FRM

Medium Pressure Regulator

DUNGS®
Combustion Controls

Medium pressure regulator Type FRM

Direct acting pressure regulator with adjustable setpoint springs and modularly mountable safety shutoff valve (SAV)

In compliance with EN 334 and EN 14382

- Inlet pressures up to 10 bar (1000 kPa)
- High flow rate
- Stable, accurate and sensitive regulation of the regulator outlet pressure
- Admission pressure compensation diaphragm for a high regulation accuracy
- External pulse
- Maintenance-friendly
- Flange connection according to DN 25 - DN 50

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FRM

Spring-loaded, pressure compensating regulator with adjustable setpoint springs for regulation of the regulator outlet pressure. External impulse of the regulator outlet pressure.

Application

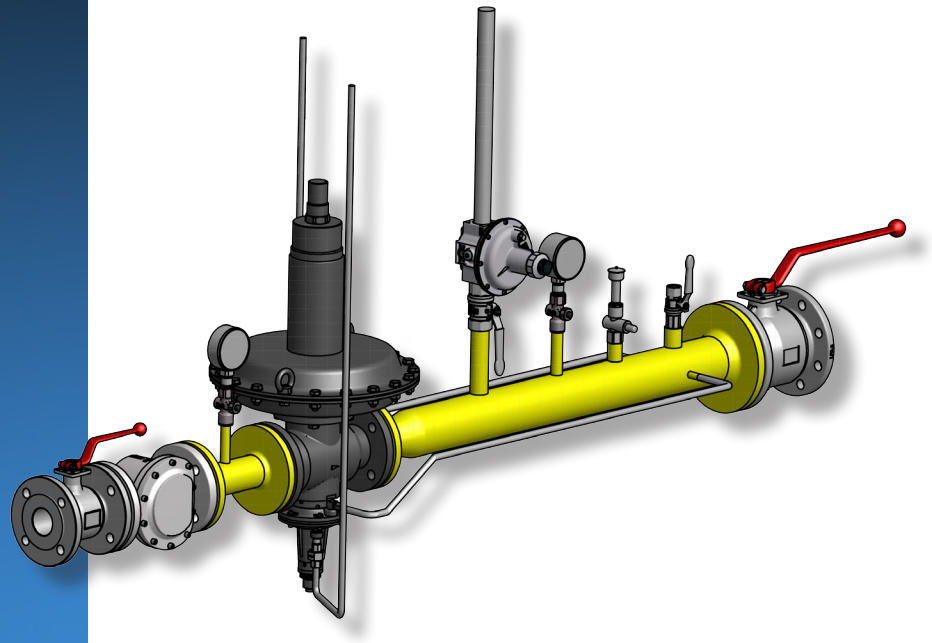
Pressure regulation of industrial gas burners and gas heating appliances. Also for installation in the municipal and commercial gas supply.

Suitable for gases of gas families 1, 2, 3 and other neutral gases.

Approval

EC type-examination certificate according to the EC pressure installation directive.

FRM 100...CE-0085CP0256



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Spring-loaded medium pressure regulator in compliance with EN334

Type	IS (integral strength range)
Type of gas	Family 1+2+3
Nominal diameters Flanges	Connecting flange PN 25 according to EN1092-1 DN 25 40 50
Max. inlet pressure	10 bar (1000 kPa)
Outlet pressure range	30 mbar up to 1500 mbar (3-150 kPa)
Minimum differential pressure (ND)	270 mbar (27 kPa)
Minimum differential pressure (MD)	350 mbar (35 kPa)
Minimum differential pressure (HD)	500 mbar (50 kPa)
Accuracy class	up to AC 5 (see adjustment range, page 3)
Lock-up pressure class	up to SG 10 (see adjustment range, page 3)
Failure mode (diaphram rupture)	fail-open
Materials	Main body housing: cast iron GGG 50 Diaphragm housing: steel Diaphragms: NBR
Ambient temperature	-20 °C to +60 °C

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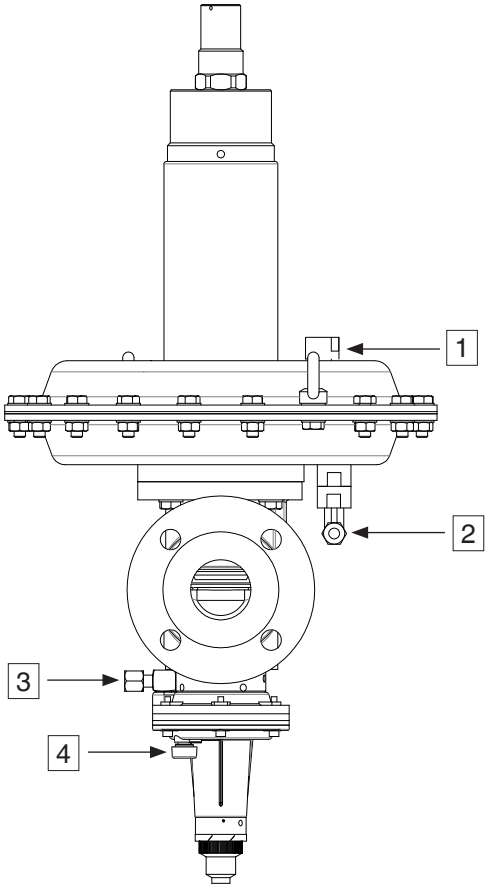
Safety shut-off valve in compliance with EN14382, class A

Type	IS	
Response time	< 2 s	
Lower adjustment range W_{du}	10 mbar up to 2500 mbar (1-250 kPa)	
Upper adjustment range W_{do}	40 mbar up to 4000 mbar (4-400 kPa)	
Materials	Main body housing:	cast iron GGG 50
	Diaphragm housing:	aluminium
	Diaphragms:	NBR



1 Vent line connection of the regulator, G 1/2 ISO 228

2 External impulse line connection of the regulator, Ermeto screw connection GE 12- 1/4 for tubes 12 x 1.5

3 External impulse line connection of the SAV, Ermeto screw connection GE 12- 1/4 for tubes 12 x 1.5

4 Vent line connection of the SAV, G 1/4 ISO 228

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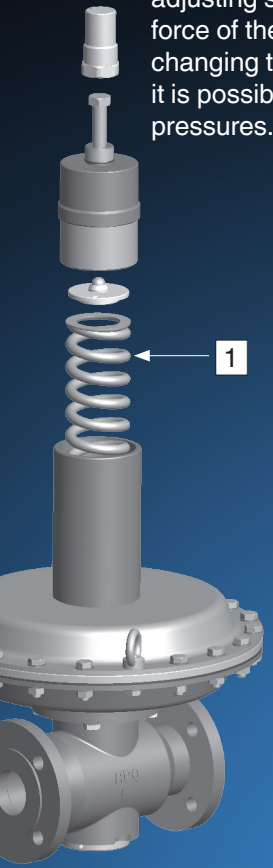
Example FRM 100025 ND / SAV ND	FRM	100	025	ND	SAV	ND
Type	Spring-loaded medium pressure regulator					
MOP	100 … 10 000 mbar					
Nominal diameter	DN 25 025 DN 40 040 DN 50 050					
Pressure range, outlet pressure	ND Low pressure MD Medium pressure HD High pressure					
Safety device	SAV Integrated shut-off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

Type	Con-nection	Ver-sion	Accuracy class* [AC]	Lock-up pressure class* [SG]	Outlet pres-sure range W_d	Under-pressure monitoring SAV		Over pressure monitoring SAV	
						W_{du}	AG	W_{do}	AG
FRM 100025 ND	DN 25	ND	AC 10	SG 20	30-100 mbar				
FRM 100025 MD	DN 25	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100025 HD	DN 25	HD	AC 5	SG 10	400-1500 mbar				
FRM 100025 ND / SAV ND	DN 25	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100025 MD / SAV MD	DN 25	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100025 HD / SAV HD	DN 25	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5
FRM 100040 ND	DN 40	ND	AC 10	SG 20	30-100 mbar				
FRM 100040 MD	DN 40	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100040 HD	DN 40	HD	AC 5	SG 10	400-1500 mbar				
FRM 100040 ND / SAV ND	DN 40	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100040 MD / SAV MD	DN 40	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100040 HD / SAV HD	DN 40	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5
FRM 100050 ND	DN 50	ND	AC 10	SG 20	30-100 mbar				
FRM 100050 MD	DN 50	MD	AC 5/10**	SG 20	90-420 mbar				
FRM 100050 HD	DN 50	HD	AC 5	SG 10	400-1500 mbar				
FRM 100050 ND / SAV ND	DN 50	ND	AC 10	SG 20	30-100 mbar	10-115 mbar	AG 10	40-240 mbar	AG 10
FRM 100050 MD / SAV MD	DN 50	MD	AC 5/10**	SG 20	90-420 mbar	35-400 mbar	AG 10	180-800 mbar	AG 10
FRM 100050 HD / SAV HD	DN 50	HD	AC 5	SG 10	400-1500 mbar	150-2500 mbar	AG 5	500-4000 mbar	AG 5

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

Selection of regulator springs

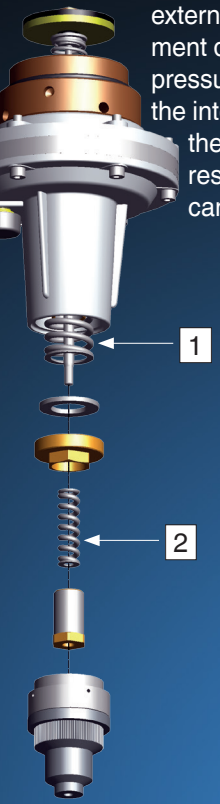
The response pressure results from the force of the installed adjusting spring and the weight force of the movable parts. By changing the setpoint **spring 1**, it is possible to set different outlet pressures.



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

Selection of SAV springs

The response pressure results from the force of the installed adjusting spring. The upper response pressure (overpressure) is set on the external **spring 1** of the measurement device. The lower response pressure (vacuum) can be set on the internal **spring 2**. By changing the setpoint springs, different response pressures can be set.

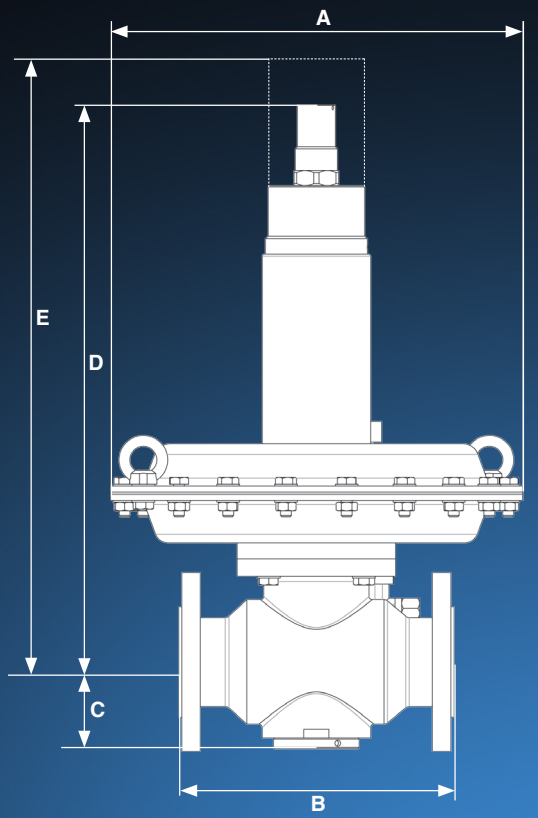


Specific set range, underpressure W_{dsu}

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

Specific set range, overpressure W_{dso}

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



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

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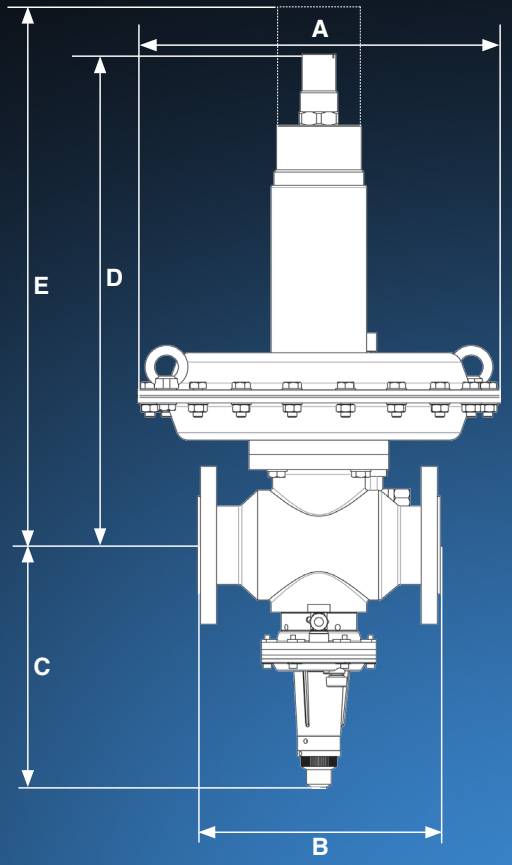


Type	Order number	p max. [bar / kPa]	DN	Dimensions					Weight [kg]
				A	B	C	D	E	
FRM 100025 ND/SAV ND	270275	10 / 1000	25	500	184	232	492	1070	40
FRM 100025 MD/SAV MD	270276	10 / 1000	25	380	184	229	492	1070	34
FRM 100025 HD/SAV HD	270277	10 / 1000	25	380	184	236	502	1080	38
FRM 100040 ND/SAV ND	270281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

Function

Mode of operation according to the force comparison principle between the force:

- of the adjustable setpoint spring,
- of the defined return spring,
- coming from the differential pressure on the working diaphragm and
- of the weight of the movable parts.

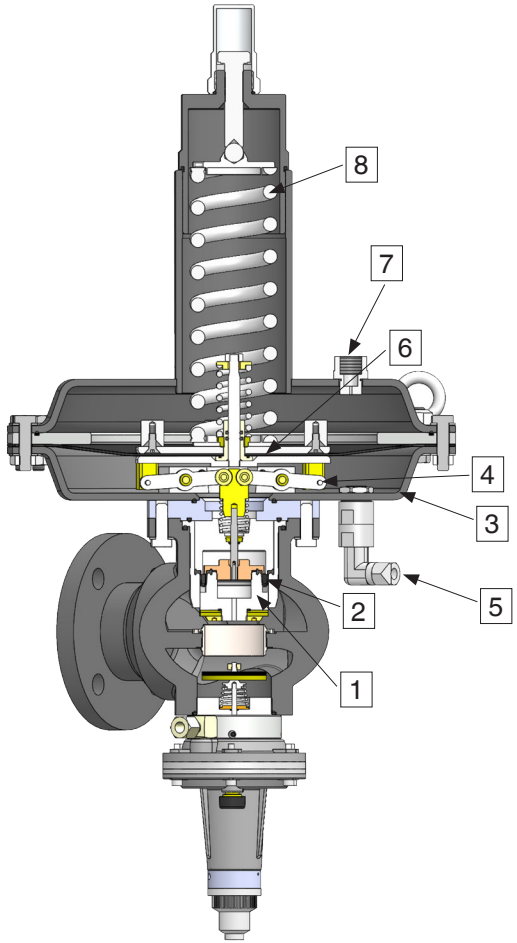
The setting spring acts independently of the weight of the movable parts. The outlet pressure is set depending on the preload of the setting spring.

Information
Gas-conveying lines, pulse and connecting lines must be resistant to thermal, chemical and mechanical stresses. They also must be durable and resistant to deformation and cracks.

Any condensate from impulse lines must not flow into the pressure regulator.

Combustible gas and gas/air mixtures must not enter the installation space of the adjusting spring.

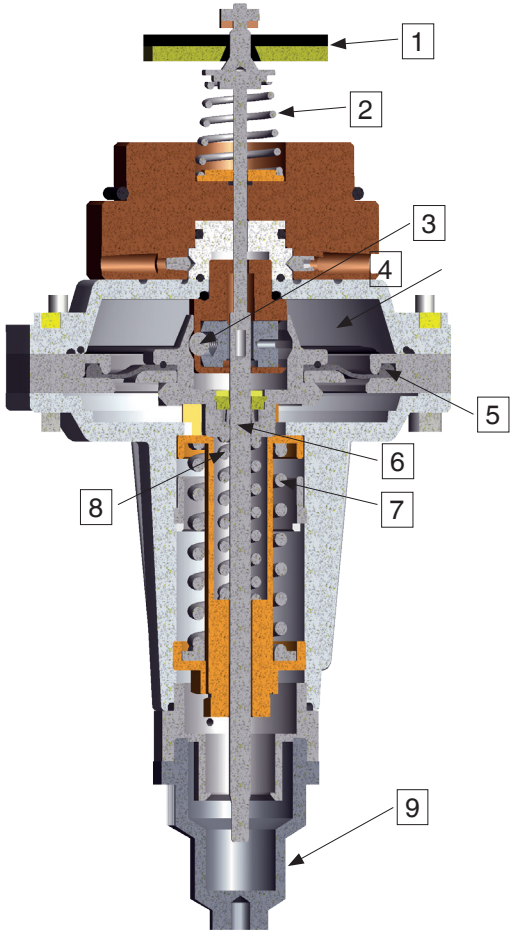
Sectional drawing FRM
Pressure regulator in open position



In case of an increase of the outlet pressure, the working diaphram 6 is pushed upwards, until the force of the setpoint spring 8 is equal to that of the outlet pressure.
The upward movement of the working diaphragm 6 causes the lever system 4 to be pulled upwards. In this way, the control plate 1 is then pushed downwards and the valve gap is reduced.
The flow volume decreased in this way reduces the outlet pressure until the set nominal value (outlet pressure) is reached and a balance of forces at the working diaphragm 6 is established.

1 Control plate
2 Inlet pressure compensation diaphragm
3 Lower diaphragm shell
4 Lever system
5 Impulse connection for the outlet pressure
6 Working diaphragm
7 Vent connection
8 Setpoint spring

Sectional drawing SAV
Device in the closed position



Chamber 4 is connected to the outlet pressure via an impulse line. The pressure being monitored 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.

1	Valve disc
2	Closing spring
3	Ball catch / trigger mechanism
4	Chamber with the pressure to be monitored
5	Working diaphragm
6	Push rod
7	Setpoint spring for pd_o
8	Setpoint spring for pd_u
9	Protective cap

The following flow rate tables can be used to select the device. The maximum indicated volume flow refers to the air with a standard density of 1.24 kg / m^3 at a temperature of 15 °C. In case of different types of gases, a conversion of the volume flow according to the equation on page 18 is carried out. It is possible to determine the maximum flow volume of the corresponding regulator at the operating point defined using p_d and p_u. This corresponds to the maximum power of the regulator at which an accuracy class of AC 10 is observed.

Design a straight stabilisation section with the equal diameter.

Impulse connection at a distance of > 5 x DN.

Maximum flow velocity in the stabilisation section of </= 30 m/s.

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

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

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

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

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

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

Calculation of gas types

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

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

Type of gas	Spec. Wgt. [kg/m³]	dv	f
Natural gas	0.81	0.65	1.24
City gas	0.58	0.47	1.46
NDG	2.08	1.67	0.77
Air	1.24	1.00	1.00

Design example

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Combustion Controls

System data
Medium: natural gas
Natural gas specific density: 0.81 kg/m³
Volume flow $V_{natural\ gas\ system}$: 550 Nm³/h
Inlet pressure p_u: 4 bar (400 kPa)
Outlet pressure p_d: 150 mbar (15 kPa)

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

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

$\mathring{V}_{FRM\ DN\ 25}$ = 510 m³/h air

Conversion $\mathring{V}_{FRM\ DN\ 25\ air}$ in $\mathring{V}_{FRM\ DN\ 25\ natural\ gas}$:

$\mathring{V}_{FRM\ DN\ 25\ natural\ gas}$ = 510 m³/h * $\sqrt{(1.24/0.81)}$

$\mathring{V}_{FRM\ DN\ 25\ natural\ gas}$ = 631 m³/h

$\mathring{V}_{FRM\ DN\ 25\ natural\ gas} > \mathring{V}_{natural\ gas\ system}$

631 m³/h > 550 m³/h

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

FRM...	ND				MD					HD					
p_d [bar] / p_u [bar]	0,03	0,05	0,075	0,1	0,15	0,2	0,25	0,3	0,35	0,4	0,5	0,75	1	1,25	1,5
0,5	240	290	290	300	270	270	270	270							
0,75	260	320	360	450	340	350	350	350	350						
1	280	350	460	570	400	410	410	440	470	470	470				
1,5	320	450	550	650	450	530	530	540	590	610	620	630	740		
2	350	530	630	720	550	620	620	640	700	730	770	820	840	840	880
2,5	415	580	700	800	615	700	700	750	800	840	870	1020	1030	1030	1100
3	460	630	780	890	670	770	770	830	890	940	940	1150	1300	1300	1300
3,5	505	670	860	970	735	840	840	930	990	1030	1040	1330	1420	1430	1500
4	540	700	950	1060	755	900	900	1020	1100	1130	1140	1410	1540	1590	1700
4,5	570	750	1050	1100	790	960	960	1100	1200	1220	1230	1540	1660	1730	1900
5	610	800	1130	1180	820	1020	1020	1170	1280	1300	1310	1670	1790	1880	2050
6	700	900	1240	1350	900	1120	1140	1320	1450	1450	1500	1900	1990	2150	2300
7	790	990	1330	1480	980	1180	1260	1450	1590	1580	1680	2120	2220	2400	2500
8	870	1070	1410	1550	1040	1220	1350	1570	1750	1690	1820	2300	2420	2600	2650
9	930	1140	1450	1580	1080	1250	1420	1690	1880	1790	1950	2500	2600	2750	2800
10	950	1190	1470	1620	1110	1270	1480	1780	2000	1810	2010	2610	2750	2850	2910

$\mathring{V}_{FRM\ DN\ 40}$ = 755 m³/h air

Conversion $\mathring{V}_{FRM\ DN\ 40\ air}$ in $\mathring{V}_{FRM\ DN\ 40\ natural\ gas}$:

$\mathring{V}_{FRM\ DN\ 40\ natural\ gas}$ = 755 m³/h * $\sqrt{(1.24/0.81)}$

$\mathring{V}_{FRM\ DN\ 40\ natural\ gas}$ = 934 m³/h

$\mathring{V}_{FRM\ DN\ 40\ natural\ gas} > \mathring{V}_{natural\ gas\ system}$

934 m³/h > 550 m³/h

Since the effective operating point of the system (550 m³/h natural gas) should correspond as closely as possible to the maximum power of the regulator, for this design example a FRM 100025 DN 25 is used. In this way optimum regulation behaviour can be guaranteed.

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Subject to technical modification in the interest of technical progress.