

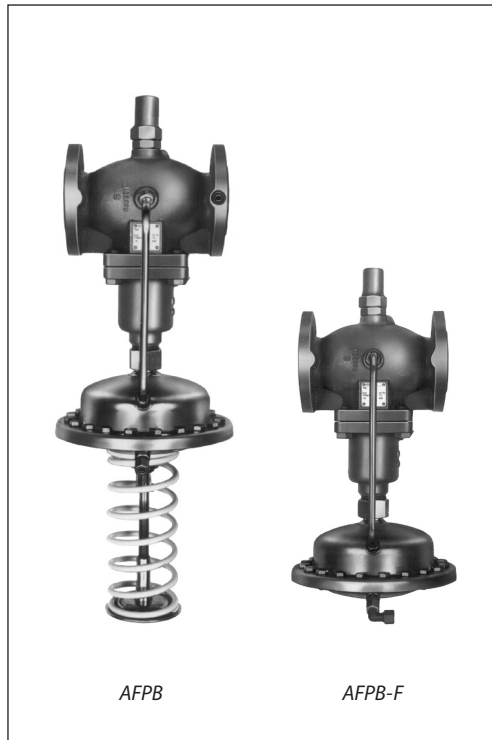
Data sheet

# Differential pressure controller with flow limitation (PN 16, 25, 40)

**AFPB / VFQ 2(1)** – return mounting, adjustable setting

**AFPB-F / VFQ 2(1)** – return mounting, fixed setting

Description



The controller is a self-acting differential pressure controller with flow limitation primarily for use in district heating systems. The controller closes on rising differential pressure or when set max. flow is exceeded.

The controller has a control valve with adjustable flow restrictor, an actuator with one control diaphragm and spring for differential pressure setting.

Further on two valve versions are available:

- VFQ 2 with metallic sealing cone
- VFQ 21 with soft sealing cone (on special request)

**Main data:**

- DN 15-125
- $k_{vs}$  4,0-160 m<sup>3</sup>/h
- Flow range: 0,05-120 m<sup>3</sup>/h
- PN 16, 25, 40
- Setting range: 0,1-07 bar/0,15-1,5 bar
- Temperature:
  - Circulation water/glycolic water up to 30 %: 2 ... 150/200 °C
- Connections:
  - Flange

Ordering

*Example 1:*  
Differential pressure controller with flow limitation; return mounting; DN 15;  $k_{vs}$  4,0; PN 16; metallic sealing; setting range 0,1-0,7 bar;  $t_{max}$  150 °C; flange;

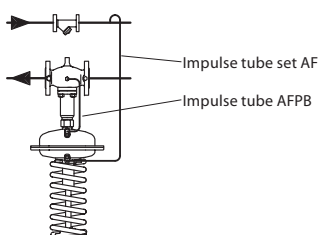
- 1x VFQ 2 DN 15 valve  
Code no: **065B2654**
- 1x AFPB actuator  
Code no: **003G1017**
- 1x AFPB DN 15 impulse tube  
Code no: **003G1355**
- 1x Impulse tube set AF  
Code no: **003G1391**

VFQ 2 Valves (metallic sealing cone)

Picture	DN (mm)	$k_{vs}$ (m <sup>3</sup> /h)	Connections	T <sub>max.</sub> (°C)	Code No.	T <sub>max.</sub> (°C)	Code No.	
					PN 16	PN 25	PN 40	
	15	4,0	Flanges acc. to EN 1092-1	150	<b>065B2654</b>	200 <sup>1)</sup>	<b>065B2667</b>	<b>065B2677</b>
	20	6,3			<b>065B2655</b>		<b>065B2668</b>	<b>065B2678</b>
	25	8,0			<b>065B2656</b>		<b>065B2669</b>	<b>065B2679</b>
	32	16			<b>065B2657</b>		<b>065B2670</b>	<b>065B2680</b>
	40	20			<b>065B2658</b>		<b>065B2671</b>	<b>065B2681</b>
	50	32			<b>065B2659</b>		<b>065B2672</b>	<b>065B2682</b>
	65	50			<b>065B2660</b>		<b>065B2673</b>	<b>065B2683</b>
	80	80			<b>065B2661</b>		<b>065B2674</b>	<b>065B2684</b>
	100	125			<b>065B2662</b>		<b>065B2675</b>	<b>065B2685</b>
125	160	<b>065B2663</b>	<b>065B2676</b>	<b>065B2686</b>				

**Note:** other valves available on special request.  
<sup>1)</sup> at temperatures above 150 °C only with seal pots (see Accessories)

Products will be delivered separately.

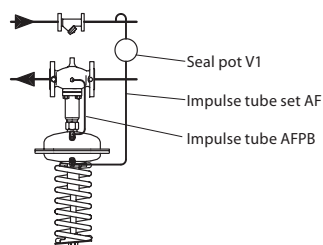


**Ordering (continuous)**

Example 2:  
Differential pressure controller with flow limitation; return mounting; DN 15;  $k_{vs}$  4,0; PN 25; metallic sealing; setting range 0,1-0,7 bar;  $t_{max}$  200 °C; flange;

- 1x VFQ 2 DN 15 valve  
Code no: **065B2667**
- 1x AFPB actuator  
Code no: **003G1017**
- 1x AFPB DN 15 impulse tube  
Code no: **003G1355**
- 1x Impulse tube set AF  
Code no: **003G1391**
- 1x Seal pot V1  
Code no: **003G1392**

Products will be delivered separately.



**AFPB(-F) Actuators**

Picture	$\Delta p$ setting range (bar)	Max. operat. pressure	Code No.
	0,1 – 0,7	25	<b>003G1017</b>
	0,15 – 1,5		<b>003G1016</b>
	0,2	25	<b>003G1026</b>
	0,5		<b>003G1027</b>

**Accessories**

Picture	Type designation	For controller	DN (mm)	PN	Code No.				
	Impulse tubes (Stainless steel)	AFPB	15	16, 25, 40	<b>003G1355</b>				
			20		<b>003G1357</b>				
			25						
			32		<b>003G1359</b>				
			40						
			50						
					Impulse tubes (Stainless steel)	AFPB	65	16, 25, 40	<b>003G1361</b>
							80		<b>003G1363</b>
							100		
	Impulse tubes (Stainless steel)	AFPB	125	16, 25, 40	<b>003G1364</b>				
Picture	Type designation	Description	Ordering number	Code No.					
	Impulse tube set AF	- 1x Copper tube $\varnothing 10 \times 1 \times 1500$ mm - 1 x compression fitting for imp. tube connection to pipe (G 1/4) - 2 x socket	-	<b>003G1391</b>					
	Seal pot V1 <sup>1)</sup>	Capacity 1 liter; with compression fittings for imp. tube $\varnothing 10$	-	<b>003G1392</b>					
	Compression fitting <sup>2)</sup>	For impulse tube $\varnothing 10$ connections to controller	G 1/4	<b>003G1468</b>					
	Combination piece KF3	For combination with pressure and electrical actuators	G 1 1/4/2x G 1 1/4	<b>003G1397</b>					
	Combination piece KF2	For combination with thermostat		<b>003G1398</b>					
	Shut off valve	For impulse tube $\varnothing 10$	-	<b>003G1401</b>					
	Throttle valve			<b>065B2909</b>					

<sup>1)</sup> Seal pot has to be used on impulse tubes always when  $T_{max} \geq 150$  °C

<sup>2)</sup> Consist of a nipple, compression ring and nut

**Service kits**

Picture	Type designation	For valve	DN (mm)	$k_{vs}$ (m <sup>3</sup> /h)	Code No.
	Valve insert	VFQ 2	15	4.0	<b>065B2796</b>
			20	6.3	<b>065B2797</b>
			25	8	<b>065B2798</b>
			32	16	
			40	20	<b>065B2799</b>
			50	32	
			65	50	<b>065B2800</b>
			80	80	
			100	125	<b>065B2801</b>
125	160				
	Stuffing cone (with EPDM O-rings)				<b>003G1464</b>

Technical data

Valve

Nominal diameter					DN	15	20	25	32	40	50	65	80	100	125
k <sub>VS</sub> value					m <sup>3</sup> /h	4,0	6,3	8,0	16	20	32	50	80	125	160
Range of max. flow setting <sup>1)</sup>	Δp <sub>SP</sub>	Δp <sub>SYSTEM</sub>	Δp <sub>b</sub>												
	0,2	0,1	0,1	from		0,05	0,15	0,25	0,4	0,6	0,9	2	3,5	6,5	11
	0,5	0,3	0,2	to	m <sup>3</sup> /h	1,4	2,1	2,5	5	6,5	10	16	25	40	50
	1,0	0,5	0,5	to		2	3	4	7	11	16	28	40	63	80
Cavitation factor z						0,6	0,6	0,6	0,55	0,55	0,5	0,5	0,45	0,4	0,35
Leakage acc. to standard IEC 534 (% of k <sub>VS</sub> )					VFQ 2	≤ 0,03									
					VFQ 21	≤ 0,01									
Nominal pressure					PN	16, 25, 40									
Min. differential pressure						see remark <sup>2)</sup>									
Max. differential pressure					PN 16	16									15
					PN 25, 40	20									
Media					Circulation water/glycolic water up to 30 %										
Media pH					Min. 7, max. 10										
Media temperature					VFQ 2	2 ... 150/2 ... 200 <sup>3)</sup>									
					VFQ 21	2 ... 150									
Connections					Flange										
<b>Materials</b>															
Valve body					PN 16	Grey cast iron EN-GJL-250 (GG-25)									
					PN 25	Ductile iron EN-GJS-400(GGG-40.3)									
					PN 40	Cast steel GP240GH (GS-C 25)									
Valve seat					Stainless steel, mat. No. 1.4021										
Valve cone					Stainless steel, mat. No. 1.4404										
Sealing					VFQ 2	Metal									
					VFQ 21	EPDM									
Pressure relieve system					Bellows (Stainless steel, mat. No. 1.4571)										

<sup>1)</sup> Max. flow rate depends on the differential pressure over the system (dp System). System is part of the application where differential pressure is controlled by AFPB(-F) and for this part the resistance is well known/defined. Flow rates in table are specified for 3 different situations.

$$\Delta p_{SP} = \Delta p_{SYSTEM} + \Delta p_b$$

Δp<sub>SP</sub> - differential pressure set point

Δp<sub>SYSTEM</sub> - system differential pressure

Δp<sub>b</sub> - differential pressure over flow restrictor

<sup>2)</sup> Depends on the flow rate and valve k<sub>VS</sub>; For Q<sub>set</sub> = Q<sub>max</sub> -> Δp<sub>min</sub> ≥ 0,5 bar; For Q<sub>set</sub> < Q<sub>max</sub> -> Δp<sub>min</sub> =  $\left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

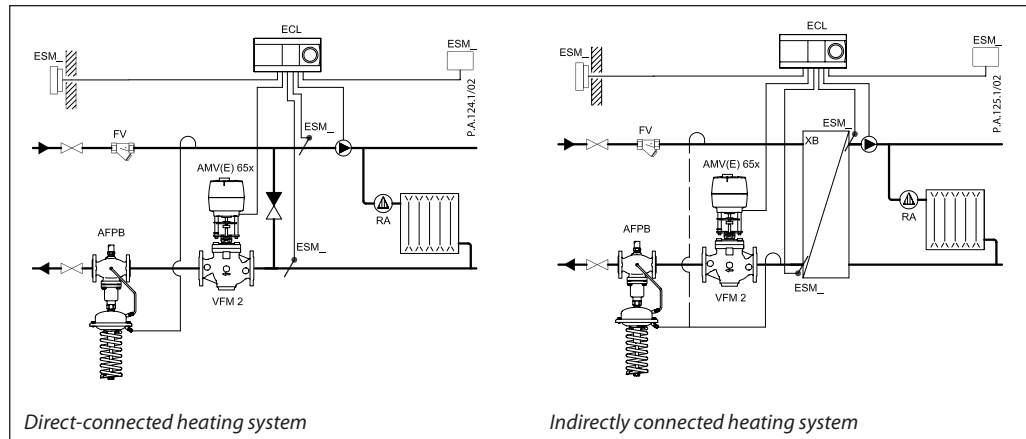
<sup>3)</sup> at temperatures above 150 °C only with seal pots (see Accessories)

Actuator

Type		AFPB	AFPB-F	
Actuator size	cm <sup>2</sup>	250		
Max. operational pressure	PN	25		
Diff. pressure setting ranges and spring colours	bar	0,1-0,7	0,15-1,5	0,2
		yellow	red	fixed setting
<b>Materials</b>				
Actuator housing		Stainless steel, mat. No.1.0338, zinc plated and yellow chromate		
Control diaphragm		EPDM (Rolling; fibre enforced)		

**Application principles**

AFPB controller must be installed in the return pipe only.



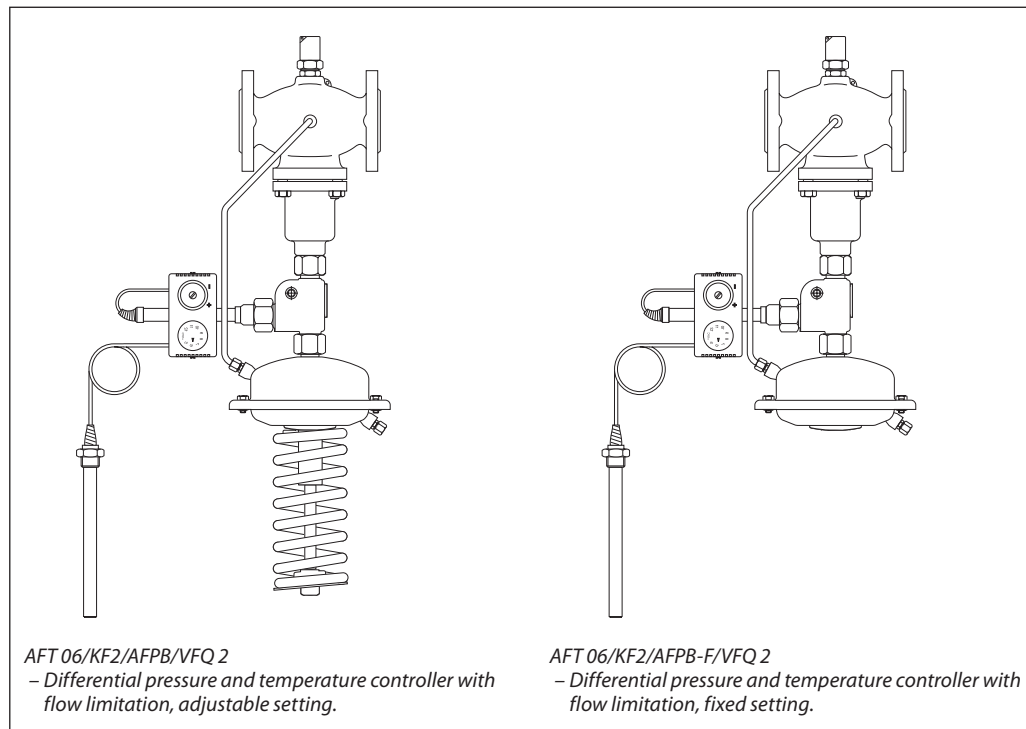
**Combinations**

Example:  
Differential pressure and temperature controller with flow limitation; return mounting; DN 15;  $k_{vs}$  4,0; PN 16; metallic sealing; setting range 0,1-0,7 bar;  $t_{max}$  150 °C; flange;

- 1x VFQ 2 DN 15 valve  
Code no: **065B2654**
- 1x AFPB actuator  
Code no: **003G1017**
- 2x Impulse tube set AF  
Code no: **003G1391**
- 1x AFT06 thermostat  
Code no: **065-4390**
- 1x Combination piece KF2  
Code no: **003G1398**

Products will be delivered separately.

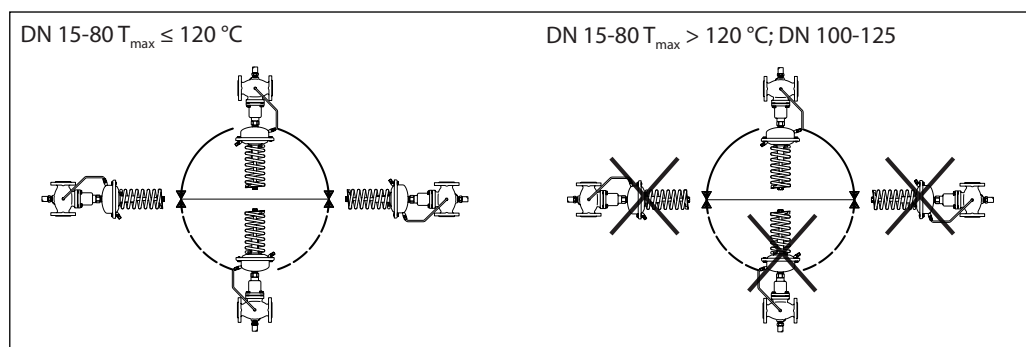
**Note:**  
For AFT 06 thermostat data see relevant data sheet



**Installation positions**

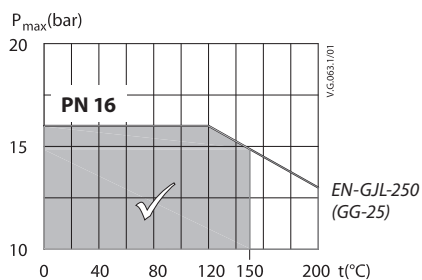
DN 15-80  $T_{max} \leq 120$  °C  
The controllers can be installed in any position.

DN 15-80  $T_{max} > 120$  °C; DN 100-125  
The controllers can be installed in horizontal pipes only, with a pressure actuator oriented downwards.

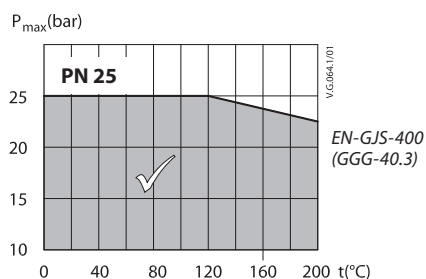


**Pressure temperature diagram**

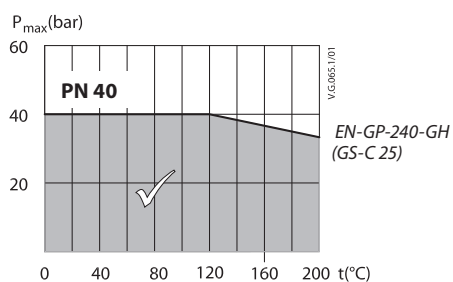
Working area is below P-T line and it ends at T<sub>max</sub> for each valve



Maximum allowed operating pressure as a function of media temperature (according to EN 1092-2)



Maximum allowed operating pressure as a function of media temperature (according to EN 1092-2)



Maximum allowed operating pressure as a function of media temperature (according to EN 1092-1)

**Sizing**

– Directly connected heating system

**Example 1**

Motorised control valve (MCV) for mixing circuit in direct-connected heating system requires differential pressure of 0,3 bar (30 kPa) and flow less than 1800 l/h.

*Given data:*

- $Q_{max}$  = 1,8 m<sup>3</sup>/h (1800 l/h)
- $\Delta p_{min}$  = 0,7 bar (70 kPa)
- $\Delta p_{circuit}^{1)}$  = 0,1 bar (10 kPa)
- $\Delta p_{MCV}$  = 0,3 bar (30 kPa) selected
- $\Delta p_b^{2)}$  = 0,1 bar (10 kPa) assumption

*Remark:*

- <sup>1)</sup>  $\Delta p_{circuit}$  corresponds to the required pump pressure in the heating circuit and is not to be considered when sizing the AFPB.
- <sup>2)</sup>  $\Delta p_b$  is differential pressure over flow restrictor.

The differential pressure set value is:

$$\Delta p_{set\ value} = \Delta p_b + \Delta p_{MCV} = 0,1 + 0,3$$

$$\Delta p_{set\ value} = 0,4\ bar\ (40\ kPa)$$

The total pressure loss across the controller is:

$$\Delta p_{AFPB} = \Delta p_{min} - \Delta p_{MCV} = 0,7 - 0,3$$

$$\Delta p_{AFPB} = 0,4\ bar\ (40\ kPa)$$

Possible pipe pressure losses in tubes, shut-off fittings, heatmeters, etc. are not included.

$k_v$  value is calculated according to formula:

$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AFPB} - \Delta p_b}} = \frac{1,8}{\sqrt{0,4 - 0,1}}$$

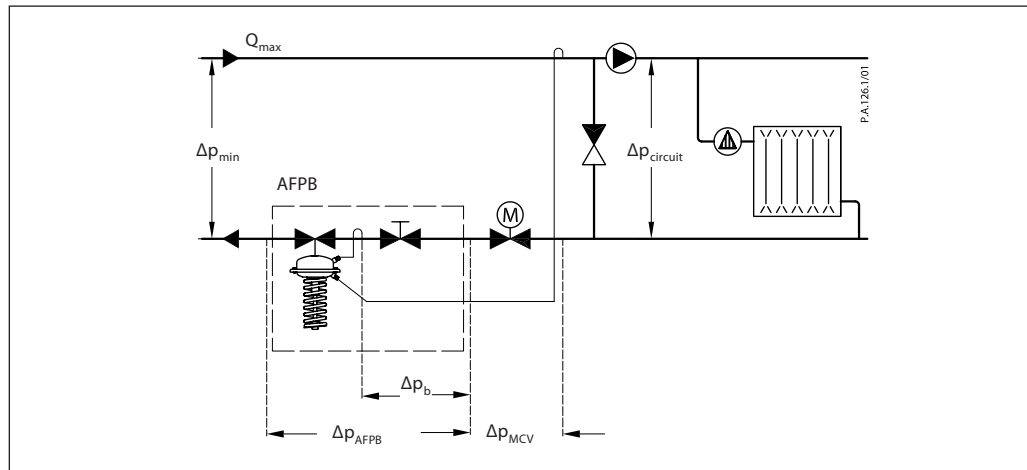
$$k_v = 3,3\ m^3/h$$

*Solution:*

The example selects AFPB/VFQ 2 DN 15;  $k_{vs}$  value 4,0; with differential pressure setting range 0,1-0,7 bar; flow setting range 0,05-1,4 m<sup>3</sup>/h.

If other differential pressure is assumed than  $\Delta p_b = 0,1$  bar, in order to maintain the  $k_{vs}$  value, the flow has to be adjusted using the flow restrictor screw. The new set value (Q-setting) of the assumed differential pressure ( $\Delta p_{b\ NEW} = 0,2$  bar) is calculated according to formula:

$$Q_{setting} = \frac{\sqrt{\Delta p_b}}{\sqrt{\Delta p_{b\ NEW}}} \times Q_{max}$$



**Sizing (continuous)**

- Indirectly connected heating system

**Example 2**

Motorised control valve (MCV) for indirectly connected heating system requires differential pressure of 0,3 (30 kPa) bar and flow less than 1300 l/h.

**Given data:**

$Q_{max}$  = 1,3 m<sup>3</sup>/h (1300 l/h)  
 $\Delta p_{min}$  = 1,0 bar (100 kPa)  
 $\Delta p_{exchanger}$  = 0,05 bar (5 kPa)  
 $\Delta p_{MCV}$  = 0,3 bar (30 kPa) selected  
 $\Delta p_b^{1)}$  = 0,2 bar (20 kPa) assumption

**Remark:**

<sup>1)</sup>  $\Delta p_b$  is differential pressure over flow restrictor

The differential pressure set value is:

$\Delta p_{set\ value} = \Delta p_b + \Delta p_{exchanger} + \Delta p_{MCV}$   
 $\Delta p_{set\ value} = 0,2 + 0,05 + 0,3$   
 $\Delta p_{set\ value} = 0,55\ bar\ (55\ kPa)$

The total pressure loss across the controller is:

$\Delta p_{AFPB} = \Delta p_{min} - \Delta p_{exchanger} - \Delta p_{MCV}$   
 $\Delta p_{AFPB} = 1,0 - 0,05 - 0,3$   
 $\Delta p_{AFPB} = 0,65\ bar\ (65\ kPa)$

Possible pipe pressure losses in tubes, shut-off fittings, heatmeters, etc. are not included.

$k_v$  value is calculated according to formula:

$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AFPB} - \Delta p_b}} = \frac{1,3}{\sqrt{0,65 - 0,2}}$$

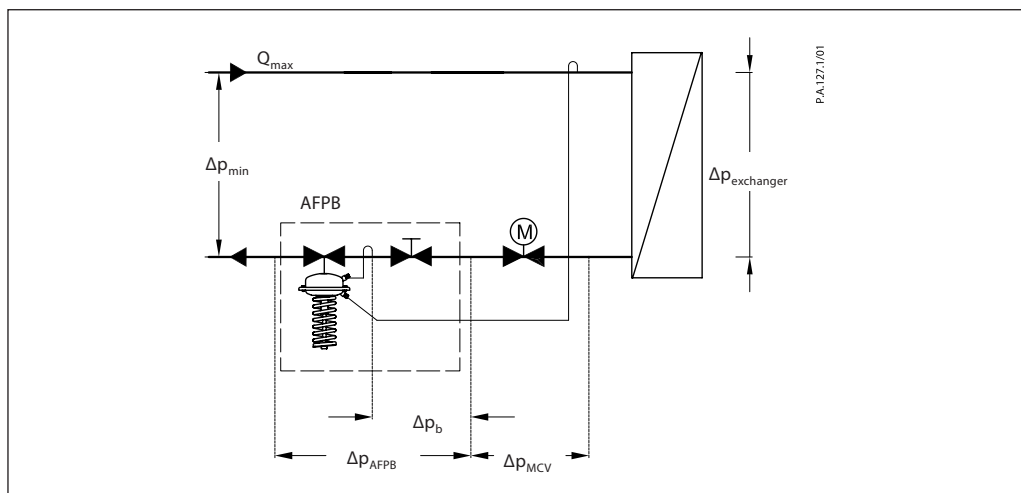
$k_v = 1,9\ m^3/h$

**Solution:**

The example selects AFPB/VFQ 2 DN 15;  $k_{vS}$  value 4,0; with differential pressure setting range 0,1-0,7 bar; flow setting range 0,05-2,0 m<sup>3</sup>/h.

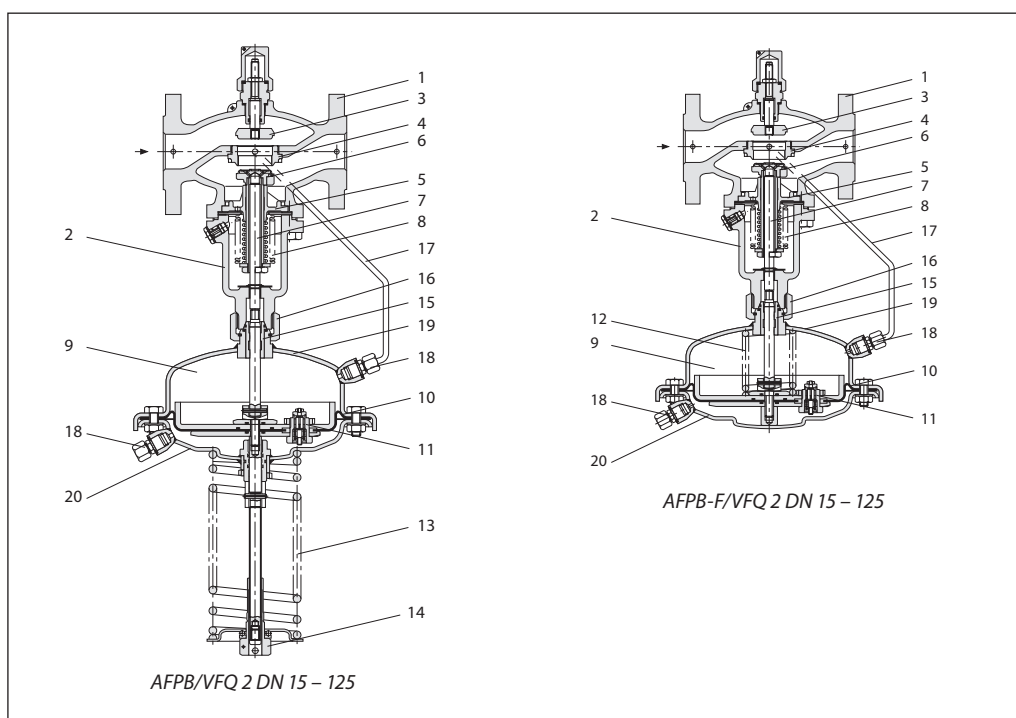
If other differential pressure is assumed than  $\Delta p_b = 0,2$  bar, in order to maintain the  $k_{vS}$  value, the flow has to be adjusted using the flow restrictor screw. The new set value (Q-setting) of the assumed differential pressure ( $\Delta p_{bNEW} = 0,1$  bar) is calculated according to formula:

$$Q_{setting} = \frac{\sqrt{\Delta p_b}}{\sqrt{\Delta p_{bNEW}}} \times Q_{max}$$



**Design**

1. Valve body
2. Cover
3. Adjustable flow restrictor
4. Valve seat
5. Valve insert
6. Pressure relieved valve cone
7. Valve stem
8. Bellows for pressure relief of valve cone
9. Actuator
10. Control diaphragm for differential pressure and flow control
11. Excess pressure safety valve
12. Built in spring for differential pressure and flow control
13. Setting spring for diff. pressure control
14. Adjuster for diff. pressure setting, prepared for sealing
15. Stuffing cone
16. Union nut
17. Impulse tube
18. Compression fitting for impulse tube
19. Upper casing of diaphragm
20. Lower casing of diaphragm



**Function**

Pressure changes from flow and return pipes are being transferred through the impulse tubes to the actuator chambers and act on control diaphragm for diff. pressure and flow control. The diff. pressure is controlled by means of setting spring for diff. pressure control. Control valve closes on rising differential pressure and opens on falling differential pressure to maintain constant differential pressure. Flow volume is limited by means of the flow restrictor.

Controller is equipped with excess pressure safety valve, which protects control diaphragm for diff. pressure and flow control from too high differential pressure.

**Settings**

*Flow setting*

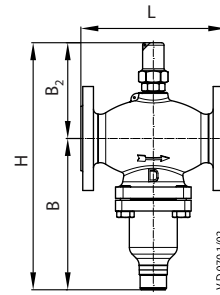
Flow setting is being done by the adjustment of the flow restrictor position. The adjustment can be performed on the basis of flow adjustment diagram (see relevant instructions) and/or by the means of heat meter.

*Differential pressure setting*

Differential pressure setting is being done by the adjustment of the setting spring for diff. pressure control. The adjustment can be done by means of adjuster for diff. pressure setting and pressure indicators.



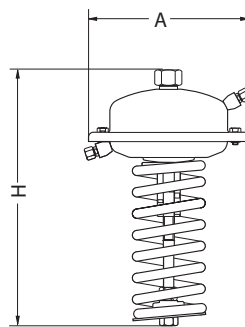
Dimensions



VFQ DN 15-125

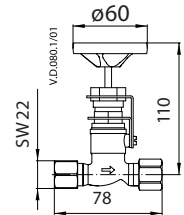
VFQ 2, VFQ 21 Valves

DN		15	20	25	32	40	50	65	80	100	125	
L		130	150	160	180	200	230	290	310	350	400	
B	mm	213	213	239	239	241	241	276	276	381	381	
B <sub>2</sub>		124	124	135	135	152	152	164	164	194	194	
H		337	337	374	374	393	393	440	440	575	575	
Weight	PN 16/25	kg	8	9	10,5	12,5	15,5	18,5	28,5	31	61	71
	PN 40								31	34	63	72

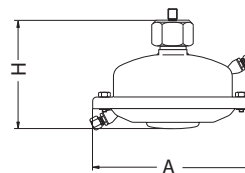


AFPB Actuator

Actuator size	cm <sup>2</sup>	250
∅ A	mm	263
H	mm	457
Weight	kg	9

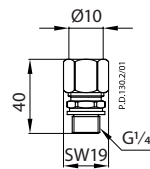


Shut off valve

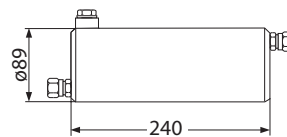


AFPB-F Actuator

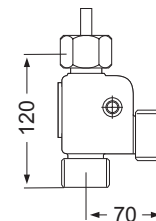
Actuator size	cm <sup>2</sup>	250
∅ A	mm	263
H	mm	160
Weight	kg	9



Compression fitting



Seal pot V1



Comb. piece KF2, KF3





