CONTROLS SUPPLY CHAIN
VALVES ACTUATORS INSTRUMENTATIONS

GAS PRESSURE REGULATORS AP (High Pressure)

ALPHARD P/AP
Pressure Regulator

Applications

It is designed for use in transmission and distribution networks, as well as commercial and industrial supplies.

Description

The ALPHARD P/AP is a pilot-operated regulator, type FTC (fail to close), or FTO (fail to open) available with or without an integrated safety shut-off device. The pilot and feeder system supplies constant outlet pressure when the inlet pressure varies and/or the flow rate varies.

Alphard P/AP

- Accurate control
- Easy maintenance
- Monitor application
- DVGW approval
- CE approval

Technical Features

Inlet pressure range	Pu: 0.5 -100 bar
Outlet pressure range	Pd: 0.5 bar – 95 bar
Minimal differential pressure	up: 0.5 to 1.5 bar, depend on the application
Flow rate	up to 1.500.000 Sm³/h Natural gas
Accuracy class AC	up to 1
Closing Pressure Class SG	depending on outlet pressure
Accuracy class SSD	AG 1 to AG 10
Operating temperature	-20°C to +60°C
Acceptable gases	Natural gas, propane, butane, air, nitrogen and all non-corrosive gases
Safety devices	Optional built-in SSD OPSO/UPSO: Over-pressure and under-pressure shut-off device
Option	Internal Silencer, Limit Switch, Position Transmitter Pneumatic and remote control devices

Sizes & Connections

Sizes	DN 25, 50, 80, 100, 150, 200, 250, 300
Face To Face dimensions	According to EN334
Flanges	PN16, 25, 40, 64, 100 ANSI 150, 300, 400, 600

Materials

Body	ASTM A352 LCB
Actuator regulator	Carbon Steel (cataforesis protected), ASTM A350 LF2
Actuator SSV	Carbon Steel, cataforesis protected
Pilot/Feeder	Carbon Steel, cataforesis protected/Stainless steel
Sealing parts	NBR rubber/NBR rubber, reinforced fabric
Trim	Stainless steel

Regulator sizing

To choose the pressure regulator, it is possible to use the following equations, on the basis of flow coefficient Cg:

a) $\frac{P_u - P_d}{P_u + P_b} \leq 0.5$: sub-critical conditions

$$Q = \frac{13.57}{\sqrt{d \cdot (t_u + 273)}} \cdot C_g \cdot \frac{P_u + P_b}{2} \cdot \sin\left[K_1 \cdot \sqrt{\frac{P_u - P_d}{P_u + P_b}}\right]_{deg}$$

b) $\frac{P_u - P_d}{P_u + P_b} > 0.5$: critical conditions

$$Q = \frac{13.57}{\sqrt{d \cdot (t_u + 273)}} \cdot C_g \cdot \frac{P_u + P_b}{2}$$

Where:

Q = flow rate in Nmc/h
d = relative density
t_u = gas temperature at the inlet of the regulator in °C
P_u = inlet pressure in barg
P_d = outlet pressure in barg
P_b = ambient atmospheric pressure in barg
K_1 = body shape factor

FLOW COEFFICIENT AND BODY SHAPE FACTOR OF REGULATOR								
Nominal Diameter (mm)	25	50	80	100	150	200	250	300
Nominal Diameter (inches)	1”	2”	3”	4”	6”	8”	10”	12”
Cg	550	2250	4500	8500	16900	29000	47000	67000
K_1	122	122	122	122	122	122	122	122

For natural gas, the relative density is d = 0.6. For gas with a different relative density δ, the value Q to be multiplied by a factor f:

$$f = \sqrt{\frac{0.6}{\delta}}$$

Gas type	*Relative Density δ*	*Factor f (at 15°C)*
Air	1	0.78
Butane	2	0.55
Propane	1.53	0.63
Carbon Dioxide	1.52	0.63
Nitrogen	0.97	0.79

Example N°1:

$P_u = 12$ bar

$P_d = 8$ bar

d = 0.6

$t_u = 15°C$

Q = 10000 Nmc/h

$$\frac{P_u - P_d}{P_u + P_b} = \frac{12-8}{12+1} = 0.31 < 0.5 \text{ : sub-critical conditions}$$

$$C_g = \frac{Q \cdot \sqrt{d \cdot (t_u + 273)}}{13.57} \cdot \frac{2}{P_u + P_b} \cdot \frac{1}{\sin\left[K_1 \cdot \sqrt{\frac{P_u - P_d}{P_u + P_b}}\right]_{deg}}$$

Cg = 1610 → **DN = 50**

Example N°2:

$P_u = 32$ bar

$P_d = 8$ bar

d = 0.6

$t_u = 15°C$

Q = 25000 Nmc/h

$$\frac{P_u - P_d}{P_u + P_b} = \frac{32-8}{32+1} = 0.73 > 0.5 \text{ : critical conditions}$$

$$C_g = \frac{Q * \sqrt{d \cdot (t_u + 273)}}{13.57} \cdot \frac{2}{P_u + P_b}$$

Cg = 1468 → **DN = 50**

FAIL TO CLOSE - Operating Principle

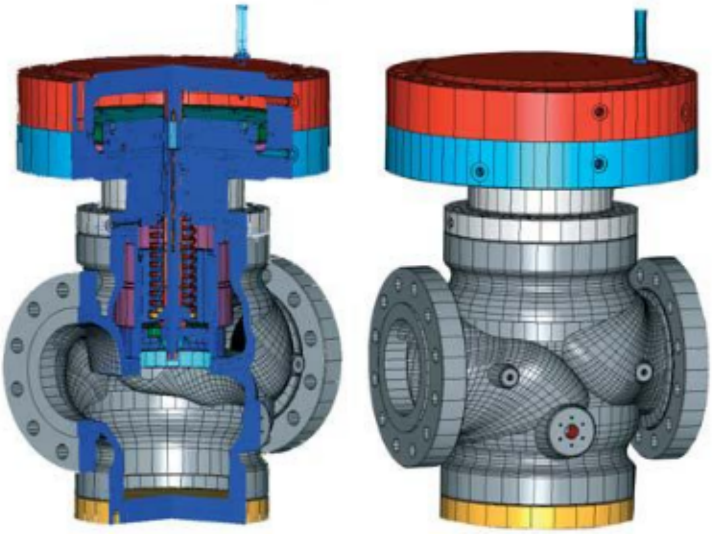
The opening grade of the regulator is based on the balance between the closing spring and the pressure difference between the outlet pressure (Pd) and the motorization pressure (Pm).

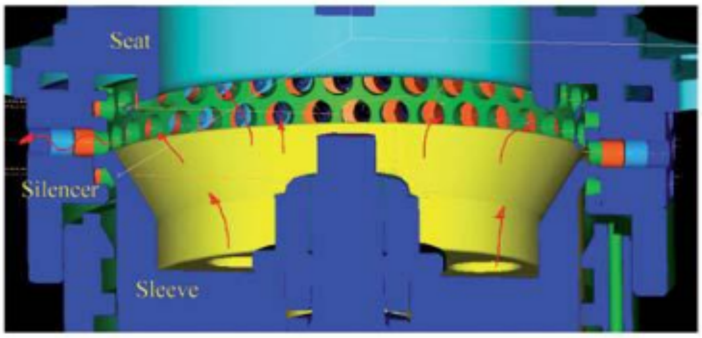
The motorization pressure, that operates on the diaphragm, is controlled by the pilot, that works as a pneumatic relay self-operated by outlet pressure.

The feeder supplies a constant pressure (Pup) to pilot, reducing the inlet pressure (Pu) to a value around 1 bar and supplementing this pressure with the outlet pressure (Pd) through an internal set spring.

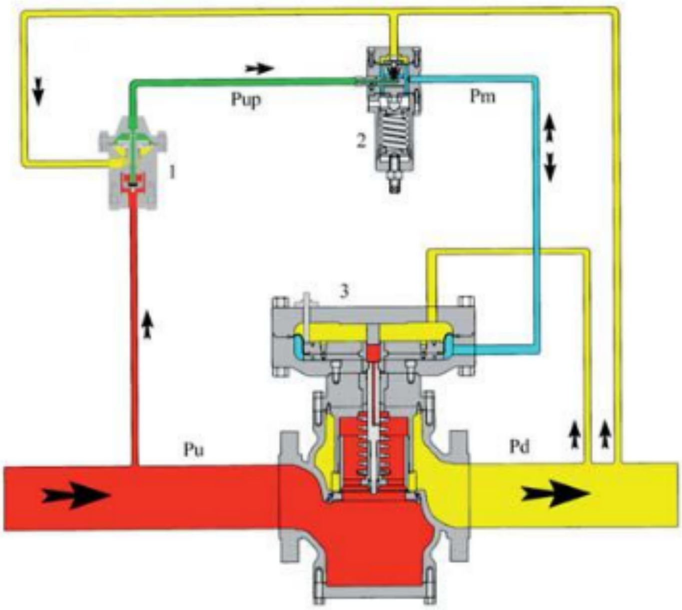
When the outlet pressure, Pd, falls below the desired value (or the flow rate increases), on the pilot, the spring force (superior to the outlet pressure force) acts on the diaphragm; the pilot opens and increases the motorization pressure.

On the regulator, the force of this pressure (Pm) increases and overcomes the combined action of the Pd and the spring. The sleeve of the regulator increase the opening and the outlet pressure increases.





Silencer position in the Regulator FTC



Pu - inlet pressure
Pd - outlet pressure
Pm - motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - pilot
3 - FTC regulator

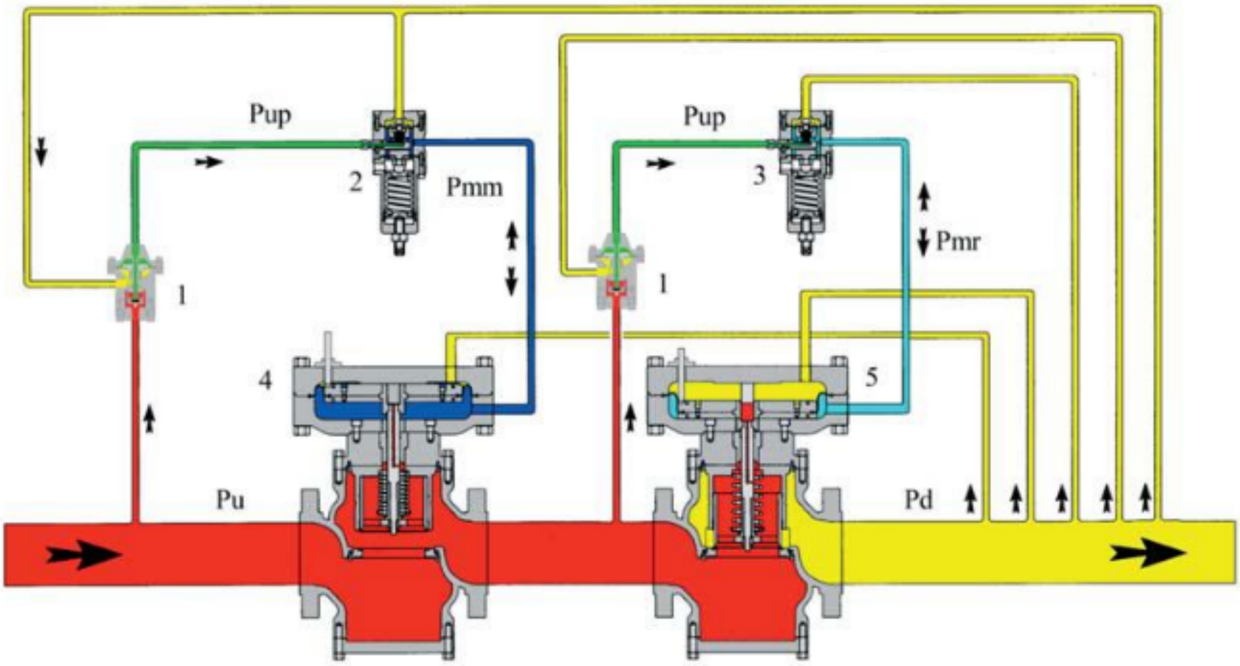
If the flow rate decreases, the motorization pressure decrease and the regulator closes.

In no-flow condition, the regulator closes, due to the closing of the pilot; the motorization pressure and the outlet pressure become the same value. So the outlet pressure is constantly controlled by the regulator through the action of the pilot, independently from the inlet pressure.

In case of diaphragm breaking, the FTC pressure regulator closes through the action of the internal spring.

The set of the outlet pressure is obtained by operating on the pilot spring. So the pressure of the regulator depends on the pressure of the pilot.

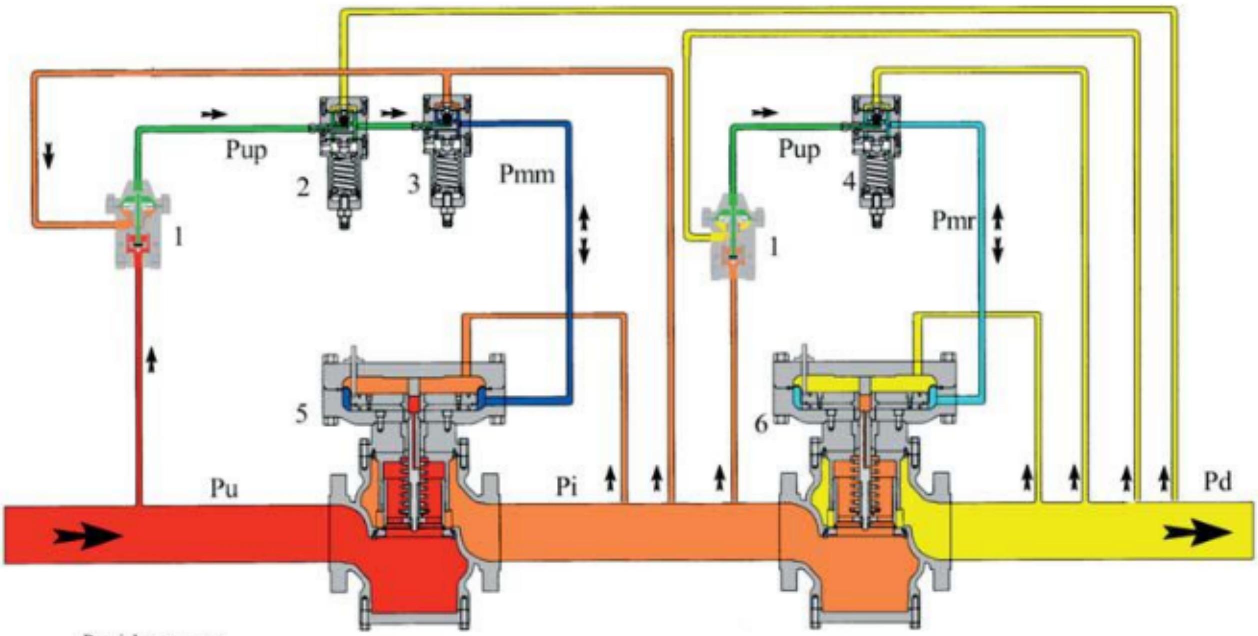
FAIL TO CLOSE
Configurations



Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - monitor pilot
3 - regulator pilot
4 - monitor
5 - regulator

Figure 1 - Operating diagram of FTC regulator with FTC passive monitor.



Pu - inlet pressure
Pi - mean pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - passive monitor pilot
3 - active monitor pilot

4 - regulator pilot
5 - monitor
6 - regulator

Figure 2 - Operating diagram of FTC regulator with FTC active monitor.

FAIL TO CLOSE

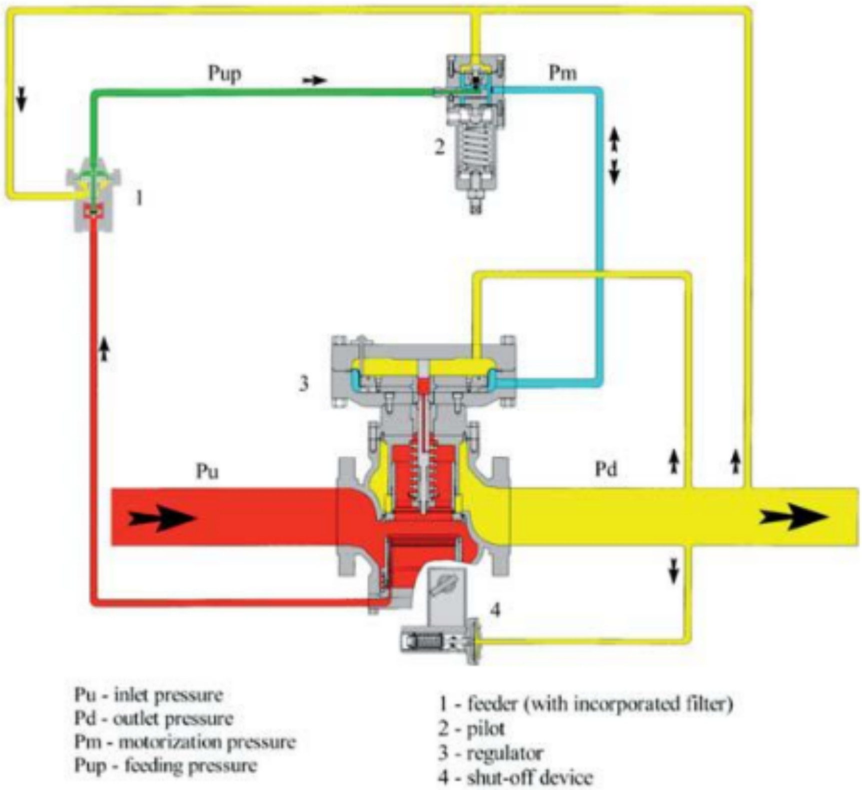


Figure 3 - Operating diagram of FTC regulator with SSD built-in.

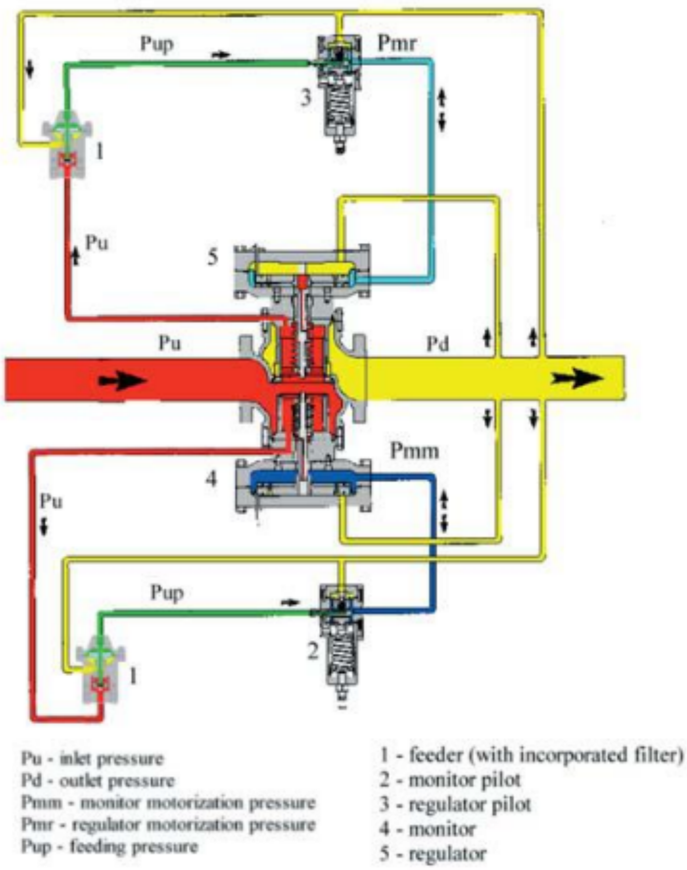


Figure 4 - Operating diagram of FTC + monitor FTC built-in.

FAIL TO CLOSE

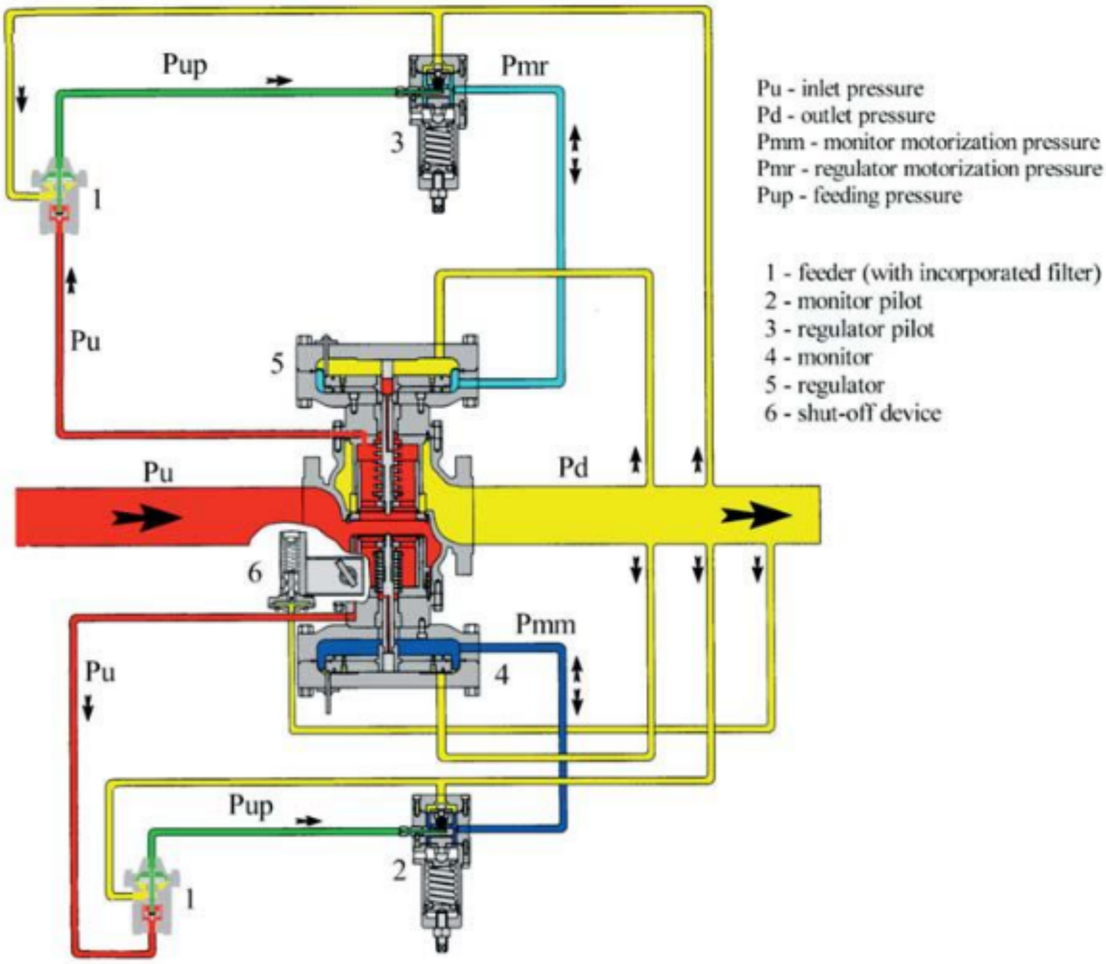


Figure 5 - Operating diagram of FTC regulator with FTC monitor and SSD built-it.

Table 1 - Pressure range

Feeder- / Regulator-type	Inlet pressure (bar)	Outlet pressure (bar)
AL 30 / CU 120	0.5 - 40.0	0.01 - 1.0
AL 30 / CU 80 MP	1.0 - 100	0.2 - 20.0
AL 30 / CU 80 MP DM	7.0 - 100	6.0 - 48.0
AL 20 / CU 80 AP	21.0 - 100	32.0 - 95.0

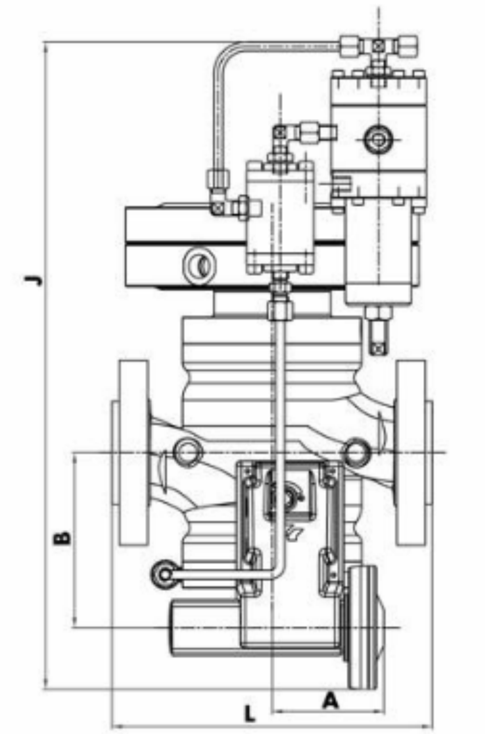
Table 2 - Spring Range of Regulator ALP2 P/AP FTC, for *High* Outlet Pressure

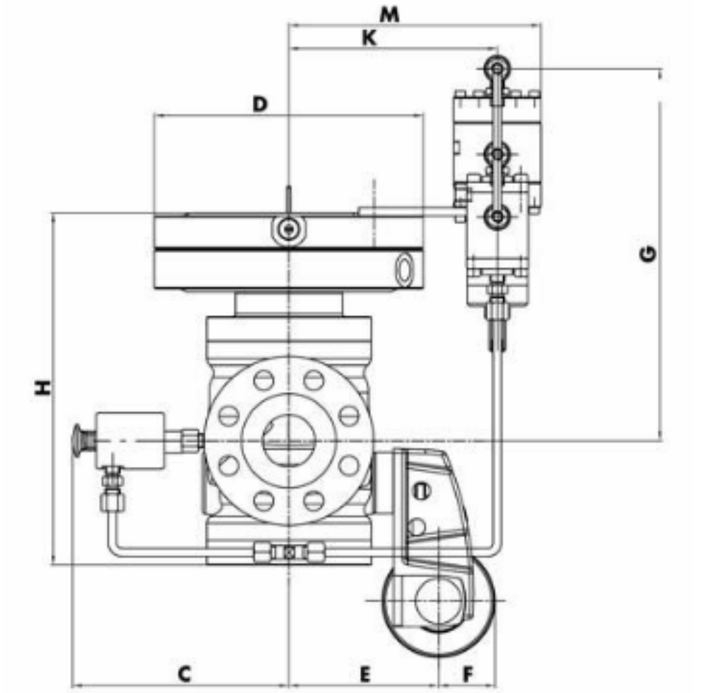
Spring						Pilot type								
						CU80 MP			CU80 MP DM			CU 80 AP		
n°	Code	Wire [mm]	Pitch [mm]	Color	RAL	[bar]	[bar]	PILOTING SYSTEM	[bar]	[bar]	PILOTING SYSTEM	[bar]	[bar]	PILOTING SYSTEM
297	5ML297I5	3,5	10	Orange	2613	0,2	0,4	M0	***					
297	5ML297I5	3,5	10	Orange	2613	0,4	1,2	M0	***					
65	5ML065I5	5	11,5	Mint Green	6029	0,5	1,5	M1						
65	5ML065I5	5	11,5	Mint Green	6029	1,5	4	M1						
58	5ML058I5	6	9	Signal Yellow	1023	2	4,5	M2	2	4,5	N7			
59	5ML059I5	7	11	Light Blue	5012	4	11	M3	4	11	N5			
60	5ML060I5	7	12,5	Signal Blue	5017	6	15	M4	6	15	N4			
61	5ML061I5	8	12	Signal Red	3001	11	20	M5	11	20	N3			
62	5ML062I5	8,5	13,5	Baked -clay brown	8003				16	27	N1			
63	5ML063H8	9	13,5	Deep Black				*	20	32	N2			
64	5ML064H8	10	13,8	Off White	9010			*	32	48	N6	32	48	A1
296	5ML296H8	11	14,5	Alluminium	9006							48	60	A3
307	5ML307H8	11,5	15	Pink	3015						**	60	80	A4
336	5ML336H8	12,5	15,5	Blu-Nero							**	75	95	A5

Dimensions and weights of the regulator

Dimensions L (mm) / Weights W (kg)								
PN	PN 16 / ANSI 150		PN 25 / PN 40		ANSI 300		ANSI 600	
DN	L	W	L	W	L	W	L	W
25	184	53	197	54	197	55	210	60
50	254	85	267	86	267	88	286	95
80	298	139	317	141	317	143	337	150
100	352	225	368	228	368	235	394	250
150	451	465	473	472	473	480	508	500
200	543	1025	568	1033	568	1050	610	1090
250	673	1770	708	1787	708	1810	752	1875
300	737	2575	775	2596	775	2640	819	2785

Dimensions (mm) - PN 16 to ANSI 600											
DN	A	B	C	D	E	F	G	H	J	K	M
25	160	150	168	206	102	55	395	330	560	215	260
50	160	156	190	262	128	55	415	370	600	265	310
80	160	167	210	332	154	55	440	420	650	305	350
100	160	173	245	400	172	55	280	460	510	355	400
150	160	205	290	530	220	55	355	570	620	415	460
200	160	230	340	650	285	55	400	700	750	455	500
250	160	243	395	780	334	55	490	880	930	525	570
300	160	260	425	910	370	55	575	1050	1100	605	650

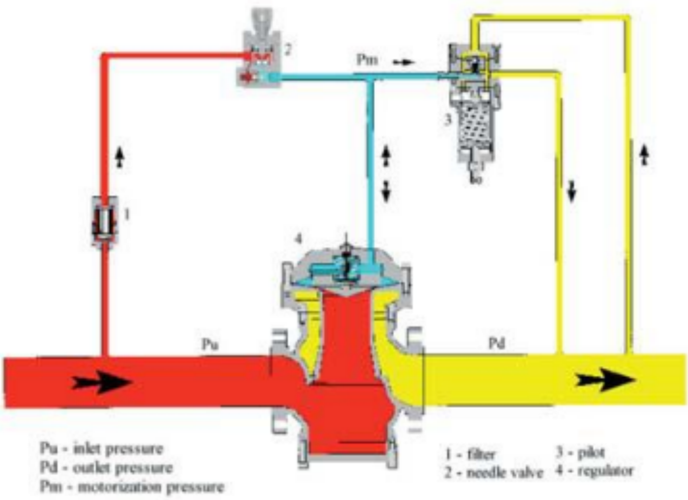


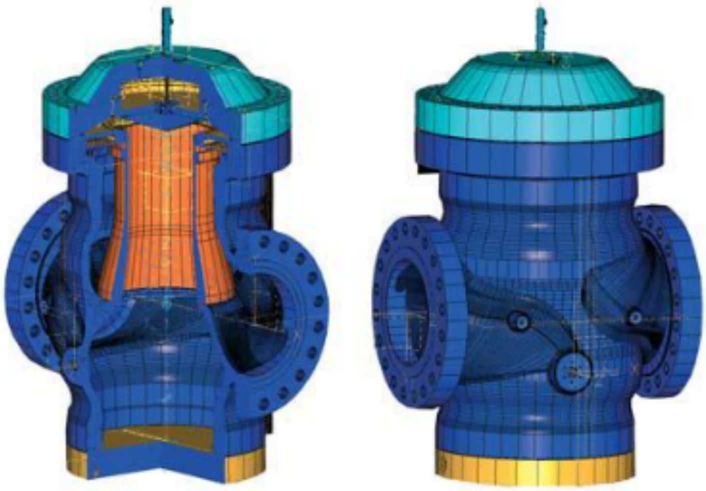


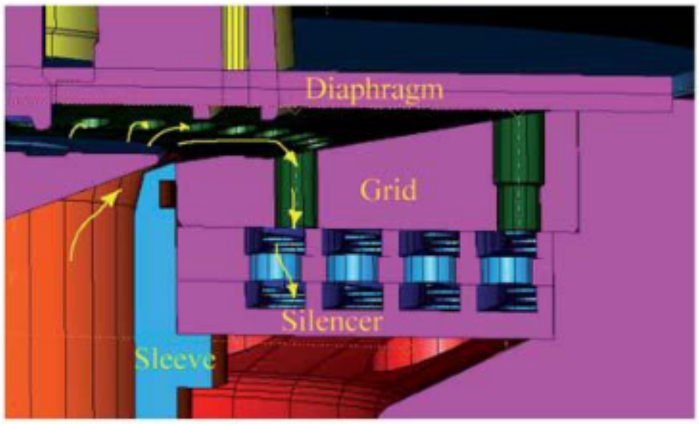
DIAPHRAGM FAIL TO OPEN

Operating principle

The opening grade of the regulator is based on the balance between the closing spring, the motorization pressure (Pm), the outlet pressure (Pd) and the inlet pressure Pu.
The motorization pressure, that operates on the diaphragm, is controlled by the pilot, that works as a discharging pneumatic relay self-operated by outlet pressure.
The pilot chamber is connected directly to downstream and its top head is always under the outlet pressure action. The pilot chamber receive the gas from the motorization chamber.
The motorization chamber is continuously fed by the inlet pressure through a needle valve.
Therefore, the pressure in the motorization chamber is regulated by the balance of the gas flowing to and from it.
The gas flowing to the chamber is controlled by the opening grade of the needle valve; the gas flowing out from the chamber is controlled by the opening grade of the pilot.
Considering the needle valve in a certain position, the pressure in the motorization chamber is controlled only by the opening grade of the pilot.
When the outlet pressure, Pd, falls below the desired value (or the flow rate increases), on the pilot, the spring force (superior to the outlet pressure force) acts on the diaphragm; the pilot opens and the motorization pressure decreases.
On the regulator, the force of inlet pressure overcomes the action of the motorization pressure force on the diaphragm. The regulator opens and the outlet pressure increases.
If the flow rate decreases, the motorization pressure increase and the regulator closes.
In no-flow condition, the regulator closes, due to the closing of the pilot and due to the needle valve, that



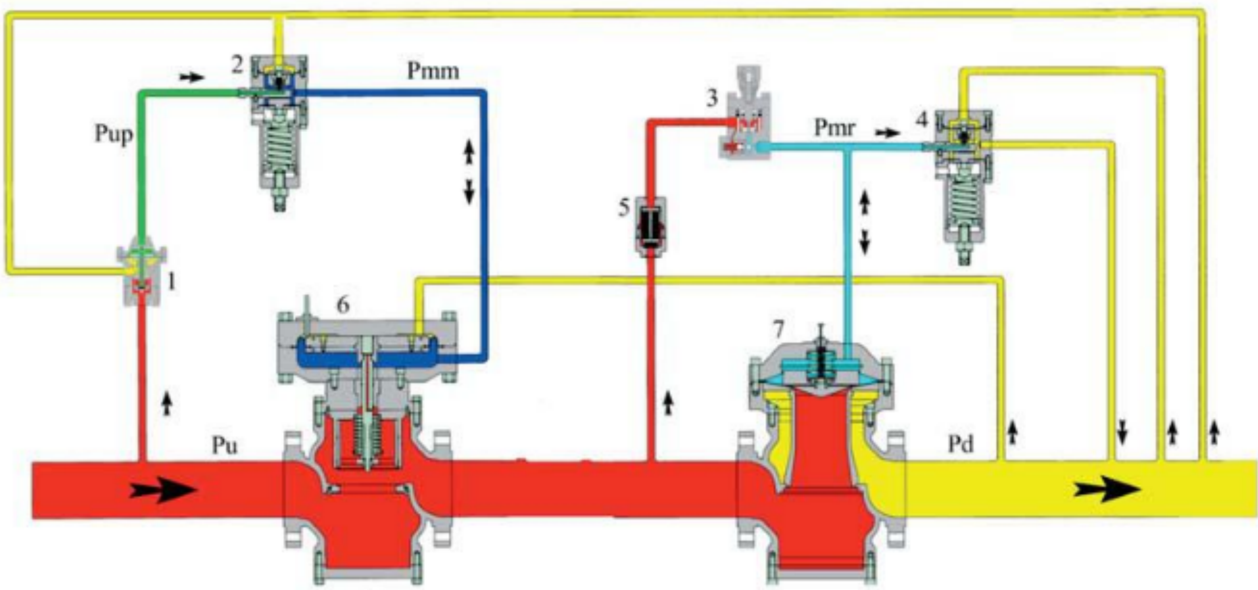




Silencer position in the Regulator DFTO

charges the motorization chambers of the regulator up to the inlet pressure.
So the outlet pressure is constantly controlled by the regulator through the action of the pilot.
In case of diaphragm breaking, the DFTO pressure regulator open. The motorization pressure is discharged to downstream through the tear, by-passing the pilot.
Needle valve functioning:
The opening and closing behaviour of the regulator depends by the opening grade of the needle valve.
A small passing section implies a reduced gas flow to the motorization chamber.
In this condition the regulator will have a quick-opening behaviour because the balance of the charging-discharging flows is shifted to the pilot side.
The complete opening of the needle valve implies the maximum gas flow to the motorization chamber.
In this condition the regulator will have a quick-closing behaviour because the balance of the charging-discharging flows is shifted to the needle valve side.

DIAPHRAGM FAIL TO OPEN
Configurations

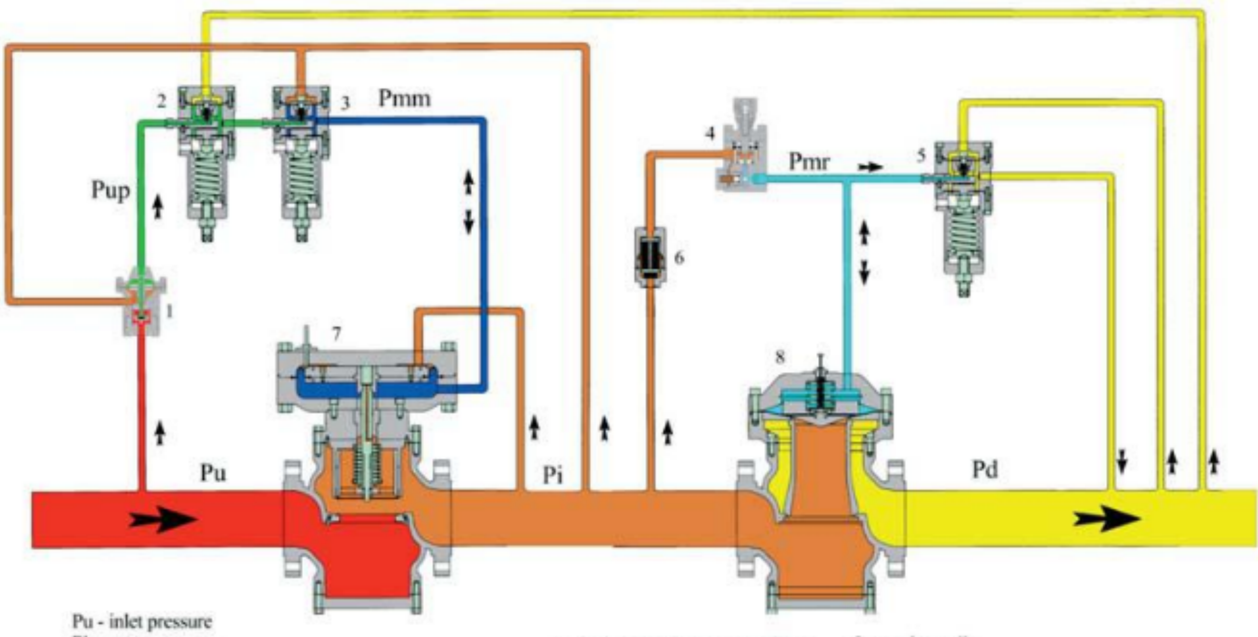


Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - monitor pilot
3 needle valve
4 - regulator pilot

5 - filter
6 - monitor
7 - regulator

Figure 6 - Operating diagram of DFTO regulator with FTC passive monitor.



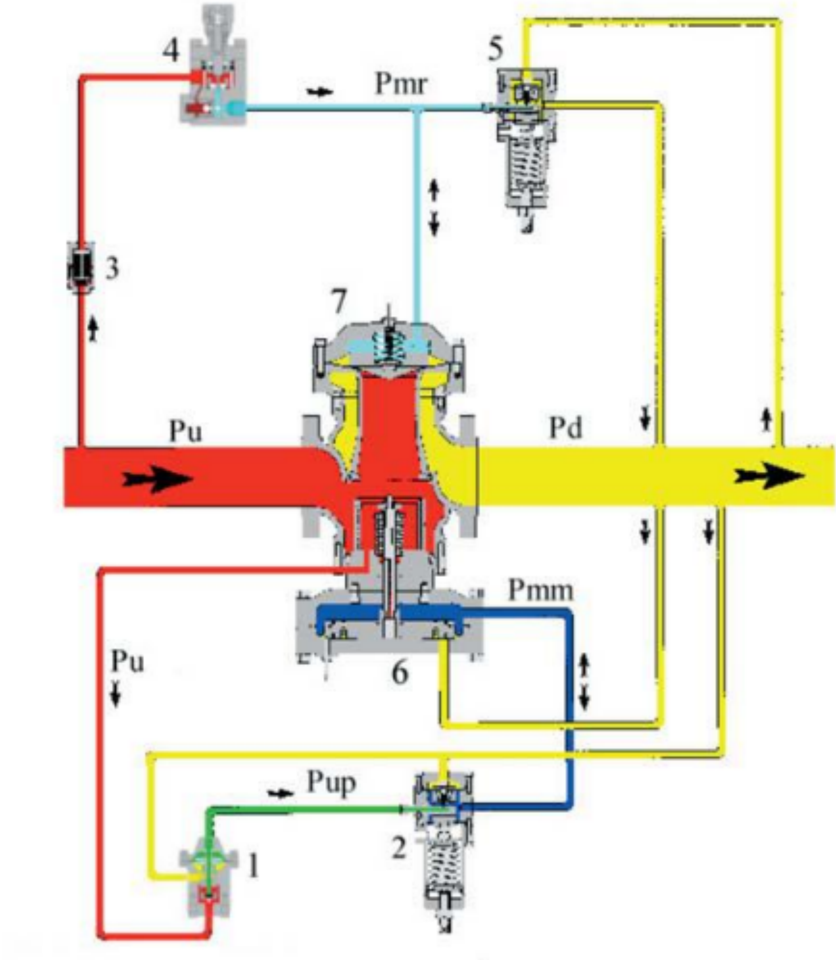
Pu - inlet pressure
Pi - mean pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - passive monitor pilot
3 - active monitor pilot
4 - needle valve

5 - regulator pilot
6 - filter
7 - monitor
8 - regulator

Figure 7 - Operating diagram of DFTO regulator with FTC active monitor.

DIAPHRAGM FAIL TO OPEN

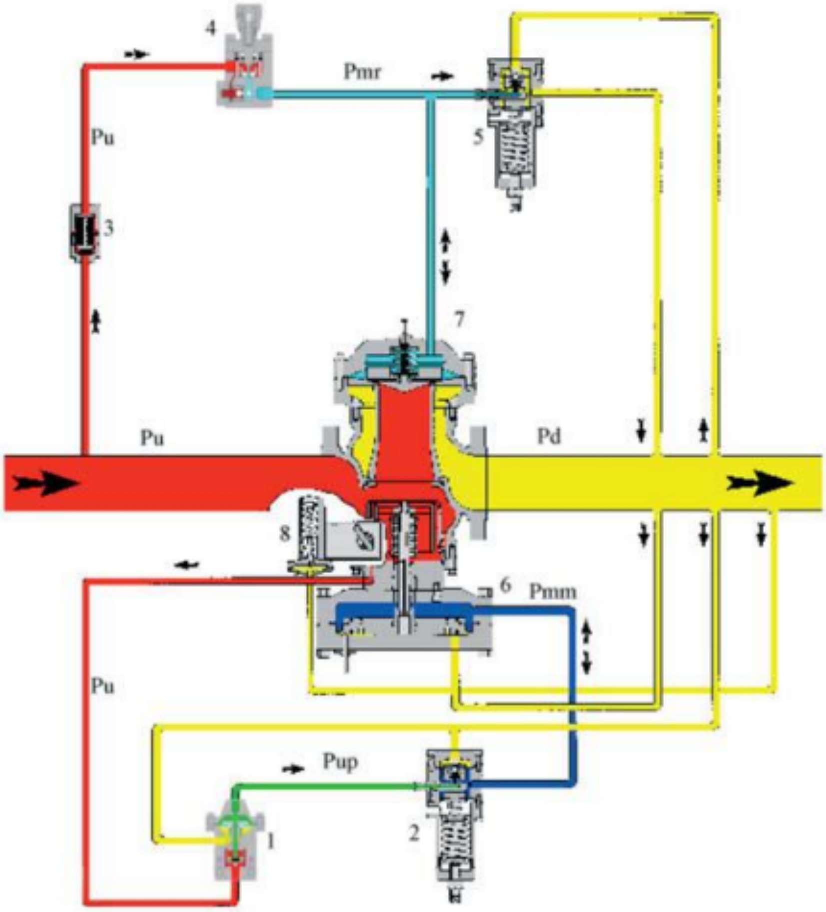


1 - feeder (with incorporated filter)
2 - monitor pilot
3 - filter
4 - needle valve

5 - regulator pilot
6 - monitor
7 - regulator

Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

Figure 8 - Operating diagram of DFTO regulator with FTC monitor built-in.



1 - feeder (with incorporated filter)
2 - monitor pilot
3 - filter
4 - needle valve
5 - regulator pilot
6 - monitor
7 - regulator
8 - shut-off device

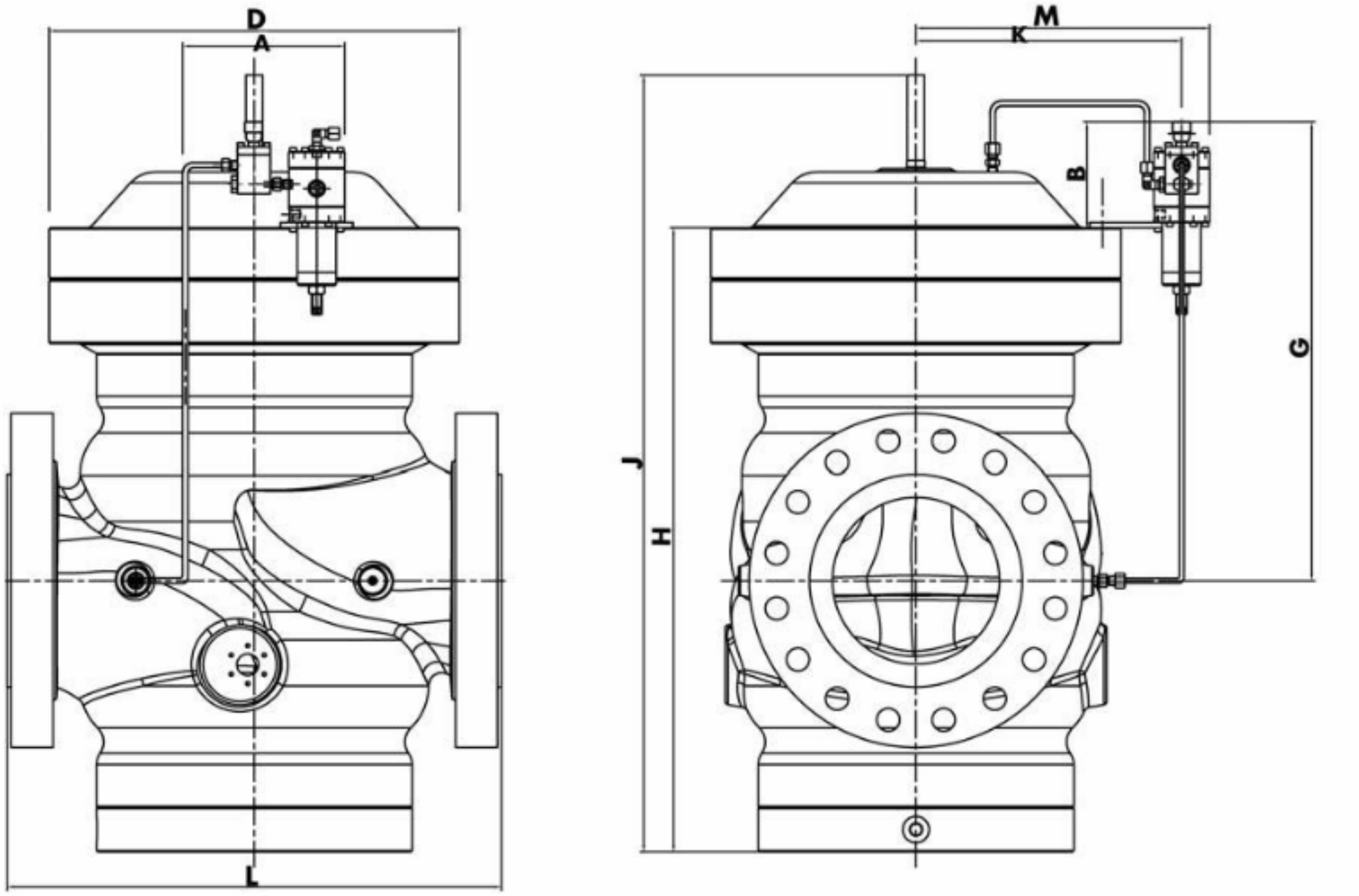
Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

Figure 9 - Operating diagram of DFTO regulator with FTC monitor and SSD built-in.

Table 3 - Spring Range of Regulator ALP2 P/AP DFTO, for *High* Outlet Pressure

Spring						Pilot type								
n°	Code	Wire	Pitch	Color		CU80 MP CB			CU80 MP DM CB			CU 80 AP CB		
		[mm]	[mm]		RAL	[bar]	[bar]	PILOTING SYSTEM	[bar]	[bar]	PILOTING SYSTEM	[bar]	[bar]	PILOTING SYSTEM
65	5ML065I5	5	11,5	Mint Green	6029	0,5	1,5	D1						
65	5ML065I5	5	11,5	Mint Green	6029	1,5	4	D1						
58	5ML058I5	6	9	Signal Yellow	1023	2	4,5	D2	2	4,5	E7			
59	5ML059I5	7	11	Light Blue	5012	4	11	D3	4	11	E5			
60	5ML060I5	7	12,5	Signal Blue	5017	6	15	D4	6	15	E4			
61	5ML061I5	8	12	Signal Red	3001	11	20	D5	12	20	E3			
62	5ML062I5	8,5	13,5	Baked -clay brown	8003				16	27	E1			
63	5ML063H8	9	13,5	Deep Black				*	20	32	E2			
64	5ML064H8	10	13,8	Off White	9010			*	32	48	E6	32	48	F1
296	5ML296I5	11	14,5	Alluminium	9006							48	60	F3
307	5ML307H8	11,5	15	Pink	3015						**	60	80	F4
336	5ML336H8	12,5	15,5	Blue-Black							**	75	95	F5

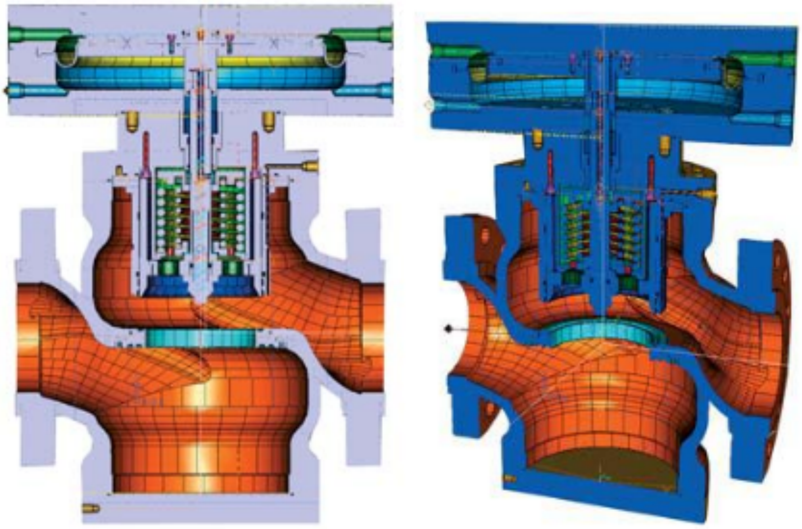
DIAPHRAGM FAIL TO OPEN



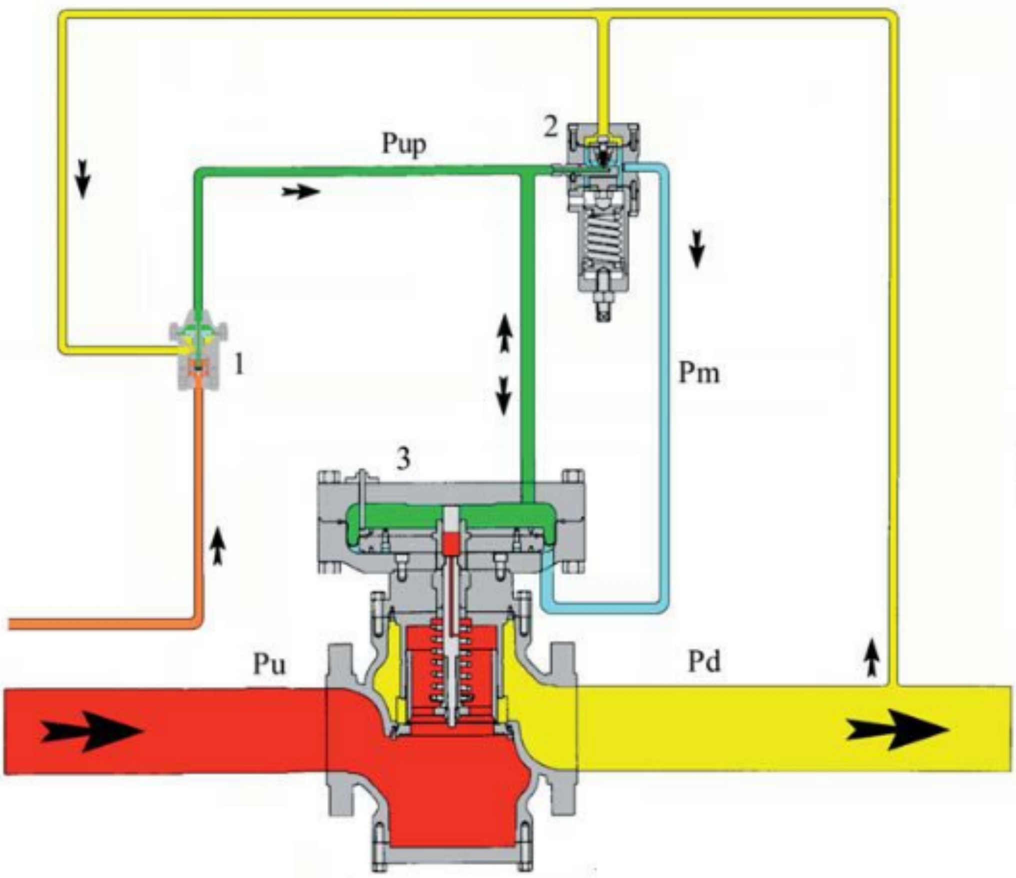
	Body length (mm) / Weight (kg)															
PN / DN	PN 16 / ANSI 150		PN 25 / PN 40		ANSI 300		ANSI 600		PN 16 to ANSI 600							
	L	W	L	W	L	W	L	W	A	B	D	G	H	J	K	M
25	184	33	197	34	197	35	210	38	250	220	178	350	225	315	247	347
50	254	57	267	58	267	60	286	65	250	220	226	380	280	380	275	370
80	298	90	317	92	317	100	337	110	250	220	272	420	350	475	292	392
100	352	140	368	143	368	150	394	165	250	220	314	455	420	545	316	411
150	451	308	473	311	473	320	508	340	250	220	406	555	590	775	359	454
200	543	598	568	602	568	620	610	660	250	220	520	670	780	970	412	507
250	673	888	708	900	708	940	752	1000	250	220	624	760	950	1190	459	554
300	737	1245	775	1270	775	1350	819	1500	250	220	720	850	1140	1410	490	585

FAIL TO OPEN

Operating Principle



The opening grade of the regulator is based on the balance between the spring force and the pressure difference between the feeding pressure (Pup) and the motorization pressure (Pm).
The motorization pressure, that operates on the diaphragm, is controlled by the pilot, that works as a pneumatic relay self-operated by outlet pressure.
The feeder supplies a constant pressure (Pup) to pilot, reducing the inlet pressure (Pu) to a valuearound 1 bar and supplementing this pressure with the outlet pressure (Pd) through an internal set spring. When the outlet pressure, Pd, falls below the desired value (or the flow rate increases), on the pilot, the spring force (superior to the outlet pressure force) acts on the diaphragm; thepilot opens and increases the motorization pressure. On the regulator, the force of this pressure (Pm) increases and overcomes the combined action of the Pup and the spring. The sleeve of the regulator increase the opening and the outlet pressure increases. If the flow rate decreases, the motorization pressure decrease and the regulator closes. In no-flow condition, the regulator closes, due to the closing of the pilot.
So the outlet pressure is constantly controlled by the regulator through the action of the pilot, independently from the inlet pressure.
In case of diaphragm breaking, the FTO pressure regulator open through the action of the internal spring. The set of the outlet pressure is obtained by operating on the pilot spring. So the pressure of the regulator depends on the pressure of the pilot.



Pu - inlet pressure
Pd - outlet pressure
Pm - motorization pressure
Pup - feeding pressure

1 - feeder (with incorporated filter)
2 - pilot
3 - regulator

FAIL TO OPEN
Configurations

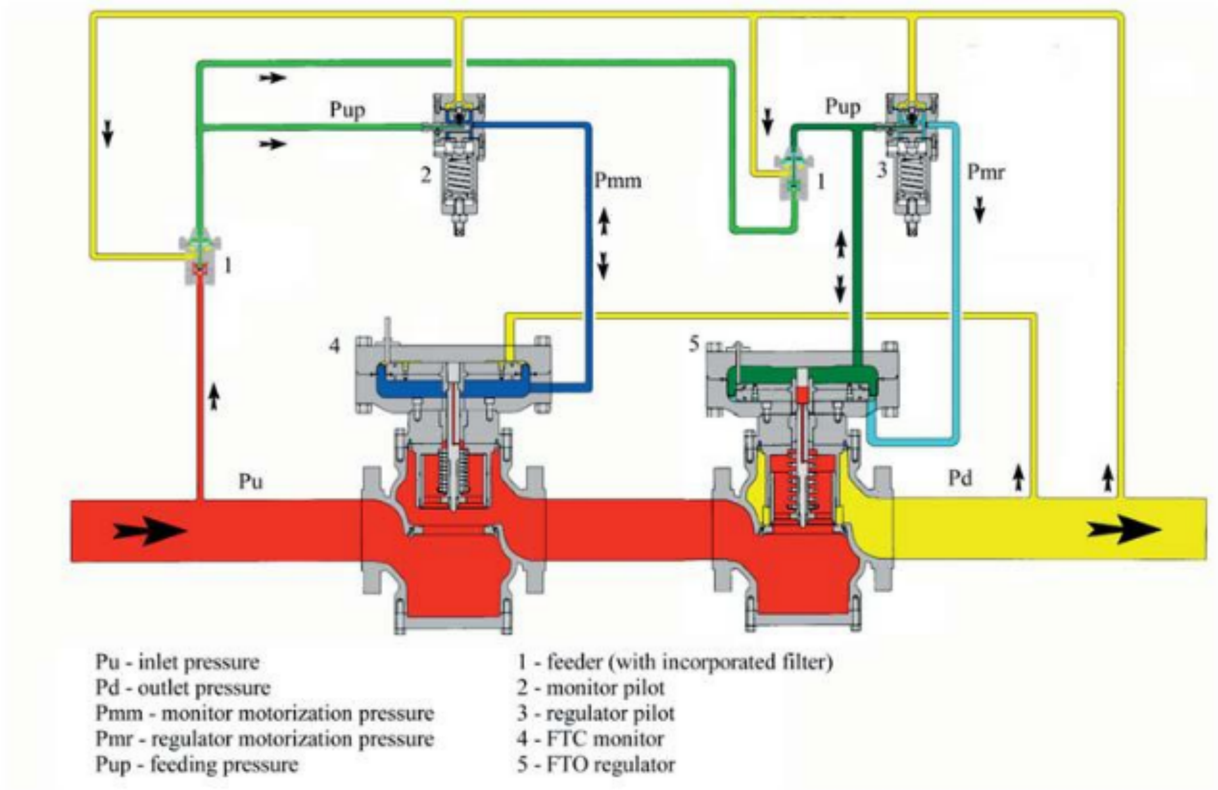


Figure 10 - Operating diagram of FTO regulator with FTC passive monitor.

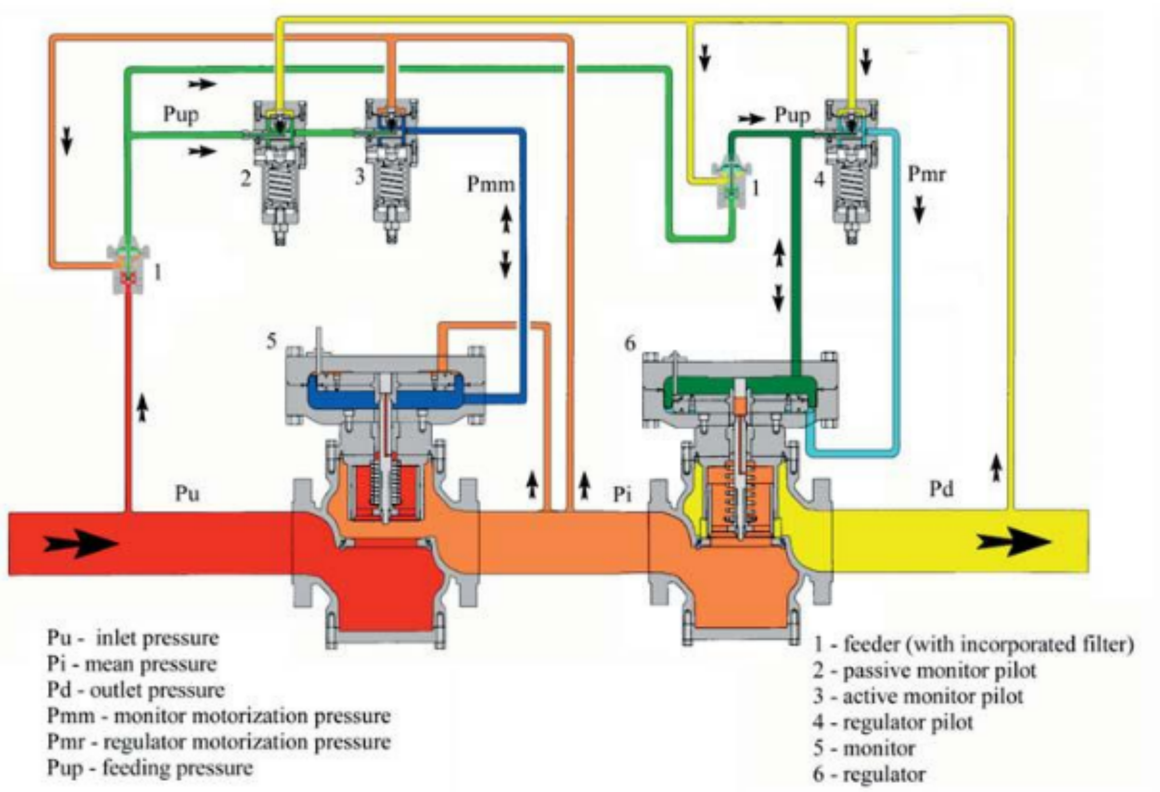


Figure 11 - Operating diagram of FTO regulator with FTC active monitor.

FAIL TO OPEN

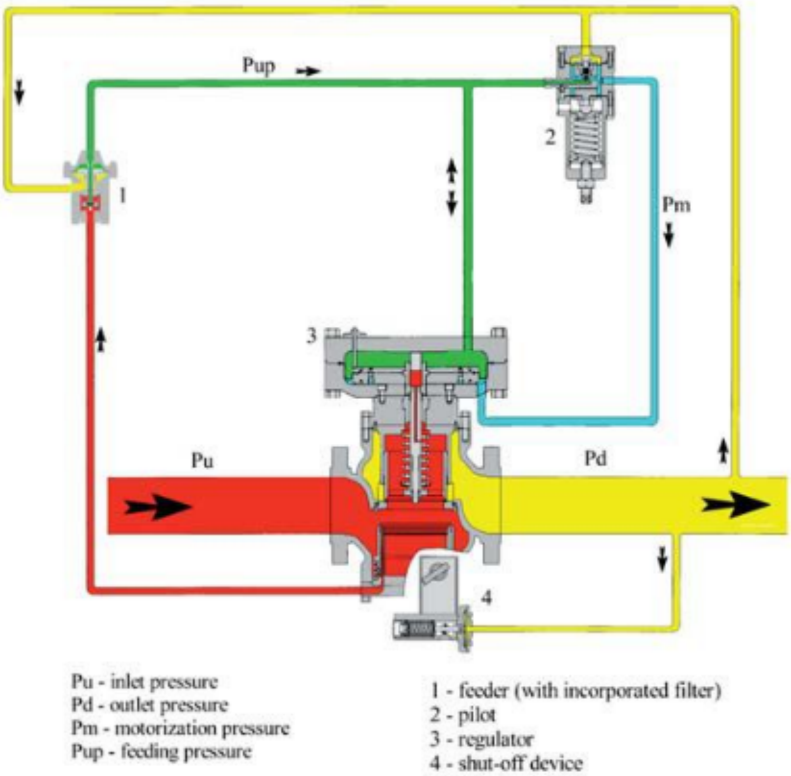


Figure 12 - Operating diagram of FTO regulator with SSD built-in.

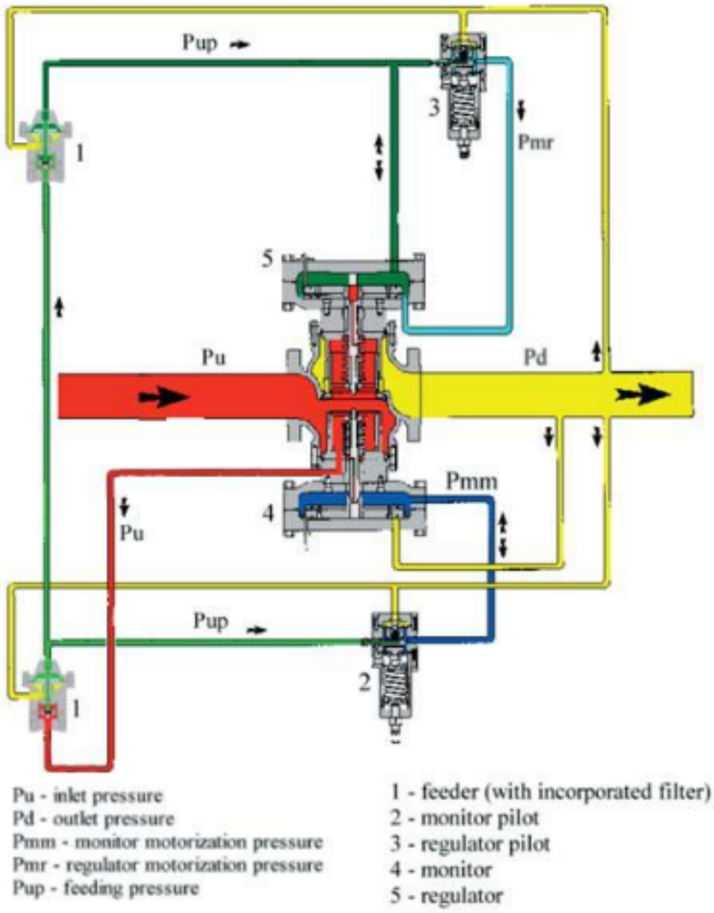


Figure 13 - Operating diagram of FTO regulator with FTC monitor built-in.

FAIL TO OPEN

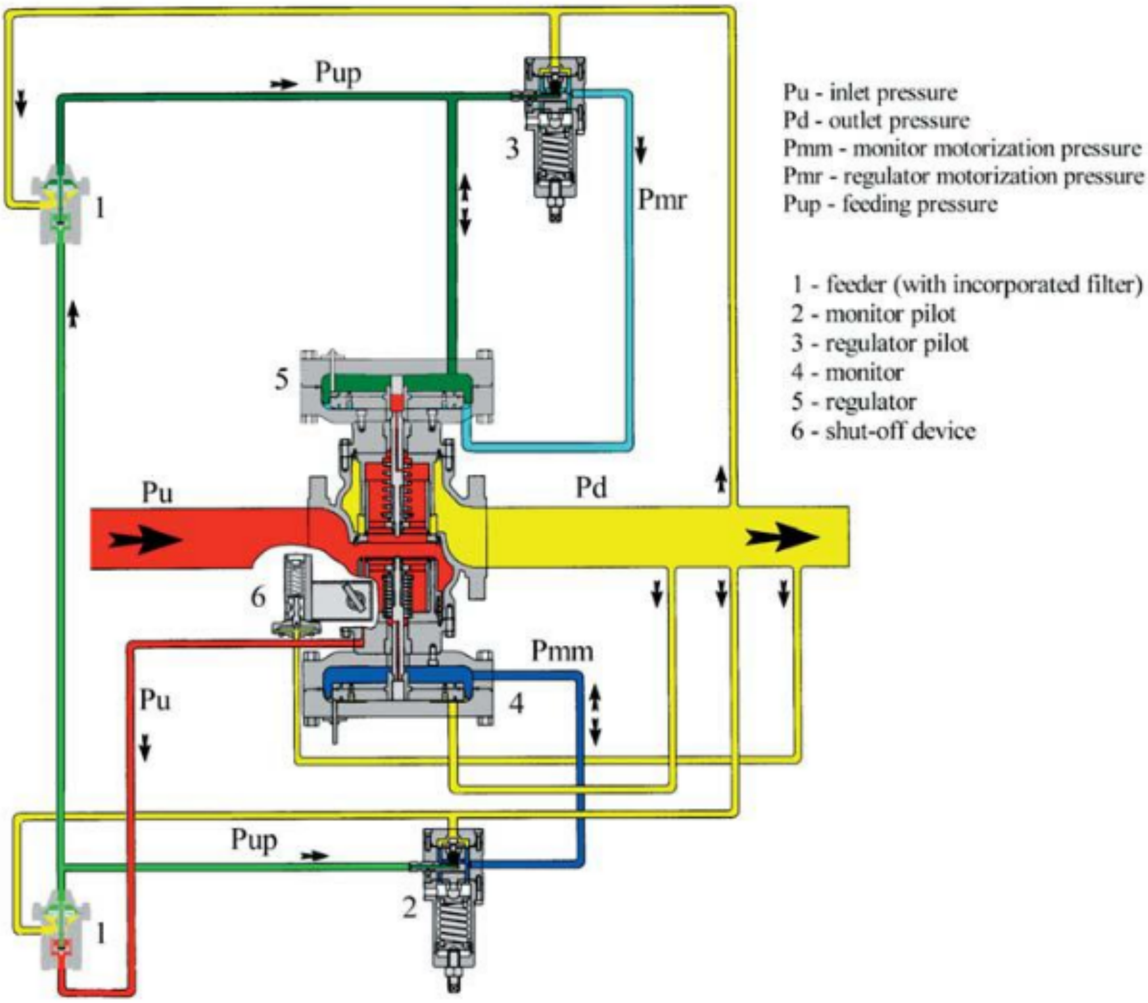
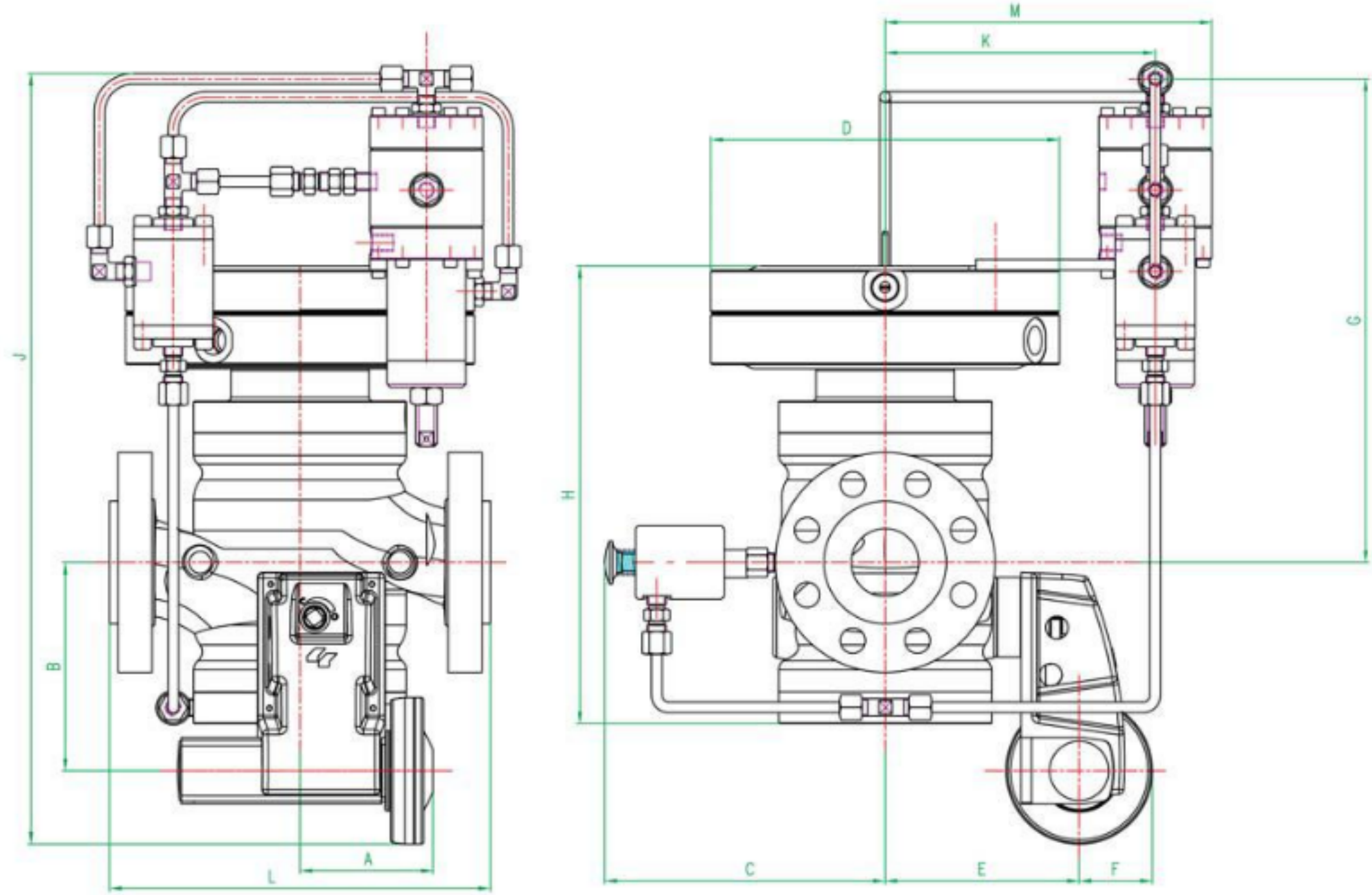


Figure 14 - Operating diagram of FTO regulator with FTC monitor and SSD built-in.

FAIL TO OPEN

Refer to table 4 (page 23) to fix the accuracy class AG value and the pressure range of SSD

Spring Range of Regulator ALP2 P/AP FTO, for High Outlet Pressure: REFER TO TABLE 2 (page 10)

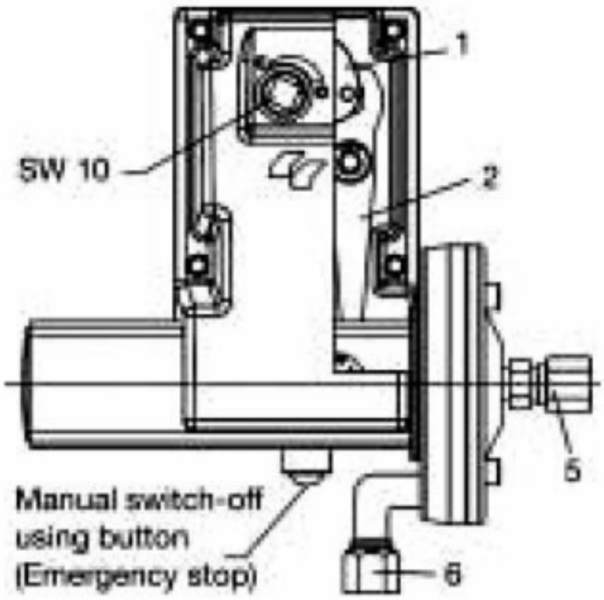


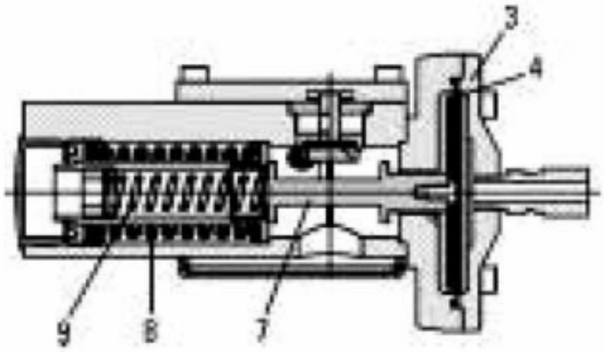
Body length (mm) / Weight (kg)																				
PN	PN 16 / ANSI 150		PN 25 / PN 40		ANSI 300		ANSI 600		PN 16 to ANSI 600											
DN	L	W	L	W	L	W	L	W	A	B	C	D	E	F	G	H	J	K	M
25	184	53	197	54	197	55	210	60	160	150	168	206	102	55	460	330	560	215	260
50	254	85	267	86	267	88	286	95	160	156	190	262	128	55	480	370	600	265	310
80	298	139	317	141	317	143	337	150	160	167	210	332	154	55	480	420	650	305	350
100	352	225	368	228	368	235	394	250	160	173	245	400	172	55	310	460	510	355	400
150	451	465	473	472	473	480	508	500	160	205	290	530	220	55	350	570	620	415	460
200	543	1025	568	1033	568	1050	610	1090	160	230	340	650	285	55	400	700	750	455	500
250	673	1770	708	1787	708	1810	752	1875	160	243	395	780	334	55	490	880	930	525	570
300	737	2575	775	2596	775	2640	819	2785	160	260	425	910	370	55	575	1050	1100	605	650

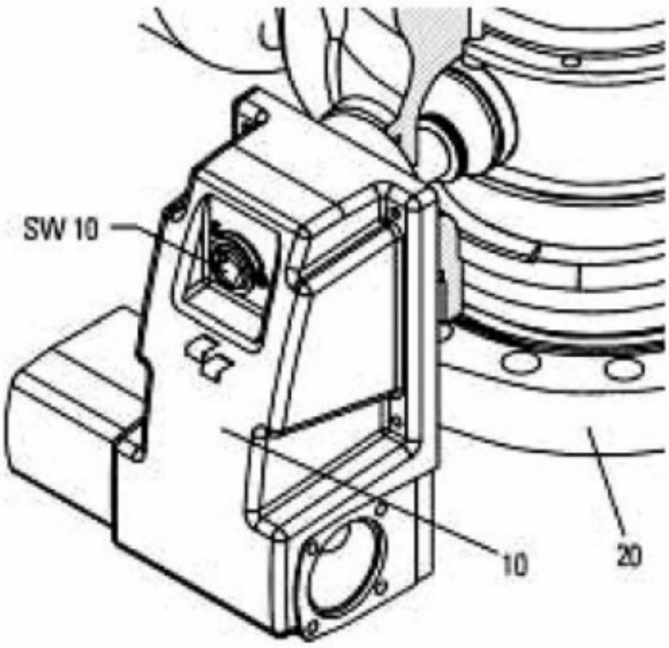
Built in shut-off device, Alphard CA

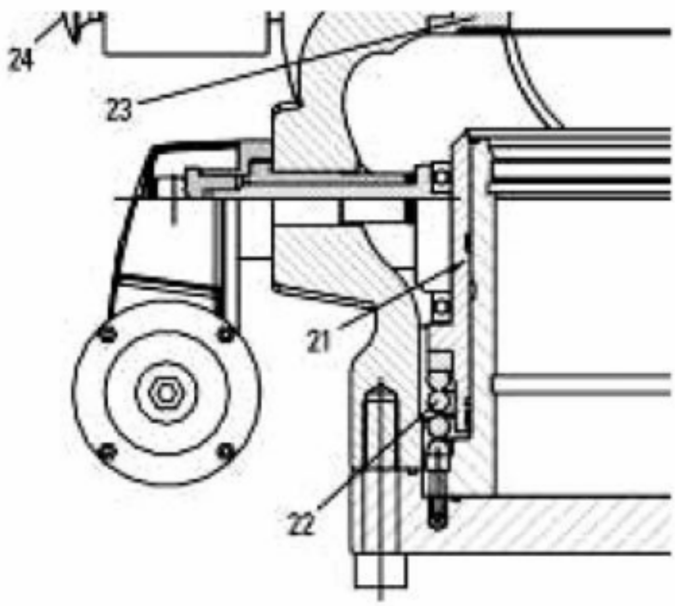
Operating principle

The safety shut-off device Alphard CA is made up of the control device (10)
and body with an integrated closing system (20).
The controlled pressure Pd is connected (5)
by a sensing line to the diaphragm (4)
of the control device (3).
The springs for higher and lower pressure shut-off are fixed to either side of the diaphragm.
Excessive or insufficient outlet pressure caused by failure of the regulation system will lift or droop the diaphragm.
A small lever opens the catch between switch lever (2) and reset lever (1).
The sliding tube (21) closes the orifice (23)
using the force of the closing spring (32).
The gas flow stops. To reset the closed SSD, pressure compensation is necessary first by operating the self-closing bypass valve (24).
Afterwards, the outlet pressure closes the control device (3).
The reset lever (1) is operated by turning a square socket key clockwise (square diameter 10 mm).
After resetting the valve, the key should be removed.



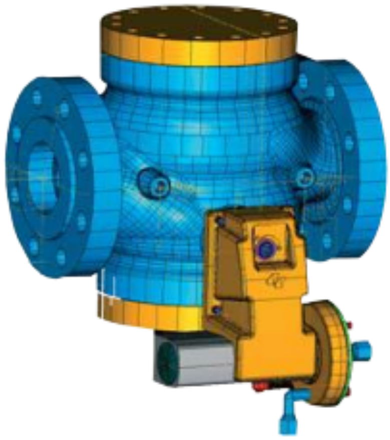






ALPHARD CA

Safety Shut-off Valve



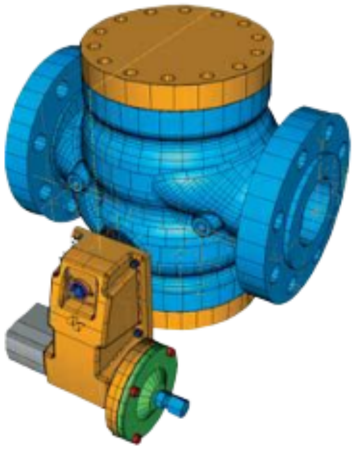
Applications

This shut-off valve is designed for transmission and distribution networks, as well as commercial and industrial supplies.

Description

The ALPHARD CA is a shut-off valve for over-pressure and under-pressure shut-off.
It automatically stops the gas flow when the outlet pressure of the regulator deviates from the acceptable valuee.

- Accurate Shut-Off
- Easy maintenance
- Small dimension
- DVGW approval
- CE approval



Technical Features

Inlet pressure range	Pu: up to 100 bar
OPSO* range	Pso: 13 mbar – 76 bar
UPSO* range	Psu: 8 mbar – 29 bar
Accuracy class AG	up to 1
Operating temperature	-20°C to +60°C
Acceptable gases	Natural gas, propane, butane, air, nitrogen and all non-corrosive gases
Options	Solenoid remote-release at power flow and/or power failure. Electrical transmission of the SSV position indication by the pulse transmitter.

* OPSO / UPSO: Over- and under-pressure shut-off

Sizes & Connections

Sizes	DN 25, 50, 80, 100, 150, 200, 250, 300
Orifice diameter (mm)	Ø 25, 51, 76, 102, 152, 203, 254, 305
Flanges	PN16, 25, 40, 64, 100
	ANSI 150, 300, 400, 600

Materials

Body	ASTM A352 LCB
Actuator SSV	Carbon Steel (cataforesis protected), ASTM A350 LF2
Sliding tube	Carbon Steel, cataforesis protected
Internal parts	Carbon Steel, cataforesis protected/Stainless steel
Sealing parts	NBR rubber/Viton
Trim	Stainless Steel

Operating Principle

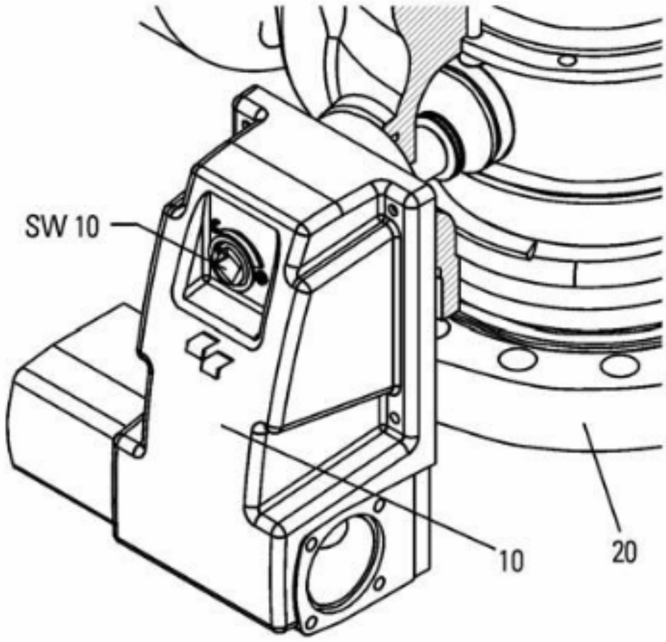
The safety shut-off valve ALPHARD CA is made up of the control device (10) and body with an integrated closing system (20). The controlled pressure po is connected (5) by a sensing line to the diaphragm (4) of the control device (3).

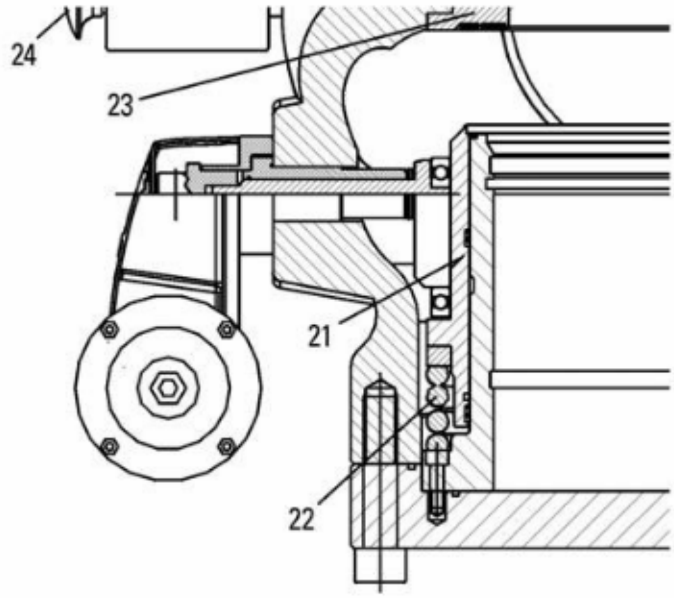
The springs for higher and lower pressure shut-off are fixed to either side of the diaphragm. Excessive or insufficient outlet pressure caused by failure of the regulation system will lift or droop the diaphragm. A small lever opens the catch between switch lever (2) and reset lever (1). The sliding tube (21) closes the orifice (23) using the force of the closing spring (32).

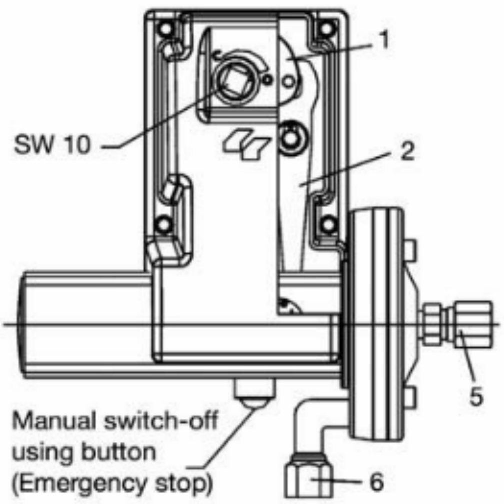
The gas flow stops.
For reset of the closed SSV, the pressure compensation is to make before by the self closing bypass valve (24). Afterwards, the outlet pressure is to discontinue on the control device (3).

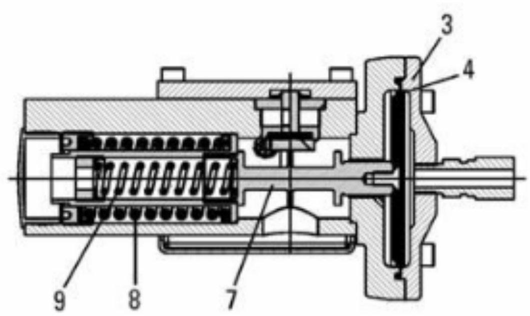
To reset the closed SSV, pressure compensation is necessary first by operating theself-closing bypass valve (24).
Afterwards, the outlet pressure closes the control device (3).

The reset lever (1) is operated by turning a square socket key clockwise (square diameter 10 mm).









FAIL TO CLOSE

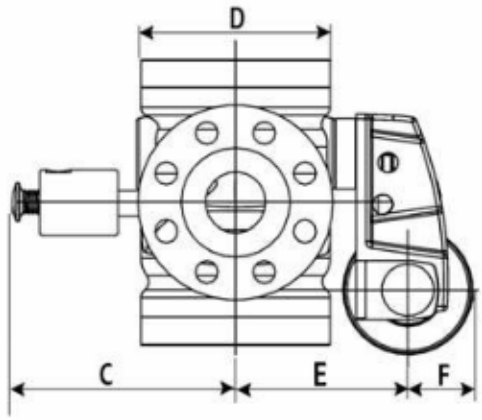
Table 4 - Closing group AG of SSD

SPRING TABLE FOR SSV								
	MIN PRESSURE SET				MAX PRESSURE SET			
MODEL	Spring n°	Min set [bar]	Max set [bar]	Δpw [bar]	Spring n°	Min set [bar]	Max set [bar]	Δpw [bar]
CA 15	261	1,90	6,50	1,50				
	262	4,00	12,60	2,00				
	263	5,70	19,00	2,50				
	264	12,00	29,00	3,50				
					267	2,90	10,00	1,50
					268	6,00	22,00	2,00
					269	13,00	40,00	3,50
					270	28,00	76,00	4,00
CA 30	261	0,80	1,70	0,40				
	262	1,40	3,00	0,60				
	263	2,50	4,40	0,70				
	264	3,80	7,00	1,00				
					267	1,00	2,40	0,40
					268	1,80	4,75	0,60
					269	3,90	9,80	0,80
					270	8,00	18,20	1,30
CA 40	260	0,13	0,32	0,08				
	261	0,25	0,90	0,12				
	262	0,50	1,80	0,20				
	263	0,80	2,50	0,30				
	264	2,00	4,00	0,50				
					266	0,20	0,60	0,10
					267	0,50	1,70	0,20
					268	1,00	3,50	0,30
					269	2,00	6,00	0,50
					270	4,50	10,20	1,00
CA 77	259	0,008	0,044	0,012				
	260	0,034	0,122	0,015				
	261	0,086	0,260	0,02				
	262	0,215	0,450	0,05				
	263	0,380	0,660	0,06				
	264	0,580	1,050	0,09				
					265	0,013	0,05	0,008
					266	0,04	0,13	0,02
					267	0,1	0,35	0,024
					268	0,27	0,72	0,04
					269	0,59	1,2	0,09

Dimensions & weights

PN 16 / ANSI 150

DN	Dimensions (mm)								Weights (kg)
	A	B	C	D	E	F	H	L	
25	160	150	168	112	102	55	200	184	17
50	160	156	190	160	128	55	270	254	29
80	160	167	210	200	154	55	340	298	56
100	160	173	245	236	172	55	400	352	83
150	160	205	290	326	220	55	550	451	220
200	160	230	340	404	285	55	700	543	375
250	160	243	395	480	334	55	880	673	650
300	160	260	425	600	370	55	1050	737	900

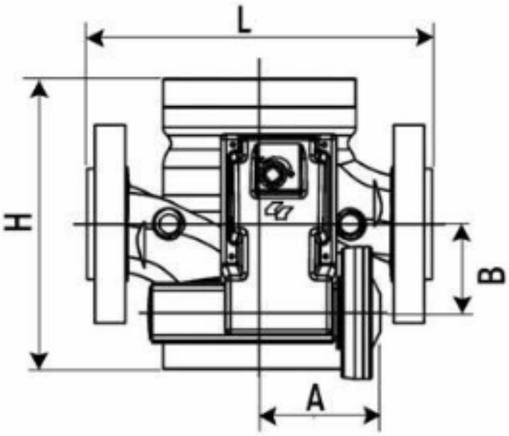


PN 25 / PN 40 / ANSI 300

DN	Dimensions (mm)								Weights (kg)
	A	B	C	D	E	F	H	L	
25	160	150	168	112	102	55	200	197	18
50	160	156	190	160	128	55	270	267	32
80	160	167	210	200	154	55	340	317	60
100	160	173	245	236	172	55	400	368	93
150	160	205	290	326	220	55	550	473	232
200	160	230	340	404	285	55	700	568	400
250	160	243	395	480	334	55	880	708	690
300	160	260	425	600	370	55	1050	775	970

ANSI 600

DN	Dimensions (mm)								Weights (kg)
	A	B	C	D	E	F	H	L	
25	160	150	168	112	102	55	200	210	20
50	160	156	190	160	128	55	270	286	40
80	160	167	210	200	154	55	340	337	66
100	160	173	245	236	172	55	400	394	110
150	160	205	290	326	220	55	550	508	250
200	160	230	340	404	285	55	700	610	440
250	160	243	395	480	334	55	880	752	750
300	160	260	425	600	370	55	1050	819	1120



Pressure Loss

The design of the SSV ALPHARD CA has a low pressure loss.
For calculation is to take the following formula:
Pressure loss for Natural gas rn = 0.78kg/m³

Formula $\Delta p \text{ (P inlet - P outlet)} = \left(\frac{Q}{Cg}\right)^2 \times \frac{1}{\text{Pi abs}} = \text{[bar]}$

Cg Factor

DN	25	50	80	100	150	200	250	300
Cg	630	2590	5175	9775	19435	33350	54000	77000

Example:

Pu = 3.0 bar
Q = 600 m³/h Natural gas
DN 50
Δp = ?

$$\Delta p = \left(\frac{600}{2590}\right)^2 \times \frac{1}{4} = 0.0134 \text{ bar}$$

SIRIO P/AP
Pressure Regulator

Applications

It is designed for use in transmission and distribution networks, as well as commercial and industrial supplies.

Sirio P/AP

- Accurate control
- Easy maintenance
- Monitor application
- CE approval

Description

The SIRIO P/AP is a pilot-operated regulator, axial type FTC (fail to close), or FTO (fail to open). The pilot and feeder system supplies constant outlet pressure when the inlet pressure and/or the flow rate varies.

Technical Features

Inlet pressure range	Pu: 1-100 bar
Outlet pressure range	Pd: 0.5 bar – 95 bar
Minimal differential pressure	up: 0.5 to 1.5 bar, depend on the application
Flow rate	up to 1.500.000 Sm^3/h Natural gas
Accuracy class AC	up to 1
Closing Pressure Class SG	depending on outlet pressure
Operating temperature	-20°C to +60°C
Acceptable gases	Natural gas, propane, butane, air, nitrogen and all non-corrosive gases
Option	Internal Silencer, Limit Switch, Position Transmitter Pneumatic and remote control devices

Sizes & Connections

Sizes	DN 25, 50, 80, 100, 150, 200, 250, 300
Face To Face Dimensions	According to EN334
Flanges	PN16, 25, 40, 64, 100 ANSI 150, 300, 400, 600

Materials

Body	Carbon Steel
Actuator regulator	Carbon Steel (cataforesis protected)
Pilot/Feeder	Carbon Steel, cataforesis protected/Stainless steel
Sealing Parts	NBR rubber/NBR rubber, reinforced fabric
Trim	Stainless steel

Regulator sizing

To choose the pressure regulator, it is possible to use the following equations, on the basis of flow coefficient Cg:

a) $\frac{P_u - P_d}{P_u + P_b} \leq 0.5$: sub-critical conditions

$$Q = \frac{13.57}{\sqrt{d \cdot (t_u + 273)}} \cdot C_g \cdot \frac{P_u + P_b}{2} \cdot \sin\left[K_1 \cdot \sqrt{\frac{P_u - P_d}{P_u + P_b}}\right]_{deg}$$

b) $\frac{P_u - P_d}{P_u + P_b} > 0.5$: critical conditions

$$Q = \frac{13.57}{\sqrt{d \cdot (t_u + 273)}} \cdot C_g \cdot \frac{P_u + P_b}{2}$$

Where:

Q = flow rate in Nmc/h
d = relative density
t_u = gas temperature at the inlet of the regulator in °C
P_u = inlet pressure in barg
P_d = outlet pressure in barg
P_b = ambient atmospheric pressure in barg
K_1 = body shape factor

FLOW COEFFICIENT AND BODY SHAPE FACTOR OF REGULATOR								
Nominal Diameter (mm)	25	50	80	100	150	200	250	300
Nominal Diameter (inches)	1”	2”	3”	4”	6”	8”	10”	12”
Cg	600	2250	4800	8900	17400	31200	48750	70000
K_1	113.5	125.6	118.6	130.4	122	122	122	122

For natural gas, the relative density is d = 0.6. For gas with a different relative density δ, the value Q to be multiplied by a factor f:

$$f = \sqrt{\frac{0.6}{\delta}}$$

Gas type	***Relative Density*** δ	***Factor*** f ***(at 15°C)***
Air	1	0.78
Butane	2	0.55
Propane	1.53	0.63
Carbon Dioxide	1.52	0.63
Nitrogen	0.97	0.79

Example N°1:

$P_u = 12$ bar
$P_d = 8$ bar
$d = 0.6$
$t_u = 15°C$
$Q = 10000$ Nmc/h

$$\frac{P_u - P_d}{P_u + P_b} = \frac{12-8}{12+1} = 0.31 < 0.5 : \text{sub-critical conditions}$$

$$C_g = \frac{Q \cdot \sqrt{d \cdot (t_u + 273)}}{13.57} \cdot \frac{2}{P_u + P_b} \cdot \frac{1}{\sin\left[K_1 \cdot \sqrt{\frac{P_u - P_d}{P_u + P_b}}\right]_{deg}}$$

Cg = 1610 → **DN = 50**

Example N°2:

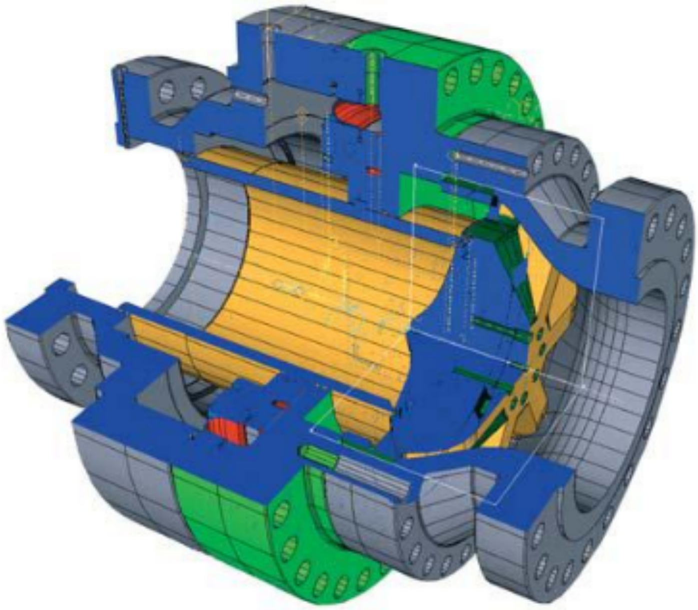
$P_u = 32$ bar
$P_d = 8$ bar
$d = 0.6$
$t_u = 15°C$
$Q = 25000$ Nmc/h

$$\frac{P_u - P_d}{P_u + P_b} = \frac{32-8}{32+1} = 0.73 > 0.5 : \text{critical conditions}$$

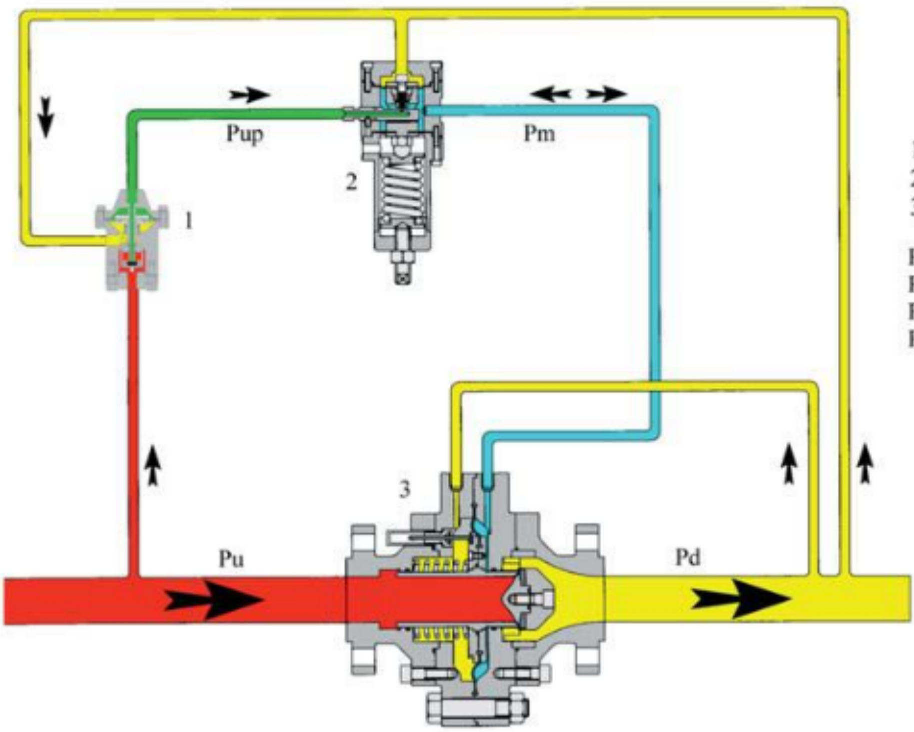
$$C_g = \frac{Q * \sqrt{d \cdot (t_u + 273)}}{13.57} \cdot \frac{2}{P_u + P_b}$$

Cg = 1468 → **DN = 50**

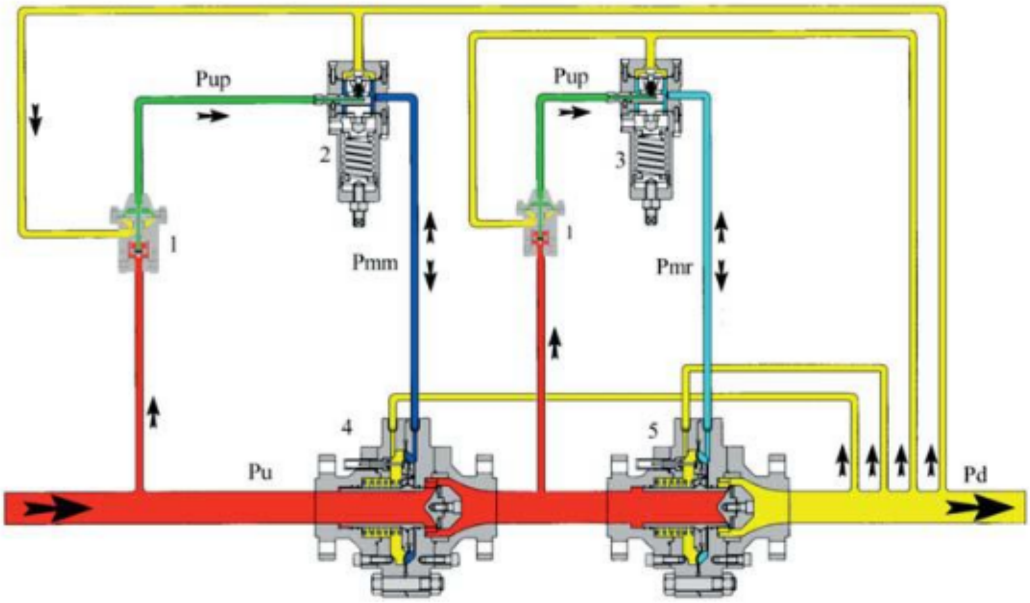
FAIL TO CLOSE - Operating Principle



The opening grade of the regulator is based on the balance between the closing spring and the pressure difference between the outlet pressure (Pd) and the motorization pressure (Pm).
The motorization pressure, that operates on the diaphragm, is controlled by the pilot, that works as a pneumatic relay self-operated by outlet pressure.
The feeder supplies a constant pressure (Pup) to pilot, reducing the inlet pressure (Pu) to a value around 1 bar and supplementing this pressure with the outlet pressure (Pd) through an internal set spring.
When the outlet pressure, Pd, falls below the desired value (or the flow rate increases), on the pilot, the spring force (superior to the outlet pressure force) acts on the diaphragm; the pilot opens and increases the motorization pressure.
On the regulator, the force of this pressure (Pm) increases and overcomes the combined action of the Pd and the spring. The sleeve of the regulator increase the opening and the outlet pressure increases.
If the flow rate decreases, the motorization pressure decrease and the regulator closes.
In no-flow condition, the regulator closes, due to the closing of the pilot; the motorization pressure and the outlet pressure become the same value.
So the outlet pressure is constantly controlled by the regulator through the action of the pilot, independently from the inlet pressure.
In case of diaphragm breaking, the FTC pressure regulator closes through the action of the internal spring.
The set of the outlet pressure is obtained by operating on the pilot spring. So the pressure of the regulator depends on the pressure of the pilot.



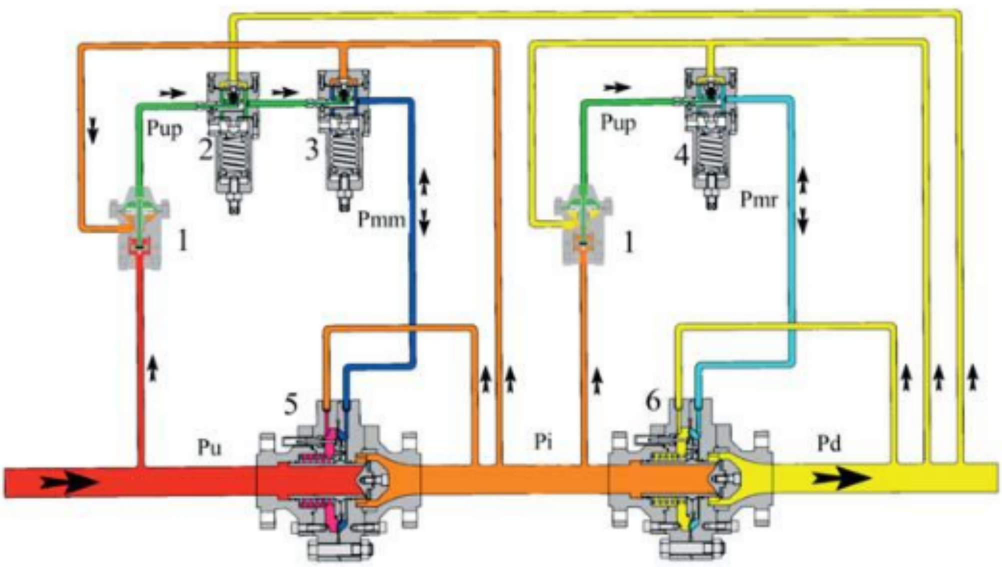
FAIL TO CLOSE
Configurations



1 - feeder (with incorporated filter)
2 - monitor pilot
3 - regulator pilot
4 - monitor
5 - regulator

Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

Figure 15 - Operating diagram of Sirio FTC regulator with Sirio FTC passive monitor.



1 - feeder (with incorporated filter)
2 - passive monitor pilot
3 - active monitor pilot
4 - regulator pilot
5 - monitor
6 - regulator

Pu - inlet pressure
Pi - mean pressure
Pd - outlet pressure
Pmm - monitor regulating pressure
Pmr - worker regulating pressure
Pup - feeding pressure

Figure 16 - Operating diagram of Sirio FTC regulator with FTC active monitor.

FAIL TO CLOSE

Pressure range

Feeder- / Regulator-type	Inlet pressure (bar)	Outlet pressure (bar)
AL 30 / CU 120	0.5 - 40.0	0.01 - 1.0
AL 30 / CU 80 MP	1.0 - 100	0.2 - 20.0
AL 30 / CU 80 MP DM	7.0 - 100	6.0 - 48.0
AL 20 / CU 80 AP	21.0 - 100	32.0 - 95.0

KG-factor and orifice diameter

DN	Orifice diameter (mm)	Kg-factor (m3/h/bar) natural gas
25	25	566
50	51	2322
80	76	4644
100	102	8772
150	152	17441
200	203	29928
250	254	48504
300	305	69144

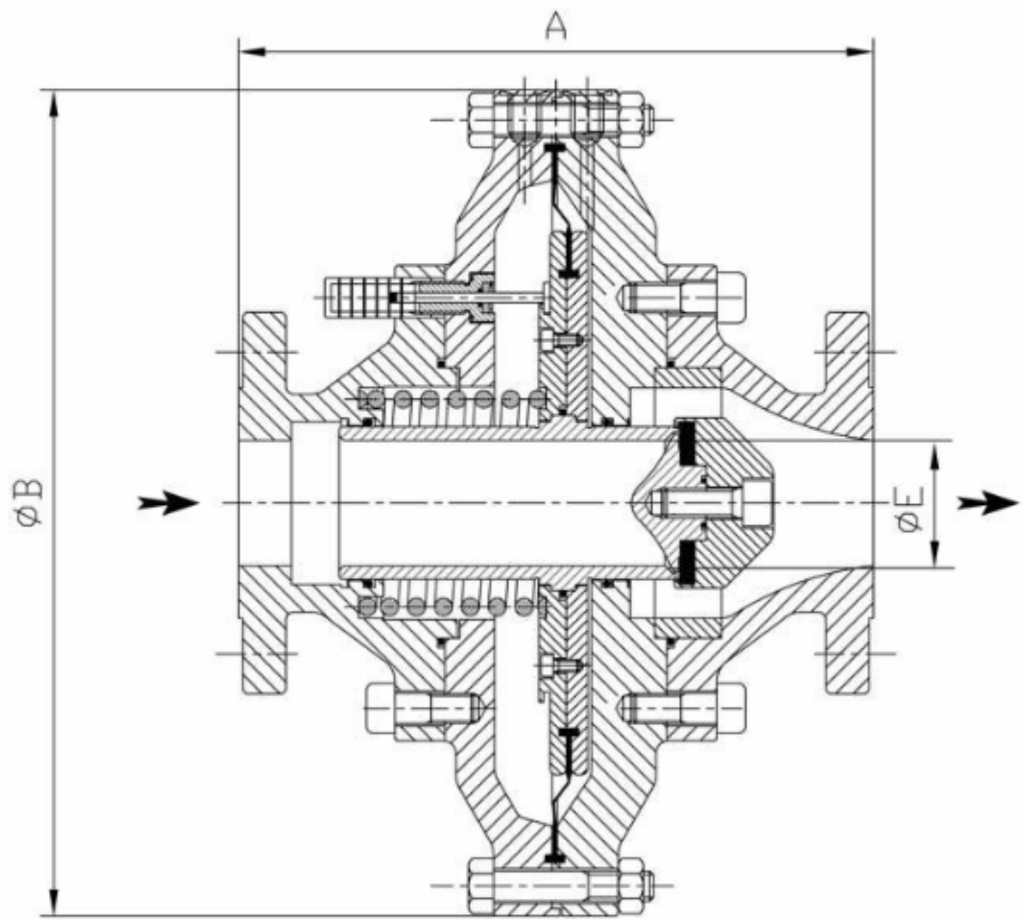
FAIL TO CLOSE

Spring Range of Regulator SIRIO P/AP FTC, for High Outlet Pressure:
REFER TO TABLE 2 (page 10)

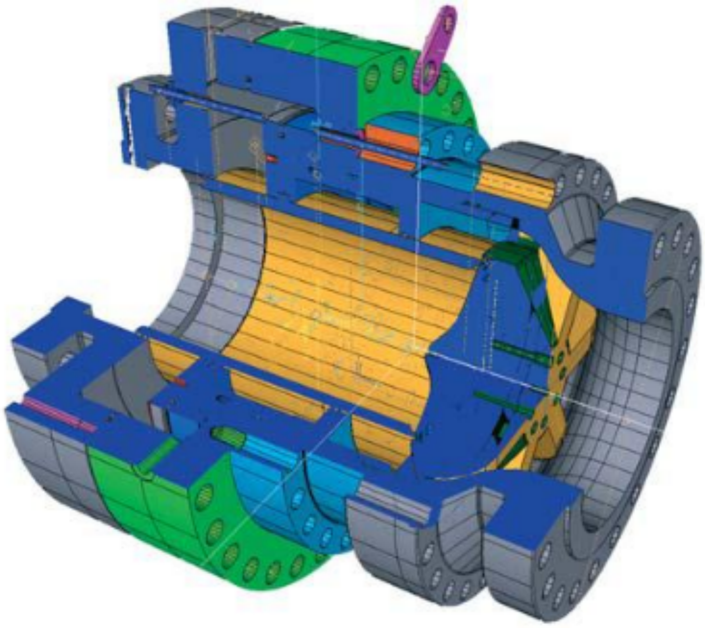
Dimensions and Weights of the regulator

Weights W (kg)			
DN	ANSI 150	ANSI 300	ANSI 600
50	60	60	60
80	110	110	110
100	150	150	150
150	340	340	340
200	450	700	700
250	650	1000	1000
300	870	1400	1500

Dimensions (mm)				
DN	CLASS ANSI	A	B	E
50	150	254	330	51
80	150	299	340	76
100	150	352	460	102
150	150	451	545	152
200	150	543	750	203
250	150	672	720	254
300	150	737	950	305
DN 50	300	267	280	51
DN 80	300	318	340	76
DN 100	300	368	400	102
DN 150	300	473	545	152
DN 200	300	568	650	203
DN 250	300	708	720	254
DN 300	300	775	850	305
DN 50	600	286	280	51
DN 80	600	337	340	76
DN 100	600	394	400	102
DN 150	600	508	545	152
DN 200	600	610	650	203
DN 250	600	752	720	254
DN 300	600	819	850	305



FAIL TO OPEN - Operating Principle



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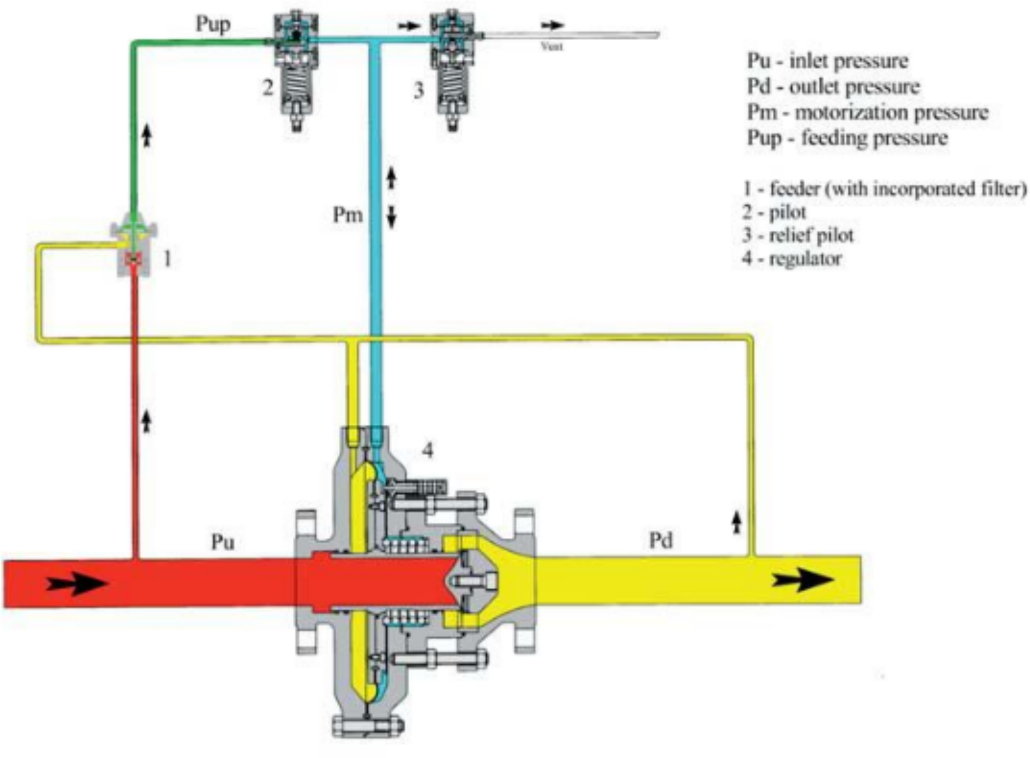
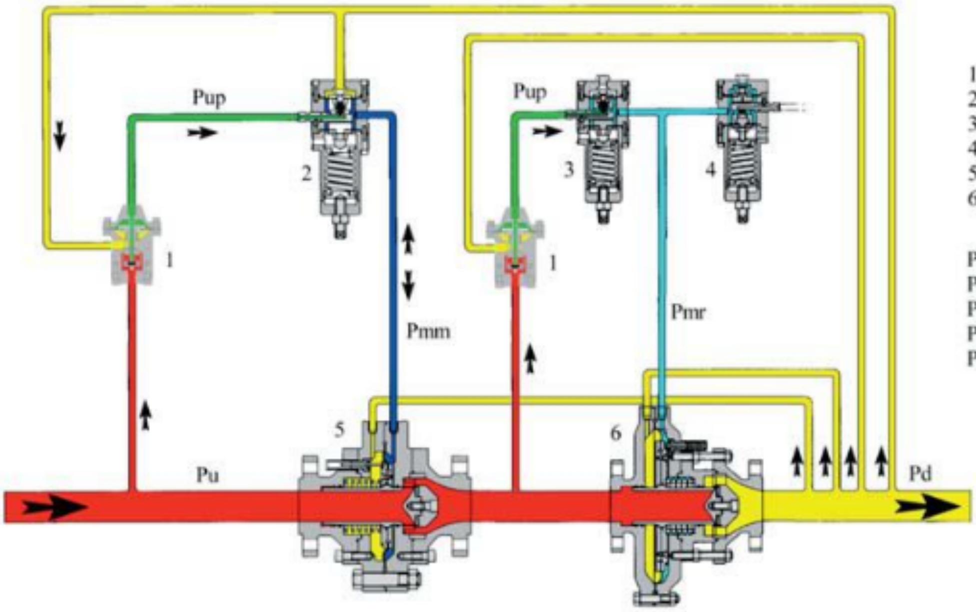
The feeder supplies a constant pressure (Pup) to pilot, reducing the inlet pressure (Pu) to a value around 1 bar and supplementing this pressure with the outlet pressure (Pd) through an internal set spring.
When the outlet pressure, Pd, falls below the desired value (or the flow rate increases), on the pilot, the spring force (superior to the outlet pressure force) acts on the diaphragm; the pilot opens and increases the motorization pressure.
On the regulator, the force of this pressure (Pm) increases and overcomes the combined action of the Pd and the spring. The sleeve of the regulator increase the opening and the outlet pressure increases.
If the flow rate decreases, the motorization pressure decrease and the regulator closes.
In no-flow condition, the regulator closes, due to the closing of the pilot; the motorization pressure and the outlet pressure become the same value.

So the outlet pressure is constantly controlled by the regulator through the action of the pilot, independently from the inlet pressure.
In case of diaphragm breaking, the FTC pressure regulator closes through the action of the internal spring.
The set of the outlet pressure is obtained by operating on the pilot spring. So the pressure of the regulator depends on the pressure of the pilot.



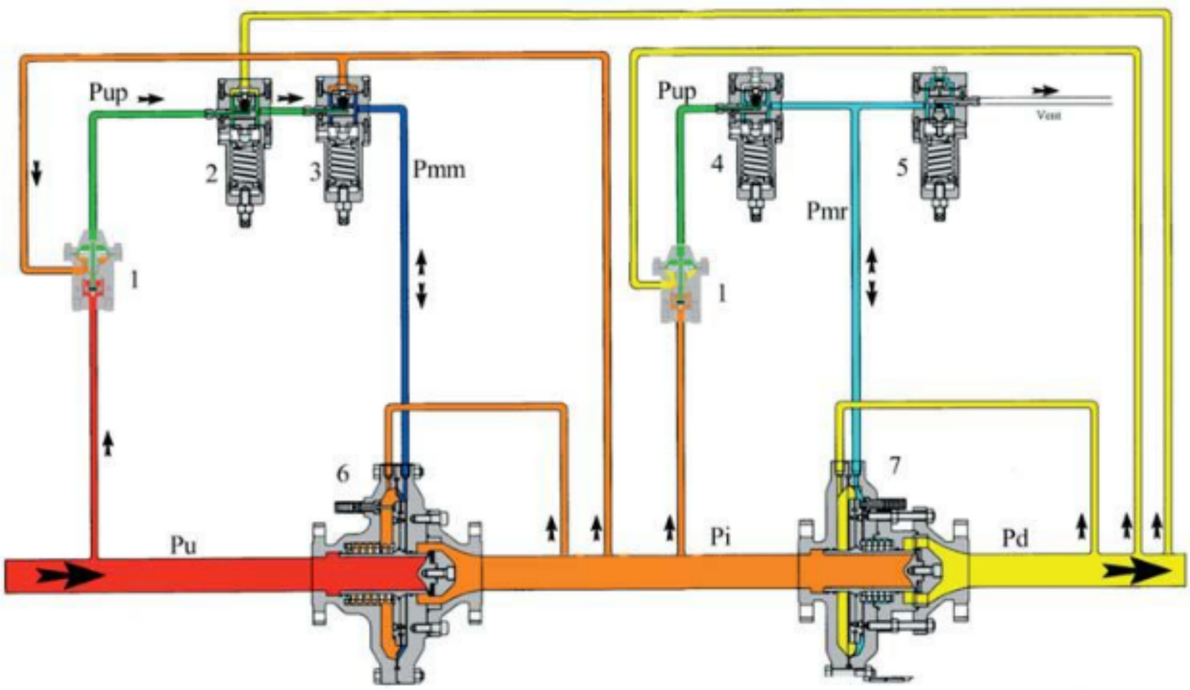
FAIL TO OPEN - Configurations



1 - feeder (with incorporated filter)
2 - monitor pilot
3 - regulator pilot
4 - relief pilot
5 - monitor
6 - regulator

Pu - inlet pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

Figure 17 - Operating diagram of Sirio FTO regulator with Sirio FTC passive monitor.



1 - feeder (with incorporated filter)
2 - passive monitor pilot
3 - active monitor pilot
4 - regulator pilot
5 - relief pilot
6 - monitor
7 - regulator

Pu - inlet pressure
Pi - mean pressure
Pd - outlet pressure
Pmm - monitor motorization pressure
Pmr - regulator motorization pressure
Pup - feeding pressure

Figure 18 - Operating diagram of Sirio FTO regulator with Sirio FTC active monitor.

FAIL TO OPEN - Configurations

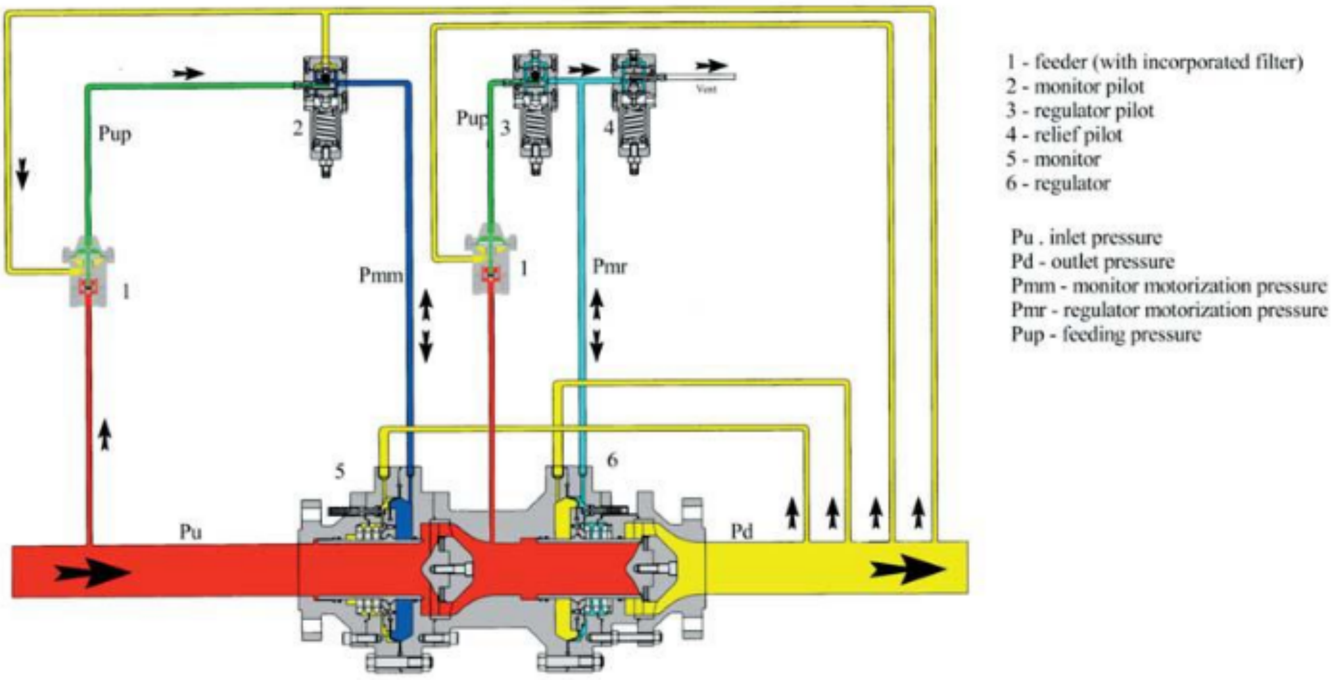
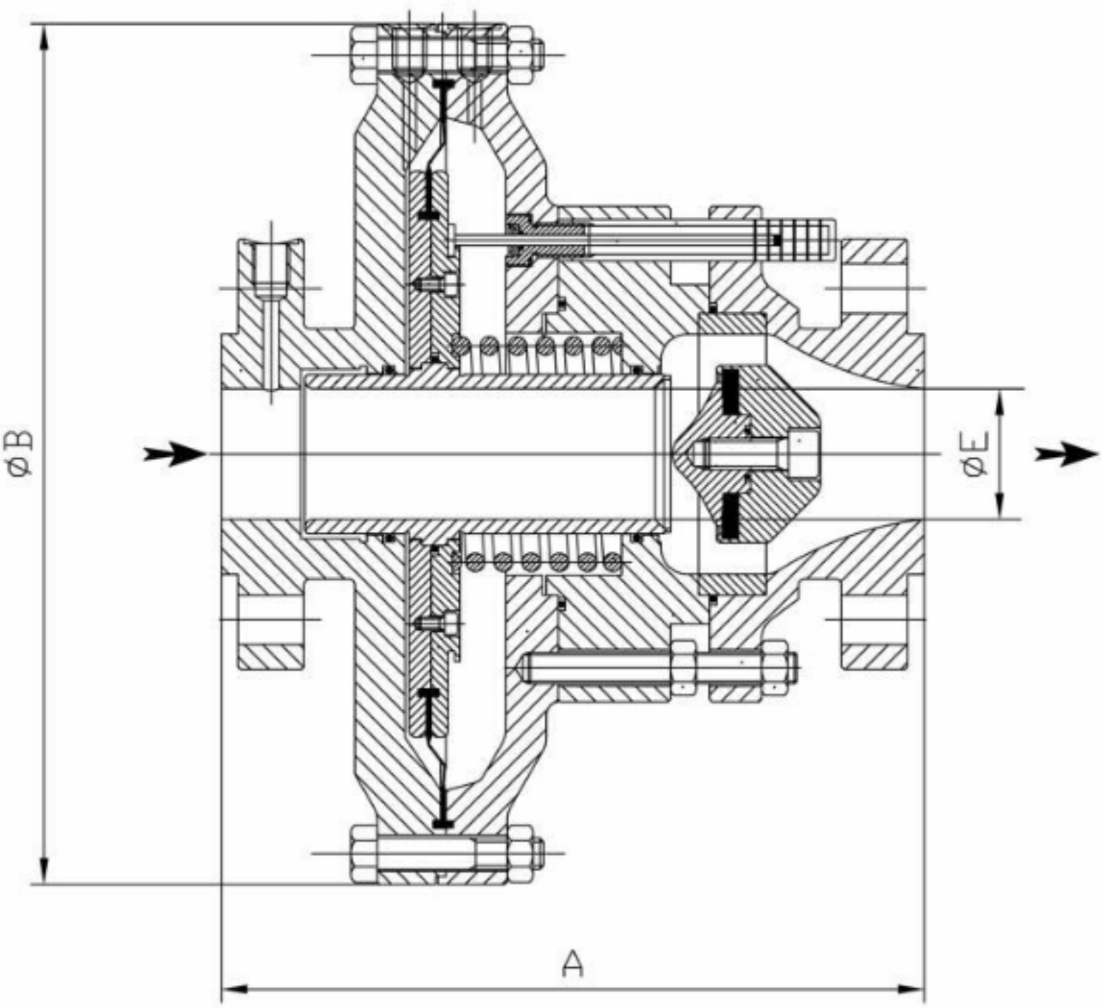


Figure 19 - Operating diagram of Sirio FTO regulator with Sirio FTC monitor built-in.

Spring Range of Regulator SIRIO P/AP FTO, for High Outlet Pressure: REFER TO TABLE 2 (page 10)



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Dimensions and Weights of the regulator

Weights W (kg)			
DN	ANSI 150	ANSI 300	ANSI 600
50	60	60	60
80	110	110	110
100	150	150	150
150	340	340	340
200	450	700	700
250	650	1000	1000
300	870	1400	1500

Dimensions (mm)				
DN	CLASS	A	B	E
	ANSI			
50	150	254	330	51
80	150	298	340	76
100	150	352	460	102
150	150	451	545	152
200	150	543	750	203
250	150	673	800	254
300	150	737	950	305
DN 50	300	267	280	51
DN 80	300	318	340	76
DN 100	300	368	400	102
DN 150	300	473	545	152
DN 200	300	568	650	203
DN 250	300	708	720	254
DN 300	300	775	850	305
DN 50	600	286	280	51
DN 80	600	337	340	76
DN 100	600	394	400	102
DN 150	600	508	545	152
DN 200	600	610	650	203
DN 250	600	752	720	254
DN 300	600	819	850	305

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