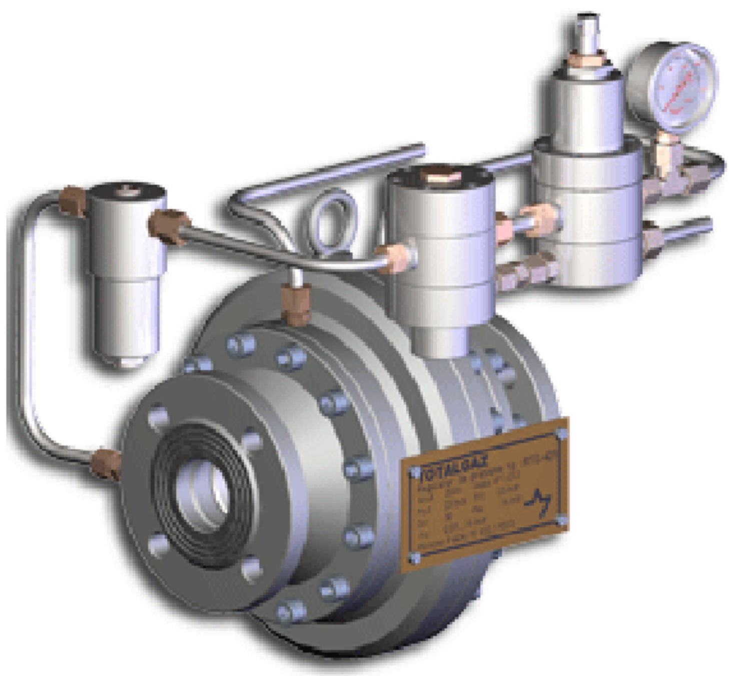
PILOT-OPERATED PRESSURE REGULATOR
RTG 420



Introduction

The RTG 420 pressure regulators are indirect acting axial regulators which are used for reducing and regulating the pressure of non-corrosive gases (natural gases, LPG, etc.). The regulators ensure constant maintenance of outlet pressure within the limits of the regulation class, irrespective of the fluctuations of inlet pressure and flow rate. They are designed for industrial use, in natural gas transportation and distribution networks. The regulators can be used in all installations with rapid variations of flow. The excellent performance of the pilot system ensures precise regulation of pressure and fast response of regulator.

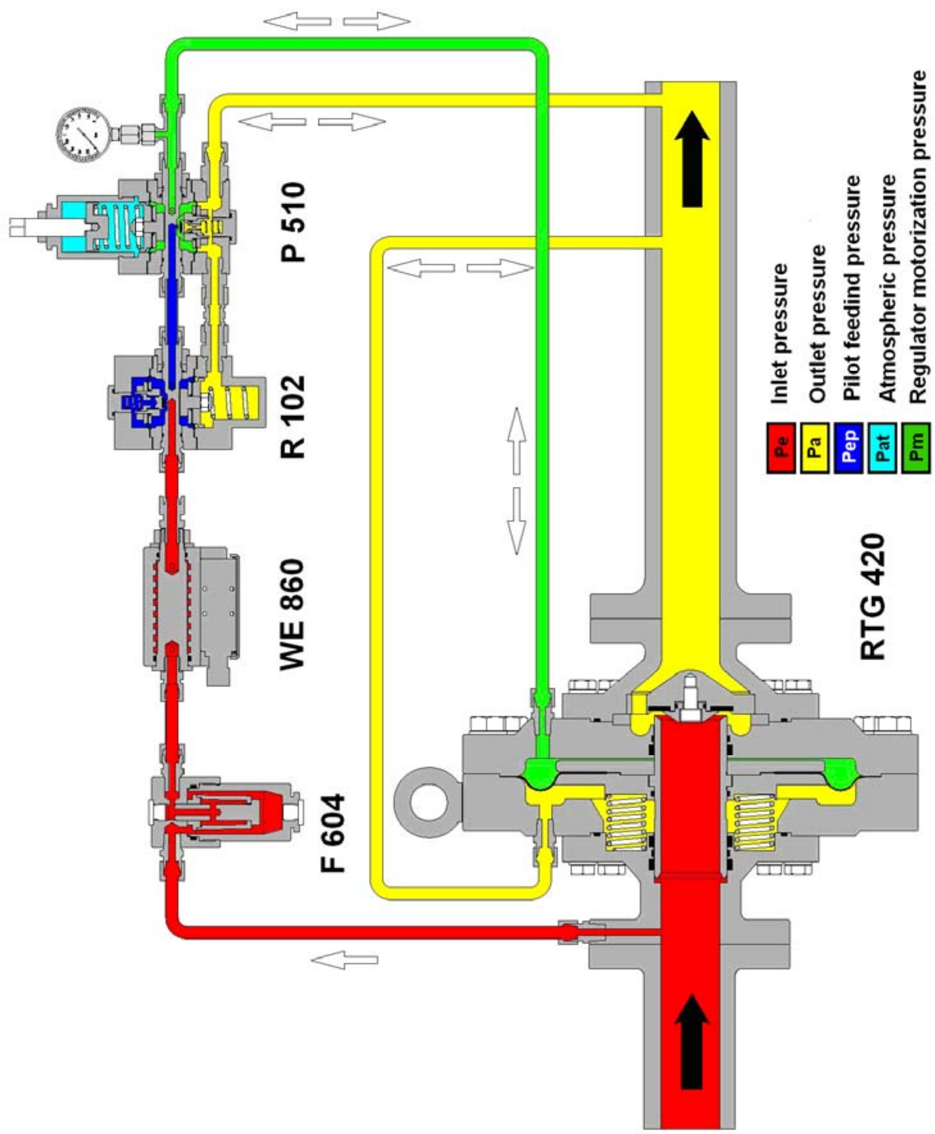


Figure 1 - RTG 420 operating diagram

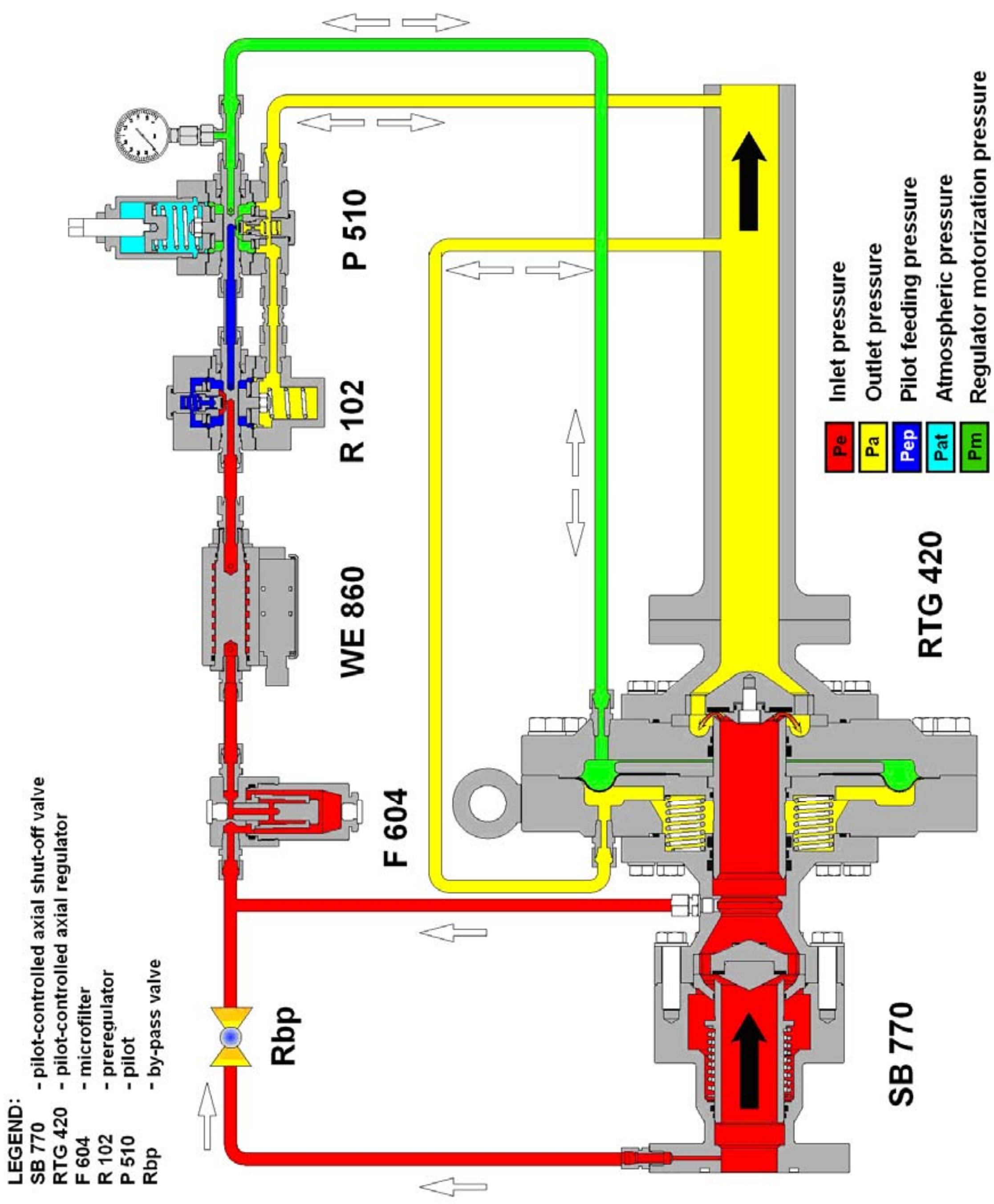


Figure 2 - Operating diagram of RTG 420 regulator equipped with SB 770 shut-off valve

Advantages of RTG 420 regulators

RTG 420 regulators of indirect action type offer a series of advantages such as:

- fast response of regulator to variations in flow rate;
- precise, exact and constant operation even if the inlet pressure fluctuates greatly;
- easy regulation of outlet pressure value;
- easy change of setting range, if desired;
- high flow rate due to the body special design (high flow coefficient);
- excellent reliability due to high quality materials, precise machining and rigorous control;
- reduced overall dimensions compared to similar products;
- wide range of dimensions intended to provide optimal solution to any problem mentioned;
- easy maintenance, without removing the regulator from the installation;
- low noise level during operation even at high flow rates;

Pressure regulator operation

RTG 420 regulators (Figure 3a and Figure 3b) comprise:

a. **control mechanism:** F 604 filter (1), R 106 (2) or R 102 preregulator, P 510 pilot (3);

b. **operating equipment:** regulator (4) and optionally, SB 770 shut-off valve (5) – for the models with incorporated shut-off valve. RTG 420 regulators can be optionally equipped with a WE 860 electrical gas heater for the pilot system.

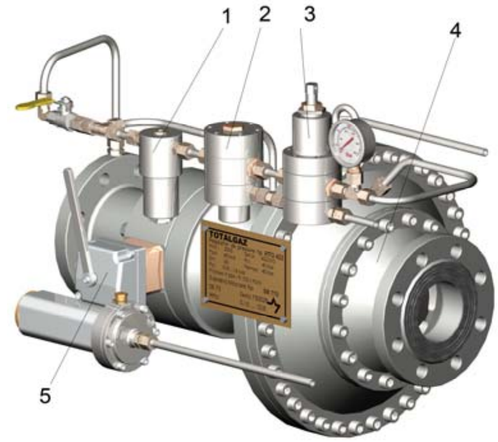


Figure 3a - RTG 420 without SB 770
1. F 604 filter; 2. R 102 preregulator; 3. P 510 pilot; 4. Regulator

Figure 3b - RTG 420 equipped with SB 770
1. F 604 filter; 2. R 102 preregulator; 3. P 510 pilot; 4. Regulator; 5. SB 770 shut-off valve (optionally)

The regulator operation is described on the basis of Figure 1.

RTG 420 regulators function on the principle of the balance between the forces acting on the operating element. The force delivered by the downstream pressure (P_a) on the diaphragm acts in conjunction with the force generated by the operating mechanism spring. The resultant force balances the force exerted by the motorization pressure (P_m) on the diaphragm.

Since the regulator is normally closed, in the absence of pressure in the control equipment circuit, the operating mechanism piston is maintained in closed position by the spring. Fluctuations in the upstream pressure do not modify this position because the piston is completely balanced and exposed to equal pressure acting on surfaces with equal areas.

The gas for the pilot system is taken from the regulator inlet, then passes through an F 604 filter and undergoes an initial pressure reduction in the R 102 preregulator. The pilot feeding pressure (Pep) is obtained at the preregulator outlet and depends on the regulator outlet pressure. The pilot feeding pressure is applied at the P 510 pilot inlet, thus generating the motorization pressure (P_m) acting on the lower side of the operating mechanism diaphragm. The value of the outlet pressure (P_a) can be modified by rotating the pilot adjustment screw [clockwise to increase (P_m) and, consequently, (P_a) and anticlockwise to decrease them]. If the pressure (P_a) downstream of the regulator decreases because of an increase in the required flow rate, this induces an imbalance in the pilot mobile subassembly, which results in the modification of the motorization pressure (P_m) value and, implicitly, in a different balance position of the adjustment element. An increase of the pressure downstream of the regulator changes the balance position of the pilot mobile subassembly and leads to the decrease of the motorization pressure (P_m) [at a certain value of the downstream pressure (P_a), the pilot moves to closed position]; the (P_m) pressure decreases and the force exerted by the spring causes the adjustment element in the regulator to move to closed position. The continuous operation is ensured by the relief nozzle in the pilot, through which the gas at (P_m) circulates towards the outlet pipe (P_a).

Technical characteristics

Precautions

Failures can occur due to external factors or dirt collected in the installation, which can lead to modifications of the parameters listed in Table 1. Therefore, it is recommended that an FTG 600 gas filter be installed upstream of the regulator in order to prevent failures which can occur due to impurities in the system.

It is recommended to install a relief valve adequate to the equipment served by the regulator if the outlet pressure reaches dangerous values because of incidents such as sudden opening or closing of valves.

Table 1 – RTG 420 regulators technical characteristics

Regulator Model	RTG 421 RTG 421 SB RTG 421 M	RTG 422 RTG 422 SB RTG 422 M	RTG 423 RTG 423 SB RTG 423 M
Inlet/ outlet connection diameter	Flange DN 25 ÷ DN 400 PN 16÷PN20/ ANSI Class 150	Flange DN 25÷DN 300 PN 25 ÷ PN 50/ ANSI Class 400	Flange DN 25 ÷ DN 300 PN 64 ÷ PN 110/ ANSI Class 600
Inlet pressure [bar]	0.3 ÷ 16/20	0.4 ÷ 25/50	0.5 ÷ 100
Outlet pressure [bar]	0.2 ÷ 12	0.2 ÷ 49	0.5 ÷ 75
Differential pressure Δp [bar]	0.3	0.4	0.5
Working medium	Natural gas (SR 3317-2003) or other non-corrosive gases		
Ambient temperature [°C]	-30 ÷ 80		
Working medium temperature [°C]	-20 ÷ 60		
Intervention accuracy class (AG) [%]	- minimum up to 2.5% - maximum up to 1% (depending on the control pressure)		
Accuracy class (AC) [%]	± 1 ÷ 5%	± 1 ÷ 5%	± 1 ÷ 2.5%
Lock-up pressure class (SG) [%]	2.5 ÷ 10%	1 ÷ 5%	1 ÷ 2.5%

Materials

Part	Material
Body	Carbon steel
Seat	Stainless steel
Piston	Stainless steel / carbon steel
Internal parts	Stainless steel, carbon steel
Valve plate	Rubber (NBR) or polyurethane
Diaphragms	Rubber (NBR) with textile insert, rubber (NBR)
O-rings	Rubber (NBR), Viton

Selection of pressure regulator

When selecting the pressure regulator, the following data should be considered:

- inlet pressure p_e
- outlet pressure p_a
- maximum flow rate Q
- working medium
- working medium temperature
- ambient temperature

According to SR EN 334 + A_1: 2009, flow coefficient Cg is taken into consideration when selecting the regulator size. The maximum flow rate is established assuming that the regulator is totally open.

The following formulas are used to determine the maximum flow rate:

a) in subcritical conditions, for $\frac{p_a}{p_e} \geq 0.5$

$$Q = \frac{13.57}{\sqrt{d \cdot (t_u + 273)}} \times C_g \sqrt{(p_e - p_a) \cdot p_a}$$

or:

$$Q = K_g \cdot \sqrt{(p_e - p_a) \cdot p_a}$$

b) in critical conditions, for $\frac{p_a}{p_e} < 0.5$

$$Q = \frac{6.78}{\sqrt{d \cdot (t_u + 273)}} \times C_g \cdot p_e$$

or:

$$Q = \frac{K_g}{2} \cdot p_e$$

Symbols:

- Q – flow rate [Nm^3/h]
- p_e – absolute inlet pressure [bar]
- p_a – absolute outlet pressure [bar]
- C_g – air flow coefficient [Nm^3/h], according to Table 2
- K_g – natural gas flow coefficient [Nm^3/h]
- d – relative density (for air d = 1)
- t_u – natural gas temperature at regulator inlet

The relative densities for other working fluids are listed in Table 3.

For natural gas, the formulas based on K_g coefficient can be directly used (the formulas already contain the correction for natural gas at t = 15ºC).

Table 2 – Flow coefficient for RTG 420 pressure regulators

DN	RTG 420	
	Cg	Kg
25	628	645
32	956	980
40	1570	1610
50	2280	2440
80	4854	4975
100	8643	8860
150	18435	18900
200	28810	29535
250	42413	43480
300	69155	70900
400	110648	113440

Table 3 – Gas relative densities

Type of gas	Relative density
Air	1.0
Propane	1.53
Butane	2.0
Nitrogen	0.97
Oxygen	1.14
Carbon dioxide	1.52

Gas velocity is also considered when selecting the pressure regulator and sizing the pipes.

For regulators, the recommended gas velocity in the outlet flange is less than 150 m/s. The erosion phenomenon accelerates and the noise level increases significantly at greater velocity.

The pipes are sized for gas velocities lower than 20 m/s.

Gas velocity in the outlet flange or in pipes is calculated using the formula:

$$V = 345.92 \times \frac{Q \times (1 - 0.002 \cdot p_a)}{D_i^2 \times (1 + p_a)}$$

where:

V – gas velocity [m/s]

Q – flow rate [Stm^3/h]

D_i – inner diameter [mm] – for pressure regulators D_i = DN

p_a – outlet pressure [barg]

Safety devices and optional accessories

Incorporated silencer

This silencer has the role of diminishing the level of noise produced during the gas pressure reducing process.

The noise level depends on the inlet pressure (p_e), outlet pressure (p_a) and flow rate (Q).

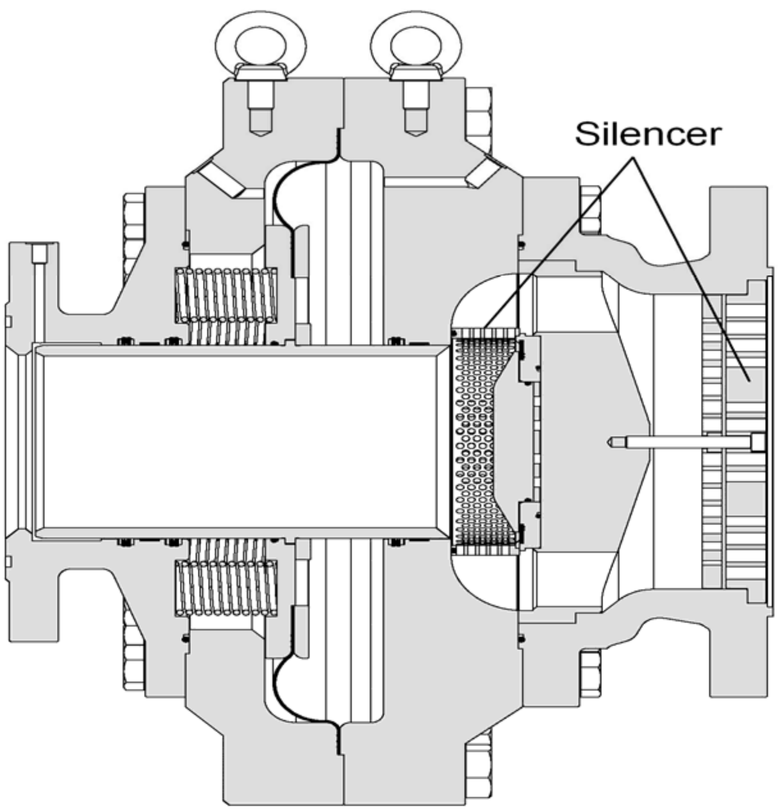


Figure 4 - RTG 423 with incorporated silencer

The reduction of the noise level is performed by dividing the gas stream when passing through the seat and outlet connection. The internal silencer is selected depending on the specific working conditions. This ensures noise reduction of up to 30 dB.

Pilot equipment

The pilot equipment mounted on RTG 420 pressure regulators consists of:

- F 604 microfilter
- WE 860 gas electrical heater (optionally)
- R 100 (R 102 or R 106) preregulator
- P 510 (P 510, P 510 A, P 511) pilot.

The type of pilot mounted on the pressure regulator is selected depending on the required outlet pressure (P_a) as follows:

P 510 A	Wh = 0.02 ÷ 2.4 bar
P 510	Wh = 0.20 ÷ 12 bar
P 511	Wh = 5 ÷ 75 bar

Table 4 – Adjustment springs for P 510 pilots

Pilot	Code	Setting range [bar]
P 510 A	1450224	0.02 ÷ 0.10
	1450225	0.10 ÷ 0.40
	1450226	0.4 ÷ 1.2
	1450227	0.8 ÷ 2.4
P 510	1450228	0.2 ÷ 0.6
	1450229	0.5 ÷ 2
	1450230	1 ÷ 3.5
	1450231	2 ÷ 7
	1450232	4 ÷12
P 510 HP	1450284	3 ÷ 8
	1450285	6 ÷ 14
	1450286	10 ÷ 26
	1450287	20 ÷ 32
P 511	1450233	5 ÷ 13
	1450234	10 ÷ 25
	1450235	20 ÷ 40
	1450236	25 ÷ 75

Shut-off valve operation

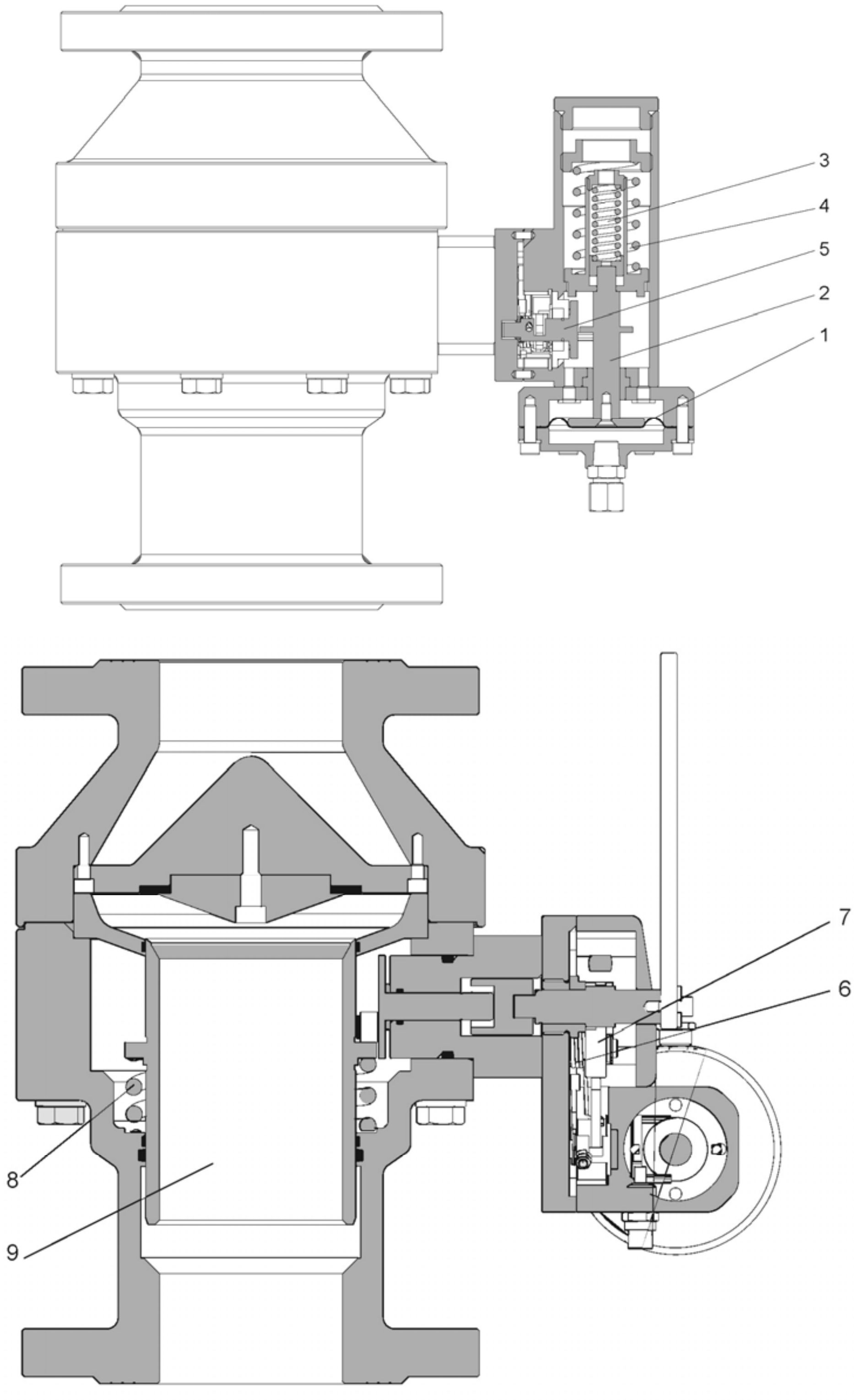


Figure 5 - SB 770 shut-off valve

The valve (Figure 5) operating position is normally open. When the set outlet pressure (p_a) is within the set range, the shut-off valve is open.

The load of the set pressure on the servomotor diaphragm (1) maintains the rod (2) in balance position. Thus, the cam (7) movement under the action of the spring is obstructed by the fork (5) whose radial movement is induced by the rod (2).

When the pressure exceeds the maximum allowable value, the force of the spring (4) is overcome, which causes the rod (2) to move. The fork (5) releases the cam (7) which moves under the action of the spring (6) and releases the piston (9).

When the pressure decreases below the minimum allowable value, the force of the spring (3) moves the rod (2) which rotates the fork (5) and releases the cam (7) which in its turn moves under the action of the spring (6) and releases the piston.

The movement of the piston (9) under the action of the spring (8) closes the valve. Sealing is ensured by O-rings and seat valve plate.

Adjustment springs

Table 5 – Adjustment springs for SB 75 control mechanism

Servomotor type	Minimum spring		Maximum spring	
	Code	Adjustment range [bar]	Code	Adjustment range [bar]
SM 15	1450353	2.4 ÷ 4.8	1450367	21.3 ÷ 42.7
	1450354	4.1 ÷ 8.3	1450368	41.9 ÷ 83.8
	1450355	8.0 ÷ 15.6		
	1450358	9.0 ÷ 18.2		
	1450359	17.8 ÷ 35.7		
	1450360	34.9 ÷ 62.1		
SM 20	1450353	1.3 ÷ 2.7	1450367	12.0 ÷ 24.0
	1450354	2.3 ÷ 4.6	1450368	23.5 ÷ 47.2
	1450355	4.5 ÷ 8.7		
	1450358	5.1 ÷ 10.2		
	1450359	10.0 ÷ 20.1		
	1450360	19.6 ÷ 34.9		
SM 25	1450354	1.4 ÷ 3.0	1450368	15.1 ÷ 30.2
	1450355	2.9 ÷ 5.6		
	1450359	6.4 ÷ 12.8		
	1450360	12.5 ÷ 22.4		
SM 37	1450352	0.2 ÷ 0.5	1450366	2.04 ÷ 4.1
	1450353	0.4 ÷ 0.9	1450367	3.9 ÷ 7.8
	1450354	0.7 ÷ 1.5	1450368	7.6 ÷ 15.4
	1450355	1.4 ÷ 2.9		
	1450358	1.6 ÷ 3.3		
	1450359	3.2 ÷ 6.5		
	1450360	6.4 ÷ 12.4		
SM 50	1450351	0.06 ÷ 0.14	1450364	0.27 ÷ 0.55
	1450352	0.12 ÷ 0.25	1450365	0.53 ÷ 1.07
	1450353	0.21 ÷ 0.44	1450366	1.0 ÷ 2.0
	1450354	0.37 ÷ 0.75	1450367	1.9 ÷ 3.8
	1450355	0.72 ÷ 1.40	1450368	3.7 ÷ 7.6
	1450356	0.21 ÷ 0.43		
	1450357	0.42 ÷ 0.85		
	1450358	0.81 ÷ 1.63		
	1450359	1.60 ÷ 3.20		
	1450360	3.13 ÷ 5.60		
SM 70	1450351	0.03 ÷ 0.08	1450361	0.02 ÷ 0.04
	1450352	0.06 ÷ 0.1	1450362	0.03 ÷ 0.08
	1450353	0.1 ÷ 0.2	1450363	0.06 ÷ 0.14
	1450354	0.1 ÷ 0.4	1450364	0.13 ÷ 0.28
	1450355	0.3 ÷ 0.7	1450365	0.27 ÷ 0.55
	1450356	0.1 ÷ 0.2	1450366	0.51 ÷ 1.02
	1450357	0.2 ÷ 0.5	1450367	0.98 ÷ 1.95
	1450358	0.4 ÷ 0.8	1450368	1.92 ÷ 3.85
	1450359	0.8 ÷ 1.7		
	1450360	1.6 ÷ 2.9		

Overall dimensions

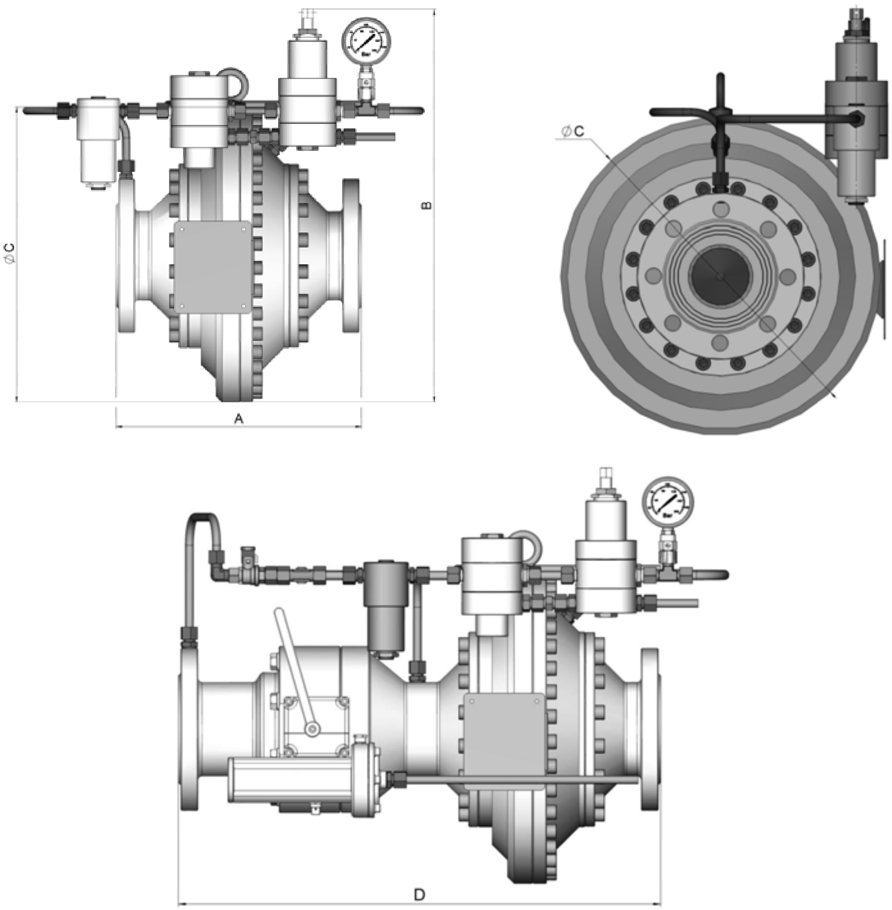


Figure 6 - Overall dimensions

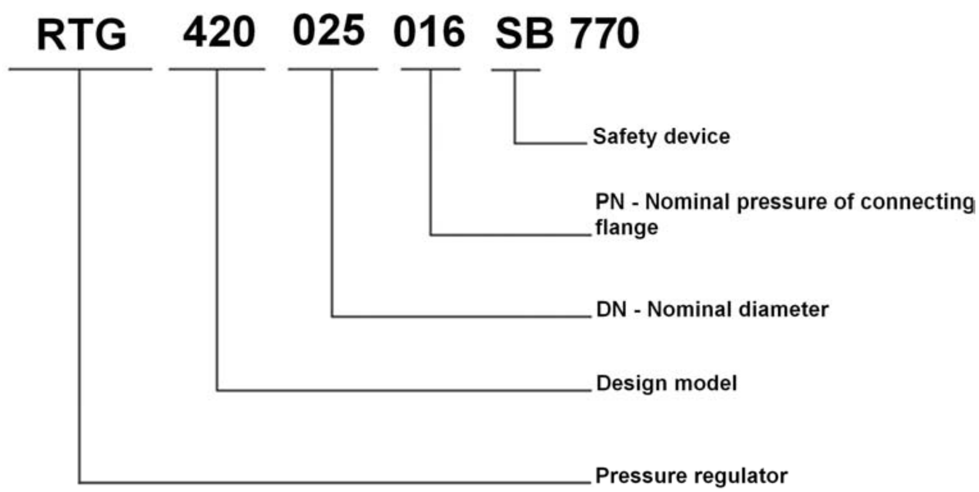
Table 6 – RTG 420 overall dimensions as per Figure 6

Nominal diameter DN [mm]	RTG 421 (PN 16, PN 25)				RTG 422 (PN 40)				RTG 423 (PN 64, PN 100)			
	A [mm]	B [mm]	ØC [mm]	D [mm]	A [mm]	B [mm]	ØC [mm]	D [mm]	A [mm]	B [mm]	ØC [mm]	D [mm]
25/25	184	385	235	380	197	385	235	380	210	405	255	400
25/50	184	385	235	380	197	385	235	380	210	405	255	400
40/40	222	420	270	430	235	420	270	430	251	430	280	450
40/80	222	420	270	430	235	420	270	430	251	430	280	450
50/50	276	450	300	475	267	450	300	475	286	470	320	500
50/100	276	450	300	475	267	450	300	475	286	470	320	500
80/80	298	475	375	575	317	475	375	575	337	480	380	600
80/150	298	475	375	575	317	475	375	575	337	480	380	600
100/100	352	550	450	650	368	550	450	650	394	545	460	700
100/200	352	550	450	650	368	550	450	650	394	545	460	700
150/150	451	615	515	800	473	615	515	800	508	620	520	850
150/200	451	615	515	800	473	615	515	800	508	620	520	850
200/200	543	630	580	900	568	630	580	900	610	635	585	1000
200/300	543	630	580	900	568	630	580	900	610	635	585	1000
250/250	673	710	660	1000	708	710	660	1000	752	730	680	1100
300/300	737	735	685	1150	775	735	685	1150	819	760	700	1300
300/400	737	735	685	1150	775	735	685	1150	819	760	700	1300

Ordering code

The pressure regulator are identified by specifying the constructive variant, the nominal dimension of inlet-outlet connections and the maximum working pressure.

Example:



For example, the notation RTG 420-25-16-SB 770 designates a 420 pressure regulator, with DN 25 flanged connections, maximum working pressure of 16 bar and it also indicates the fact that the regulator is equipped with an SB 770 shut-off valve.

Additional requirements, if any, must be specified when placing the order.

The manufacturer reserves the right to make modifications without any prior notification.

CT No. 203 / 2009 / 01

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Nr. R.C.: J-22-3277/1994
CUI: RO6658553

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