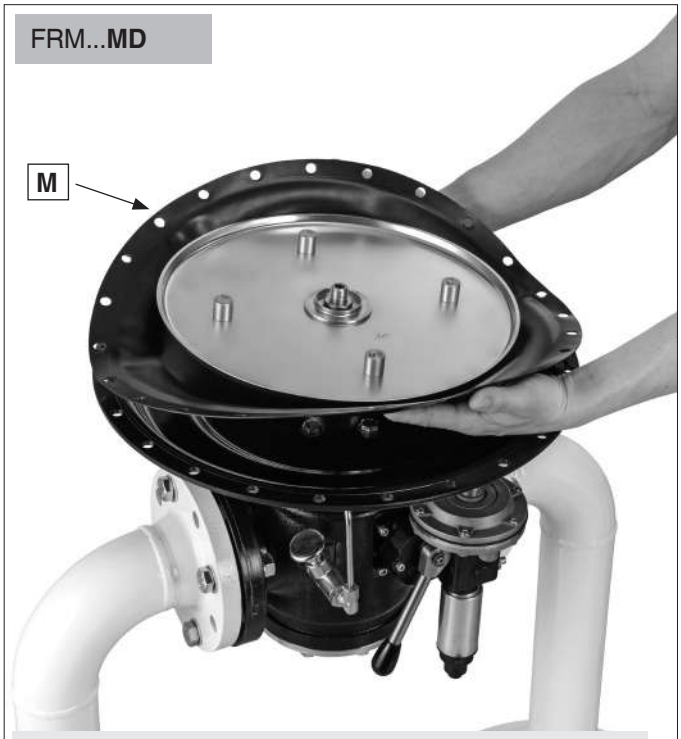
Remove the safety spring **L.**

9 FRM...**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...**MD**



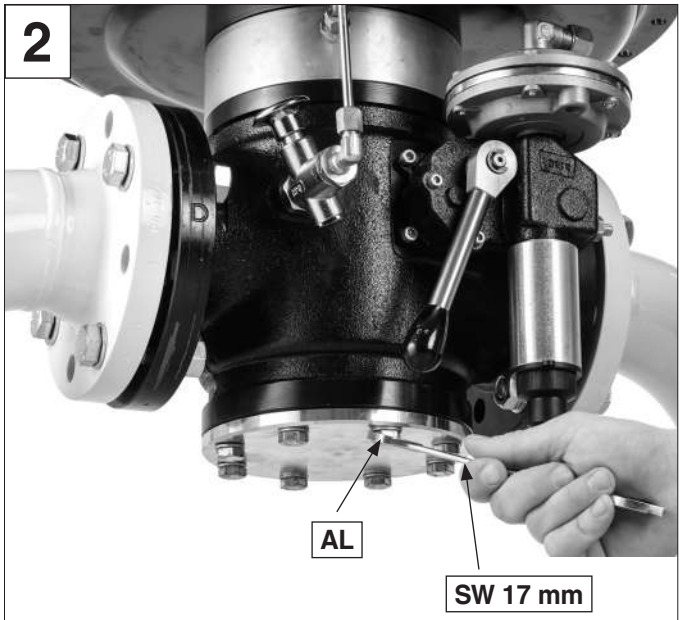
Remove the working diaphram **M** from the guide rod **N** and check for signs of damage or wear. If necessary, reassemble a new working diaphragm **M** (maintenance kit 2).

14.2.3 Replacement of the control plate / valve seat

1

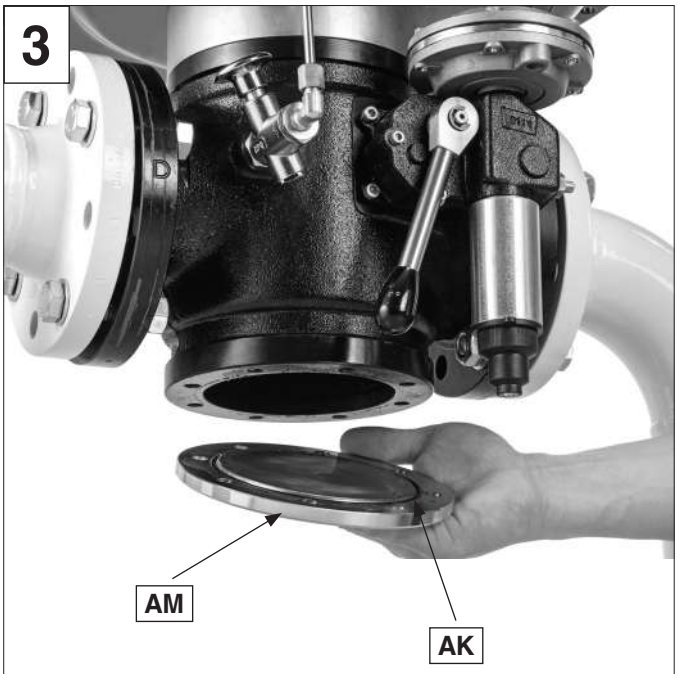
Make sure that SAV is tripped by pushing triggering button.

2



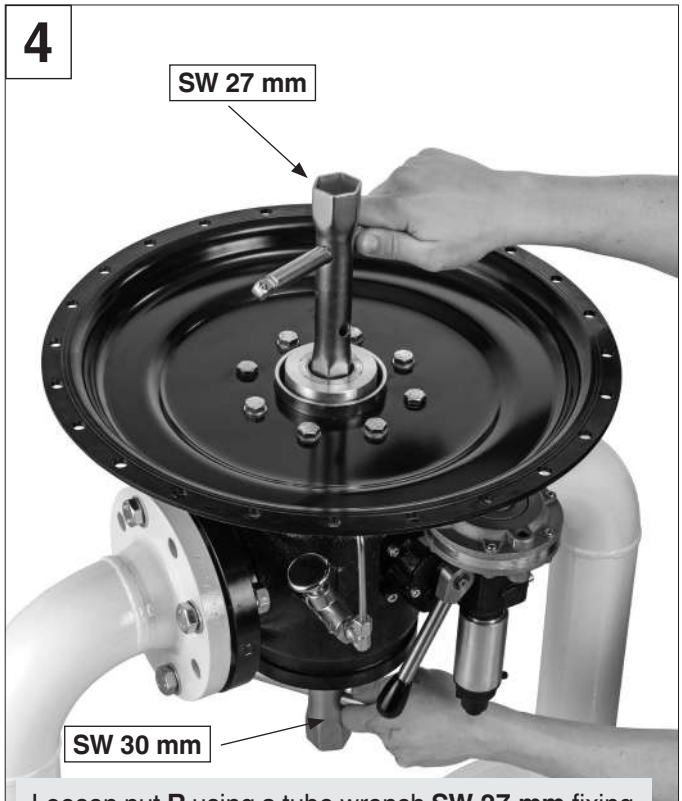
Loosen the 8 screws **AL** using an open-ended wrench size **SW 17 mm**.

3



Remove the lower cover **AM** and O-Ring **AK**.

4



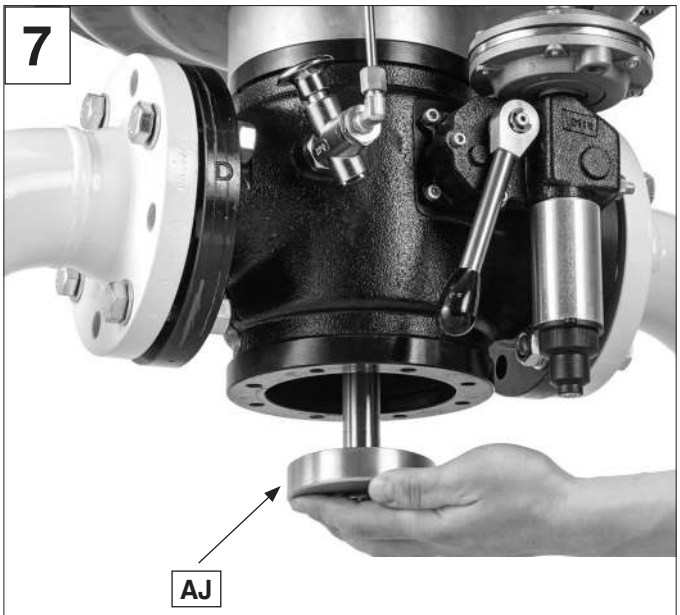
Loosen nut **R** using a tube wrench **SW 27 mm** fixing the control plate **AJ** with a tube wrench **SW 30 mm**.

5

6

Take out the guide rode **N** and the bottom control plate **AJ** with a hammer. For safety, hold the control plate from below with your hand so that it does not fall.

7



14.2.4 Replacement of the compensation membrane

1

Loosen screws **Y** using an open-ended wrench **SW 17 mm.**

2

Remove lower cover of the working diaphragm **O**.

3

Remove compensation guide support **S.**

4

Remove upper compensation fixing disc **U.**

5

Replace compensation membrane **T.**

14.2.5 Replacement closing part SAV

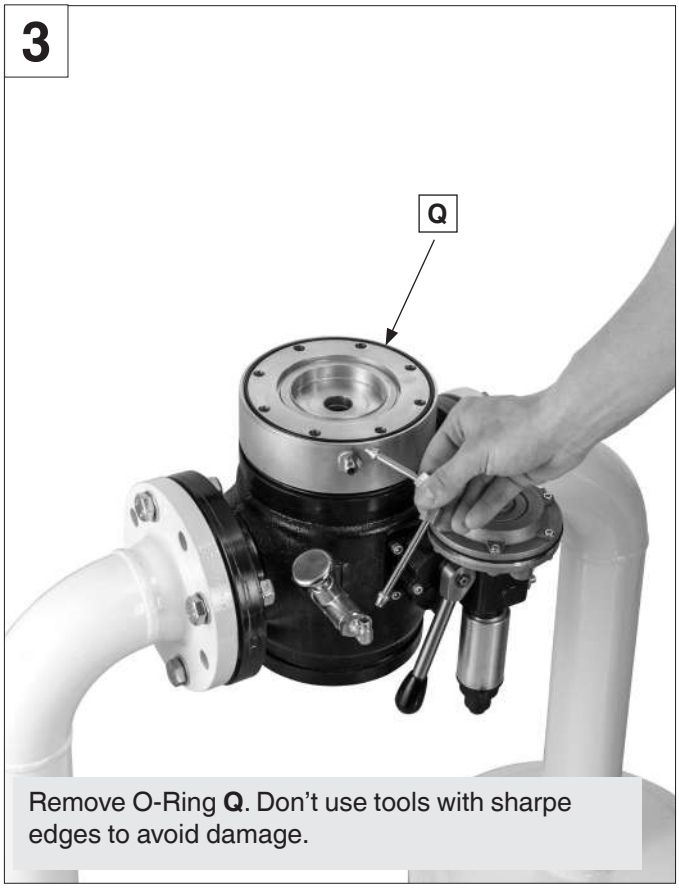
1

Remove the under compensation fixing disc **V** under the compensating membrane **T.**

2

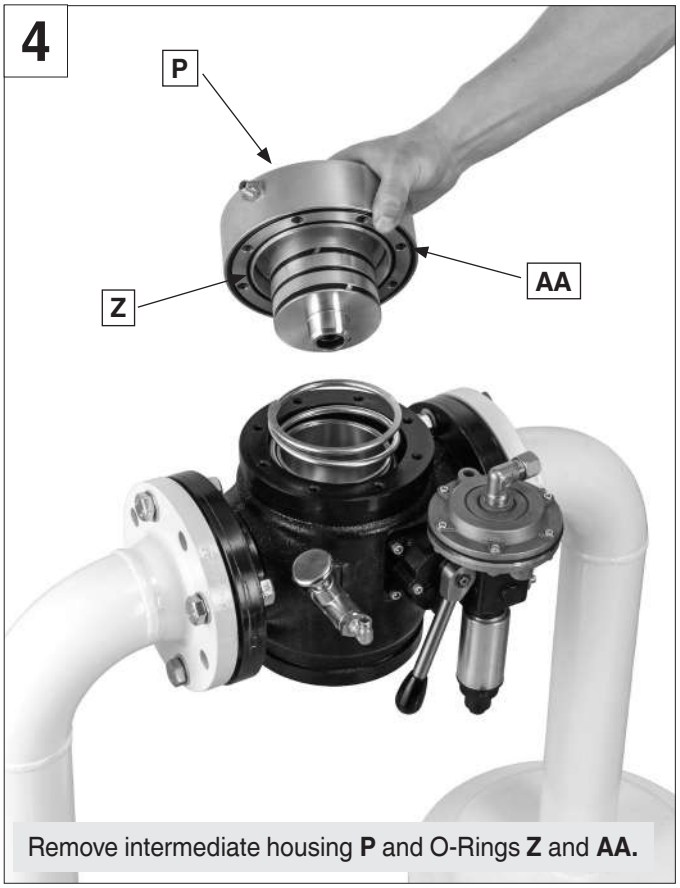
Remove bypass tubbing using an open-ended wrench **SW 14 mm.**

3



Remove O-Ring **Q**. Don't use tools with sharpe edges to avoid damage.

4



Remove intermediate housing **P** and O-Rings **Z** and **AA.**

5

Remove closing spring SAV.

6

Replace closing shell SAV.

14.3 Maintenance instruction of the SAV

14.3.1 Preparation

1

Make sure that SAV is tripped by pressing triggering button.

2

1. Remove the impulse and vent lines.
2. Remove the protective cap **A**.
3. Release the setpoint springs at the adjusting screws **B** and **C** (page 20).

13.3.2 Removing the ASE from the housing

1

Remove circlip.

2

Remove resetting lever.

3 Loosen the 2 screws using an allen key **SW 5 mm.**

4 Replace ASE.

14.3.3 Mounting of the ASE on the housing

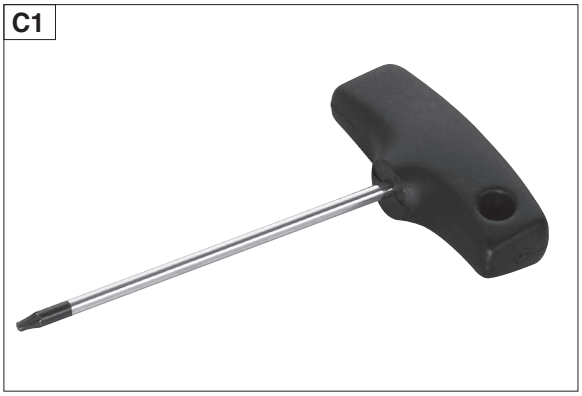
1	Place the new O-Ring **G** in the turned groove on the housing **M** intended for this purpose.
2	Screw the thread of the connecting piece **H** into the housing **F** using a hook wrench.
3	Fix the connecting piece **H** of the ASE **J** using 4 hexagonal socket grub screws **I** (M5x8).

14.4 Required tools

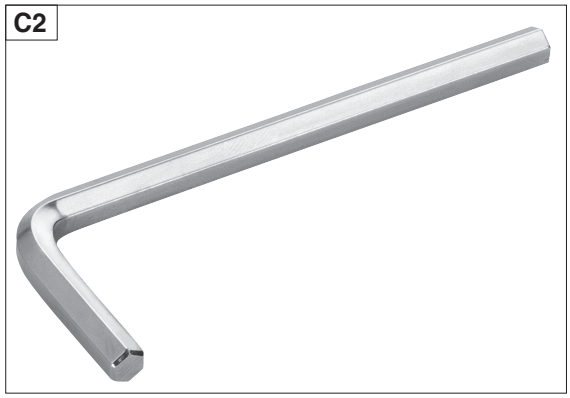
A

B

C1



C2



D

E

SAV

Work step		Tool designation	Pressure rating	Wrench size
1	Loosen the pulse lines.	Open-ended spanner (A)	MD/HD/UHD	SW 24
2	Release the setpoint springs.	Tube/socket wrench (B)	MD/HD/UHD	SW 17
		Tube/socket wrench (B)		SW 22
3	Loosen ASE from the housing.	Internal hex key (C1)	MD/HD/UHD	SW 5

Regulator

Work step		Tool designation	Pressure rating	Wrench size
1	Loosen the pulse lines.	Open-ended spanner (A)	MD/HD/UHD	SW 24
2	Release the setpoint springs.	Open-ended spanner (A)	MD/HD/UHD	SW 24
		Hinged hook wrench (D)		90-155
3	Replace the working diaphragm.	Open-ended spanner (A)	MD/HD/UHD	SW 17
		Open-ended spanner (A)		SW 13
4	Replace the control plate.	Tube socket wrench (B) / Hammer (E)	MD/HD/UHD	SW 30
5	Loosen bypass pipe.	Open-ended spanner (A)	MD/HD/UHD	SW 14
6	Replace closing shell SAV.	Open-ended spanner (A)	MD/HD/UHD	SW 17

14.5 SAV Leakage test

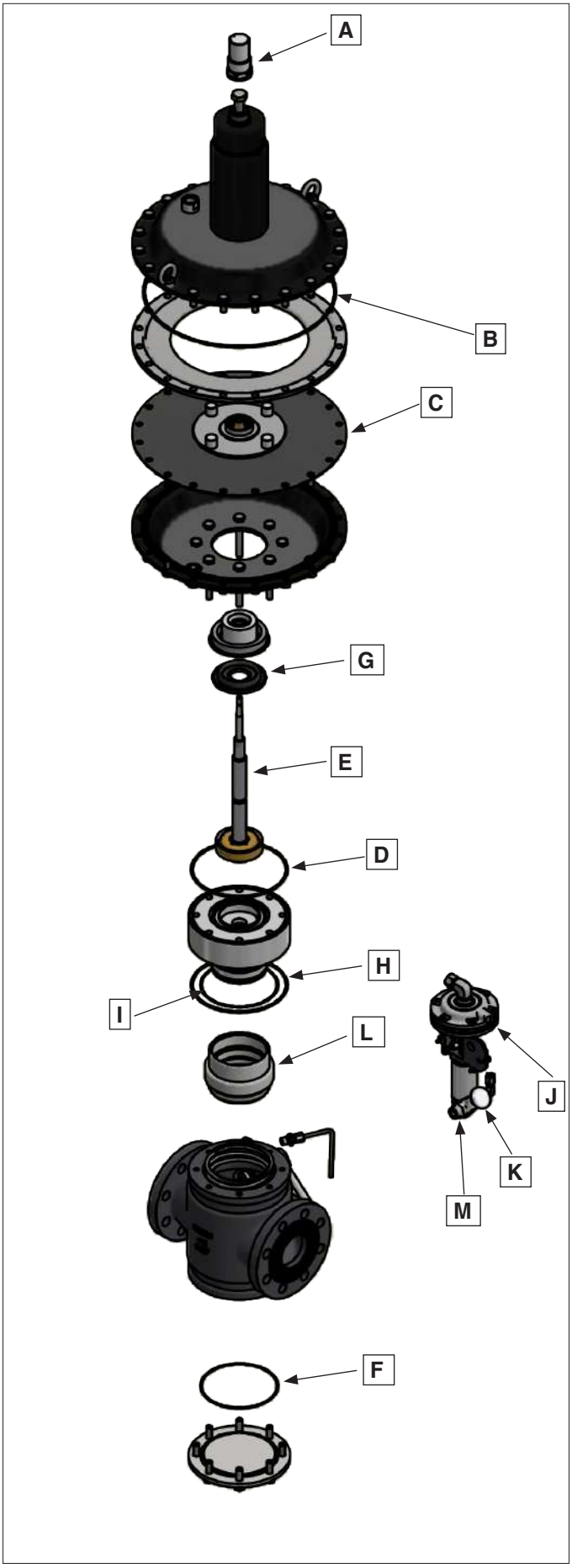
Go to section "12. Commissioning, decommissioning and recommissioning FRM or SAV" for performing functional and leakage testing of SAV.

14.6 Recommended maintenance intervals for SAV and FRM

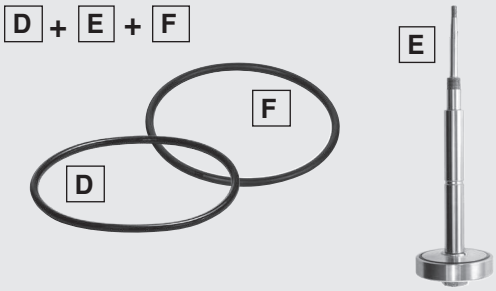
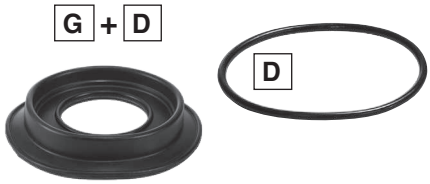
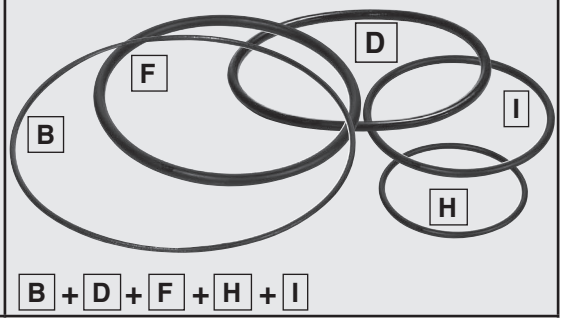
1. The maintenance intervals depend on the system-specific operating and environmental conditions, gas quality, state of the pipelines, etc.
2. The maintenance intervals have to be set by the system operator according to the system requirements.
3. It is recommended to perform a functional test on a 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

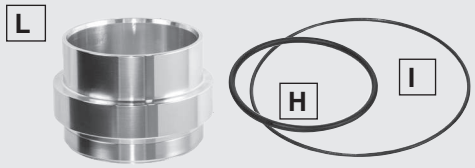
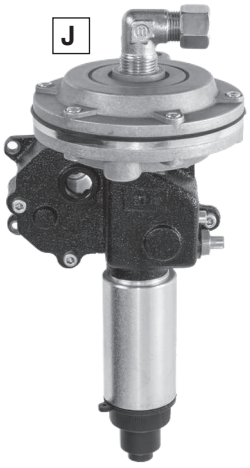
15. Spare parts



15.1 List of spare parts of the regulator

Kit	Spare part	Version	Order number	Spare part / image
1	Protective cap	FRM 100065-100080 FRM 250065-250080	270396	
2	Working diaphragm with O-Ring	FRM 100065-100080 MD	277997	
		FRM 100065 - 100080 HD FRM 250065 - 250080 UHD	277998	
3	Control plate with shaft	FRM 100065 FRM 250065	277999	
		FRM 100080 FRM 250080	278000	
4	Compen-sating membrane	FRM 100065 FRM 250065	278001	
		FRM 100080 FRM 250080	278002	
5	Kit O-Rings	FRM 100065 - 100080 FRM 250065 - 250080	278004	
6	Protective cap	SAV 100065 - 100080 SAV 250065 - 250080	278005	

15.2 List of spare parts of SAV

Kit	Spare part	Version	Order number	Spare part / image
1	Closing shell SAV	SAV 100065 - 100080 SAV 250065 - 250080	278003	
2	ASE with O-Ring	SAV 100065 - 100080 MD	278006	
		SAV 100065 - 100080 HD SAV 250065 - 250080 UHD	278007	
3	Bypass push button valve	SAV 100065 - 100080 SAV 250065 - 250080	278008	

15.3 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	

15.4 Storage conditions

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

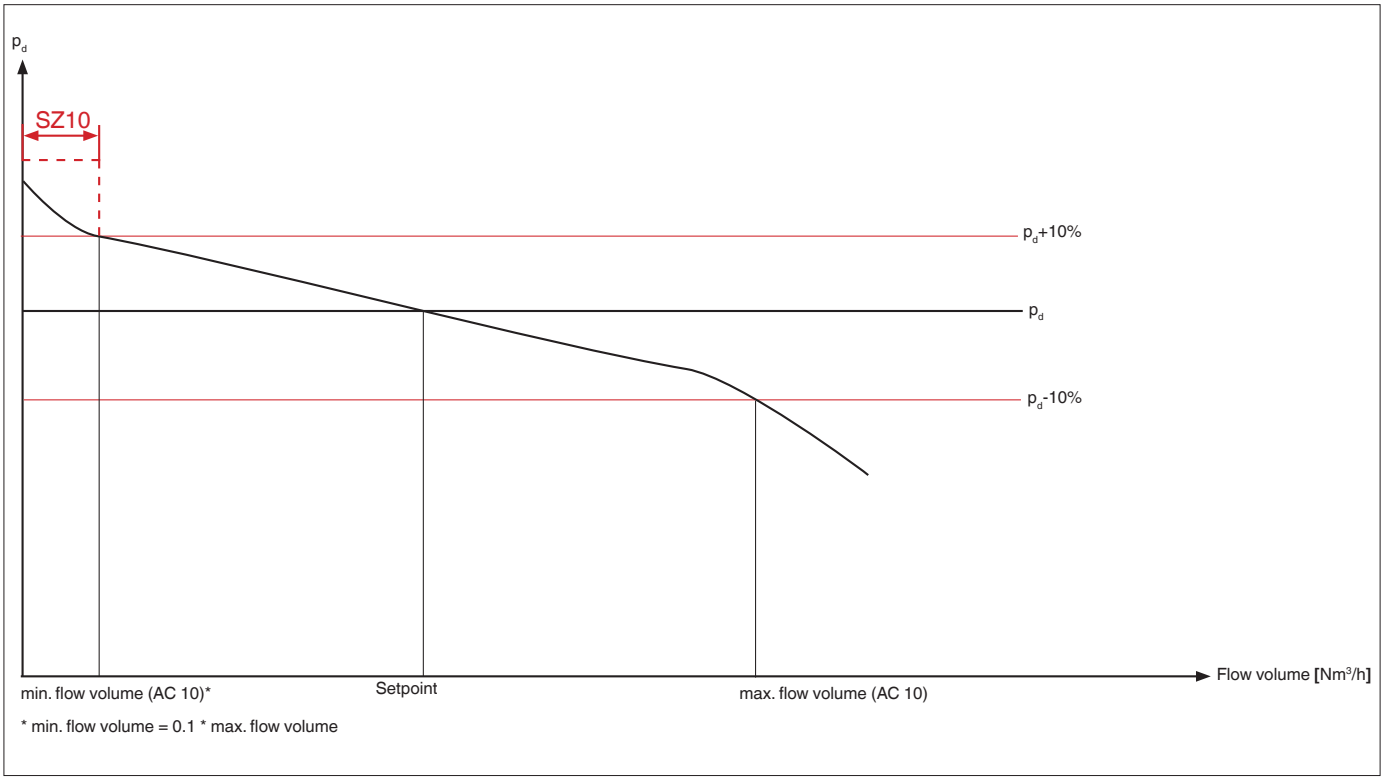
The ageing process mostly depends on the following factors:

- 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



16.1 Natural gas flow volume tables

FRM 100065 … DN 65 - max. flow volume [Nm³/h] natural gas of density 0.81 kg/m³ (AC 10)

FRM ...	MD							HD					
p_d [bar] / p_u [bar]	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	346	399											
0,5	602	652	702	882	1061	1132	1202	1407					
0,75	809	857	906	1089	1273	1342	1411	1490	1517				
1	1010	1057	1105	1293	1480	1548	1615	1571	1599	1627			
1,5	1396	1443	1490	1685	1879	1944	2010	1726	1890	2054	2227	2400	
2	1759	1808	1857	2057	2257	2321	2386	1872	2164	2457	2668	2879	3877
2,5	2101	2154	2207	2411	2615	2679	2743	2009	2422	2835	3085	3335	4726
3	2420	2479	2537	2745	2953	3017	3082	2137	2663	3188	3478	3768	5527
3,5	2717	2783	2850	3061	3271	3336	3402	2257	2887	3516	3847	4178	6281
4	2991	3068	3145	3357	3569	3636	3703	2368	3094	3820	4192	4565	6986
4,5	3243	3333	3422	3634	3846	3916	3986	2470	3284	4098	4514	4929	7643
5	3473	3577	3680	3892	4104	4177	4250	2563	3457	4352	4811	5270	8253
6	3866	4005	4143	4350	4558	4640	4722	2723	3754	4785	5334	5883	9328
7	4170	4352	4534	4732	4931	5025	5120	2847	3983	5119	5761	6404	10211
8	4385	4618	4852	5038	5224	5333	5443	2936	4145	5353	6093	6833	10902
9	4511	4804	5097	5266	5436	5563	5691	2990	4239	5489	6329	7169	11401
10	4548	4909	5270	5419	5567	5716	5865	3009	4267	5525	6469	7414	11708

FRM 100065 … DN 65 - max. flow volume [CFH] natural gas of density 0.81 kg/m³ (AC 10)

FRM ...		MD						HD				
Outlet pressure p_u [PSI]	Inlet pressure p_d [PSI]	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.]	41.6	55.4	83.1	110.8	138.5	166.2	166.2	277.1	415.6	554.2	609.6
3.0		12553	13829									
5.0		16700	17948	12374	16601	19154	20474	23974				
10.0		26902	28093	31122	40030	45338	48030	51912				
15.0		36709	37868	40864	50021	55361	57986	55846	58166			
20.0		46104	47258	50266	59646	65022	67595	59617	67771	732619	724500	
30.0		63900	65107	68252	78012	83468	85974	66761	85952	97275	123028	141016
40.0		80131	81495	84948	94989	100537	103036	73283	102517	117409	154461	181499
50.0		94990	96598	100513	110744	116396	118940	79258	117661	136065	183666	219003
60.0		108259	110217	114767	125087	130856	133505	84599	131165	153014	210296	253066
70.0		120073	122474	127822	138137	144034	146843	89361	143162	168397	234564	283972
80.0		130111	133069	139412	149607	155646	158684	93414	153323	181869	255950	311025
90.0		139099	142684	150137	160144	166334	169640	97049	162399	194213	275634	335805
100.0		146573	150884	159614	169335	175689	179320	100081	169910	204931	292864	357303
110		152220	157375	167586	176903	183435	187462	102385	175534	213683	307131	374841
120		156683	162759	174581	183418	190137	194604	104217	179932	221162	319476	389811
130		159846	166927	180505	188777	195695	200651	105531	182987	227245	329714	401964
145		64167	64167	64167	64167	64167	64167	64167	64167	64167	64167	64167

FRM 100080 … DN 80 - max. flow volume [Nm³/h] natural gas of density 0.81 kg/m³ (AC 10)

FRM ...	MD							HD					
p_d [bar] / p_u [bar]	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	407	469	531										
0,5	708	767	825	1037	1249	1331	1414	1655					
0,75	951	1008	1065	1282	1498	1579	1660	1753	1784				
1	1188	1244	1300	1521	1741	1821	1900	1848	1881	1914			
1,5	1642	1698	1753	1982	2210	2287	2364	2030	2224	2417	2620	2823	
2	2070	2128	2185	2420	2655	2731	2807	2202	2546	2891	3139	3387	4561
2,5	2471	2534	2596	2836	3077	3152	3227	2363	2849	3335	3629	3923	5560
3	2847	2916	2985	3230	3474	3550	3625	2515	3132	3750	4092	4433	6503
3,5	3196	3275	3353	3601	3848	3925	4002	2655	3396	4137	4526	4915	7389
4	3519	3610	3700	3949	4199	4278	4357	2786	3640	4494	4932	5371	8219
4,5	3816	3921	4026	4275	4525	4607	4689	2905	3863	4821	5310	5799	8992
5	4086	4208	4330	4579	4828	4914	5000	3015	4067	5120	5660	6200	9709
6	4549	4711	4874	5118	5362	5459	5555	3203	4416	5629	6275	6921	10974
7	4906	5120	5334	5567	5801	5912	6023	3350	4686	6022	6778	7534	12012
8	5159	5433	5708	5927	6145	6274	6403	3455	4876	6298	7168	8038	12825
9	5307	5652	5997	6196	6395	6545	6695	3518	4988	6457	7446	8435	13413
10	5350	5775	6200	6375	6549	6724	6900	3540	5020	6500	7611	8722	13774

FRM 100080 … DN 80 - max. flow volume [CFH] natural gas of density 0.81 kg/m³ (AC 10)

FRM ...		MD						HD				
Outlet pressure p_u [PSI]	Inlet pressure p_d [PSI]	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.]	41.6	55.4	83.1	110.8	138.5	166.2	166.2	277.1	415.6	554.2	609.6
3.0		14769	16270									
5.0		19647	21115	14558	19531	22534	20474	23974				
10.0		31650	33050	36614	47094	53338	48030	51912				
15.0		43187	44550	48075	58848	65130	57986	55846	68430			
20.0		54240	55597	59137	70172	76497	67595	59617	79730	861900	852350	
30.0		75176	76597	80296	91779	98198	85974	66761	101120	114441	144739	141016
40.0		94273	95877	99939	111752	118279	103036	73283	120608	138128	181719	181499
50.0		111752	113645	118250	130287	136936	118940	79258	138425	160076	216078	219003
60.0		127365	129667	135020	147162	153948	133505	84599	154311	180016	247407	253066
70.0		141263	144087	150379	162514	169451	146843	89361	168426	198114	275958	283972
80.0		153072	156553	164014	176008	183113	158684	93414	180380	213964	301117	311025
90.0		163645	167864	176632	188405	195687	169640	97049	191058	228487	324276	335805
100.0		172438	177510	187781	199218	206693	179320	100081	199894	241094	344546	357303
110		179082	185147	197160	208121	215806	187462	102385	206510	251392	361330	374841
120		184333	191481	205389	215786	223691	194604	104217	211685	260191	375854	389811
130		188054	196385	212358	222090	230229	200651	105531	215279	267346	387899	401964
145		64167	64167	64167	64167	64167	64167	64167	64167	64167	64167	64167

FRM 250065 UHD... DN 65 - 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	2,5	3	3,5	4
1,5	1002						
2	1093	1233					
2,5	1185	1598	2011				
3	1275	1692	2108	2537			
3,5	1366	1829	2291	2768	3705		
4	1456	1964	2472	2995	4040	5085	
6	1813	2495	3177	3880	4695	5511	6351
8	2164	3008	3852	4722	5688	6655	7650
10	2509	3503	4498	5523	6622	7721	8854
12	2847	3981	5114	6282	7497	8712	9964
14	3180	4440	5700	6999	8312	9626	10979
16	3506	4881	6257	7674	9068	10463	11900
18	3827	5305	6784	8307	9765	11224	12726
20	4141	5711	7281	8898	10403	11908	13458
22	4449	6099	7748	9448	10982	12515	14096
25	4900	6647	8394	10194	11738	13283	14875

FRM 250065 UHD... DN 65 - 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	2,5	3	3,5	4
1,5	979						
2	1024	1195					
2,5	1068	1282	1496				
3	1112	1259	1405	1556			
3,5	1156	1351	1545	1745	2038		
4	1201	1442	1682	1931	2318	2706	
6	1378	1795	2213	2643	3296	3949	4622
8	1555	2133	2711	3307	4039	4771	5525
10	1732	2455	3178	3923	4728	5534	6365
12	1909	2760	3612	4489	5364	6239	7140
14	2086	3050	4014	5007	5946	6885	7852
16	2263	3323	4383	5476	6474	7472	8500
18	2440	3580	4721	5896	6948	8000	9084
20	2617	3822	5026	6268	7369	8470	9604
22	2794	4047	5300	6590	7735	8881	10060
25	3060	4354	5649	6983	8185	9387	10625

FRM 250080 UHD... DN 80 - 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	2,5	3	3,5	4
1,5	1178						
2	1286	1450					
2,5	1394	1880	2366				
3	1501	1991	2480	2985			
3,5	1607	2151	2695	3256	4359		
4	1713	2311	2908	3524	4753	5982	
6	2133	2935	3738	4564	5524	6484	7472
8	2546	3539	4532	5556	6692	7829	9000
10	2951	4122	5292	6498	7791	9084	10417
12	3350	4683	6016	7390	8820	10249	11722
14	3741	5224	6706	8234	9779	11324	12917
16	4125	5743	7361	9028	10669	12309	14000
18	4502	6241	7981	9773	11489	13204	14972
20	4871	6718	8566	10469	12239	14009	15833
22	5234	7175	9115	11115	12920	14724	16583
25	5764	7820	9875	11992	13810	15627	17500

FRM 250080 UHD... DN 80 - 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	2,5	3	3,5	4
1,5	1152						
2	1204	1406					
2,5	1256	1508	1760				
3	1308	1481	1653	1831			
3,5	1360	1589	1817	2053	2398		
4	1412	1696	1979	2271	2727	3183	
6	1621	2112	2604	3110	3878	4646	5437
8	1829	2510	3190	3891	4752	5613	6500
10	2037	2888	3739	4615	5563	6511	7488
12	2246	3247	4249	5281	6311	7340	8400
14	2454	3588	4722	5890	6995	8100	9238
16	2662	3910	5157	6442	7616	8790	10000
18	2871	4212	5554	6937	8174	9412	10687
20	3079	4496	5913	7374	8669	9964	11299
22	3287	4761	6235	7753	9100	10448	11836
25	3600	5123	6646	8215	9629	11043	12500

FRM 250065 UHD… DN 65 - 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	30.00	35.00	45.00	50.00	58.00
22	33151						
30	39475	29376					
40	44491	64693	69153				
50	49010	71299	82511	93992			
60	53545	78858	91591	104631	151717		
80	62525	93682	109355	125407	166528	187738	
100	71396	108141	126624	145554	187905	209404	244813
120	80174	122289	143473	165169	212532	236500	275976
140	88817	135985	159710	184008	235935	262138	305295
160	97336	149258	175375	202123	258194	286415	332894
180	105761	162221	190621	219706	279613	309691	359229
200	114069	174788	205331	236610	299959	331689	383950
250	134293	204375	239626	275730	345863	380781	438290
300	153812	231592	270717	310785	385351	422232	482975
320	161438	241870	282328	323762	399495	436847	497785
360	176288	261078	303728	347407	424137	461736	497786

FRM 250065 UHD… DN 65 - 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]	15.00	25.00	30.00	35.00	45.00	50.00	58.00
22	32362						
30	36788	26797					
40	38948	47681	48055				
50	41128	50341	54976	59722			
60	43437	55759	61957	68305	87168		
80	48043	66300	75483	84889	112309	126639	
100	52631	76473	88466	100748	133132	149887	244813
120	57204	86334	100987	115994	151354	169419	275976
140	61756	95741	112836	130344	168506	187814	305295
160	66288	104724	124058	143859	184662	205150	332894
180	70805	113395	134819	156760	200084	221706	359229
200	75304	121668	144990	168875	214570	237267	383950
250	86463	140512	167699	195542	246456	271570	438290
300	97509	156974	186885	217519	272744	299922	482975
320	179972	273718	337784	225104	281819	309731	498365
360	110614	173540	205191	237607	296786	325968	497786

FRM 250080 UHD… DN 80 - 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	30.00	35.00	45.00	50.00	58.00
22	39000						
30	46442	34560					
40	52342	76109	81356				
50	57660	83882	97071	110580			
60	62993	92774	107754	123096	178490		
80	73558	110215	128654	147537	195914	220867	
100	83994	127225	148969	171240	221064	246357	244813
120	94322	143869	168791	194316	250038	278235	275976
140	104491	159982	187894	216480	277571	308398	305295
160	114513	175598	206324	237792	303757	336959	332894
180	124425	190849	224260	258478	328956	364342	359229
200	134199	205633	241565	278365	352892	390223	383950
250	157992	240441	281914	324388	406898	447978	438290
300	180955	272461	318490	365630	453354	496744	482975
320	189926	284553	332150	380897	469994	513938	497785
360	207398	307151	357327	408715	498984	543218	497786

FRM 250080 UHD… DN 80 - 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]	15.00	25.00	30.00	35.00	45.00	50.00	58.00
22	38073						
30	43281	31526					
40	45821	56095	56535				
50	48385	59225	64678	70262			
60	51103	65599	72891	80358	102551		
80	56521	78000	88804	99869	132128	148987	
100	61919	89968	104077	118527	156626	176337	244813
120	67299	101570	118808	136463	178063	199316	275976
140	72655	112637	132749	153346	198243	220958	305295
160	77986	123205	145951	169245	217249	241353	332894
180	83300	133407	158610	184423	235393	260831	359229
200	88593	143139	170577	198677	252435	279137	383950
250	101721	165308	197293	230050	289949	319494	438290
300	114716	184676	219866	255905	320875	352848	482975
320	119881	191702	227829	264827	331551	364389	497785
360	130134	204164	241401	279538	349160	383492	497786

16.2 Air flow volume tables

FRM 100065... DN 65 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	MD							HD					
p_d [bar] / p_u [bar]	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	280	322	0	0	0								
0,5	486	527	567	713	858	915	971						
0,75	653	693	732	881	1029	1085	1140	1204	1226				
1	816	855	893	1045	1196	1251	1305	1270	1292	1315	0		
1,5	1128	1166	1204	1361	1518	1571	1624	1395	1528	1660	1800	1939	0
2	1422	1462	1501	1663	1824	1876	1928	1513	1749	1986	2156	2327	3133
2,5	1698	1741	1783	1949	2114	2165	2217	1624	1957	2291	2493	2695	3820
3	1956	2003	2051	2219	2387	2439	2491	1727	2152	2577	2811	3045	4467
3,5	2196	2250	2304	2474	2644	2697	2749	1824	2333	2842	3109	3377	5076
4	2417	2480	2542	2713	2884	2939	2993	1914	2500	3087	3388	3690	5646
4,5	2621	2693	2766	2937	3109	3165	3221	1996	2654	3312	3648	3984	6178
5	2807	2891	2975	3146	3317	3376	3435	2071	2794	3517	3888	4259	6670
6	3125	3237	3349	3516	3684	3750	3816	2200	3034	3867	4311	4755	7539
7	3371	3517	3664	3825	3985	4062	4138	2301	3219	4137	4656	5176	8252
8	3544	3733	3921	4072	4222	4310	4399	2373	3350	4327	4925	5522	8811
9	3646	3883	4120	4256	4393	4496	4600	2417	3426	4436	5115	5794	9214
10	3676	3968	4260	4379	4499	4620	4740	2432	3449	4465	5229	5992	9463

FRM 100080... DN 80 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	MD							HD					
p_d [bar] / p_u [bar]	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	329	379	429	0,0	0,0								
0,5	572	620	667	838	1009	1076							
0,75	769	815	861	1036	1211	1276	1341	1417	1442				
1	960	1005	1051	1229	1407	1472	1536	1494	1520	1547	0		
1,5	1327	1372	1417	1602	1786	1849	1911	1641	1797	1953	2118	2282	0
2	1673	1720	1766	1956	2146	2207	2268	1780	2058	2336	2537	2737	3686
2,5	1997	2048	2098	2292	2487	2547	2608	1910	2303	2696	2933	3171	4494
3	2301	2357	2413	2610	2808	2869	2930	2032	2532	3031	3307	3583	5256
3,5	2583	2647	2710	2910	3110	3172	3234	2146	2745	3343	3658	3973	5972
4	2844	2917	2991	3192	3393	3457	3521	2251	2942	3632	3986	4341	6643
4,5	3084	3169	3254	3455	3657	3724	3790	2348	3122	3897	4292	4687	7268
5	3303	3401	3499	3701	3902	3971	4041	2437	3287	4138	4575	5011	7847
6	3676	3808	3940	4137	4334	4412	4490	2589	3569	4550	5072	5594	8869
7	3965	4138	4311	4500	4689	4778	4868	2707	3787	4867	5478	6089	9709
8	4170	4391	4613	4790	4967	5071	5175	2792	3941	5090	5794	6497	10366
9	4289	4568	4847	5008	5168	5290	5411	2843	4031	5219	6018	6817	10840
10	4324	4668	5011	5152	5293	5435	5576	2861	4057	5253	6151	7050	11132

FRM 250065 UHD... DN 65 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	UHD						
p_d [bar] / p_u [bar]	1	1,5	2	2,5	3	3,5	4
1,5	809						
2	884	996					
2,5	957	1291	1625				
3	1031	1367	1704	2051			
3,5	1104	1478	1852	2237	2994		
4	1177	1587	1998	2421	3265	4110	
6	1465	2017	2568	3136	3795	4454	5133
8	1749	2431	3114	3817	4597	5378	6183
10	2028	2831	3635	4464	5352	6241	7156
12	2301	3217	4133	5077	6059	7041	8053
14	2570	3588	4607	5656	6718	7780	8874
16	2834	3945	5057	6202	7329	8456	9618
18	3093	4288	5483	6714	7893	9071	10286
20	3347	4616	5884	7192	8408	9624	10877
22	3596	4929	6262	7636	8876	10115	11392
25	3960	5372	6784	8239	9487	10736	12022

FRM 250065 UHD... DN 65 - max. air flow volume [Nm³/h] (AC 5)

FRM ...	UHD						
p_d [bar] / p_u [bar]	1	1,5	2	2,5	3	3,5	4
1,5	791						
2	827	966					
2,5	863	1036	1209				
3	899	1017	1136	1258			
3,5	935	1092	1249	1410	1647		
4	970	1165	1360	1560	1874	2187	
6	1113	1451	1789	2136	2664	3192	3735
8	1257	1724	2191	2673	3265	3856	4465
10	1400	1984	2568	3170	3822	4473	5144
12	1543	2231	2919	3628	4335	5042	5771
14	1686	2465	3244	4047	4806	5564	6346
16	1829	2686	3543	4426	5232	6039	6870
18	1972	2894	3816	4765	5616	6466	7342
20	2115	3089	4062	5066	5956	6845	7762
22	2258	3271	4283	5326	6252	7177	8131
25	2473	3519	4566	5644	6615	7587	8587

FRM 250080 UHD... DN 80 - max. air flow volume [Nm³/h] (AC 10)

FRM ...	UHD						
p_d [bar] / p_u [bar]	1	1,5	2	2,5	3	3,5	4
1,5	952						
2	1040	1172					
2,5	1126	1519	1912				
3	1213	1609	2005	2413			
3,5	1299	1739	2179	2632	3523		
4	1385	1868	2351	2848	3842	4835	
6	1724	2372	3021	3689	4465	5240	6039
8	2058	2860	3663	4490	5409	6327	7274
10	2385	3331	4277	5251	6297	7342	8419
12	2707	3785	4863	5973	7128	8284	9474
14	3023	4222	5420	6655	7904	9153	10439
16	3334	4642	5949	7297	8623	9949	11315
18	3638	5044	6450	7899	9285	10672	12101
20	3937	5430	6923	8461	9892	11323	12797
22	4230	5799	7367	8983	10442	11900	13403
25	4659	6320	7981	9693	11161	12630	14144

FRM 250080 UHD... DN 80 - max. air flow volume [Nm³/h] (AC 5)

FRM ...	UHD						
p_d [bar] / p_u [bar]	1	1,5	2	2,5	3	3,5	4
1,5	931						
2	973	1137					
2,5	1015	1219	1423				
3	1057	1197	1336	1480			
3,5	1099	1284	1469	1659	1938		
4	1142	1371	1600	1836	2204	2573	
6	1310	1707	2104	2514	3134	3755	4394
8	1478	2028	2578	3145	3841	4537	5253
10	1647	2334	3022	3730	4496	5262	6052
12	1815	2625	3434	4269	5100	5932	6789
14	1983	2900	3816	4761	5654	6546	7466
16	2152	3160	4168	5207	6156	7105	8082
18	2320	3405	4489	5606	6607	7607	8638
20	2488	3634	4779	5960	7006	8053	9132
22	2657	3848	5039	6266	7355	8444	9566
25	2909	4140	5371	6640	7783	8925	10103

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 100065...	65	2600
FRM 100080...	80	3200

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

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)

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

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

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.

DUNGS®
Combustion Controls

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