ENGINEERING
TOMORROW

Data sheet

Differential pressure and flow controller (PN 16, 25, 40)

AFPQ / VFQ 2(1) - return mounting, adjustable setting

AFPQ 4 / VFQ 2(1) - flow mounting, adjustable setting

Description

The controller is a self-acting differential pressure and flow controller 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 two control diaphragms and spring for differential pressure setting. Differential pressure control and flow control are independent.

Further on two valve versions are available:
- VFQ 2 with metallic sealing cone
- VFQ 21 with soft sealing cone (on special request)

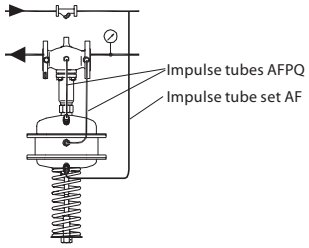
Main data:
- DN 15-250
- k_{VS} 4.0-400 m³/h
- Flow range: 0.1-250 m³/h
- PN 16, 25, 40
- Setting range: 0.1-0.7 bar / 0.15-1.5 bar
- Flow restrictor Δp_b: 0.2 bar or 0.5 bar
- Temperature:
  - Circulation water / glycolic water up to 30 %: 2 … 150/200 °C
- Connections:
  - Flange

Ordering

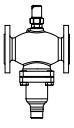
Example 1:
Differential pressure and flow controller; return mounting; DN 15; k_{VS} 4.0; PN 16; metallic sealing; setting range 0.1-0.7 bar; flow restrictor Δp_b 0.2 bar; T_{max} 150 °C; flange;

- *1× VFQ 2 DN 15 valve*
  Code no: ***065B2654***
- *1× AFPQ actuator*
  Code no: ***003G1029***
- *1× AFPQ DN 15 impulse tubes*
  Code no: ***003G1365***
- *1× Impulse tube set AF*
  Code no: ***003G1391***

Products will be delivered separatly.



VFQ 2 *Valves (metallic sealing cone)*

Picture	DN (mm)	k_{VS} (m³/h)	Connections	T_{max} (°C)	Code No. PN 16	T_{max} (°C)	Code No. PN 25	Code No. PN 40
	15	4.0	Flanges acc. to EN 1092-1	150	**065B2654**	200 [1]	**065B2667**	**065B2677**
	20	6.3			**065B2655**		**065B2668**	**065B2678**
	25	8.0			**065B2656**		**065B2669**	**065B2679**
	32	16			**065B2657**		**065B2670**	**065B2680**
	40	20			**065B2658**		**065B2671**	**065B2681**
	50	32			**065B2659**		**065B2672**	**065B2682**
	65	50			**065B2660**		**065B2673**	**065B2683**
	80	80			**065B2661**		**065B2674**	**065B2684**
	100	125			**065B2662**		**065B2675**	**065B2685**
	125	160			**065B2663**		**065B2676**	**065B2686**
	150	280		150	**065B2664**	150	–	**065B2687**
	200	320			**065B2758**		–	**065B2688**
	250	400			**065B2759**		–	**065B2689**

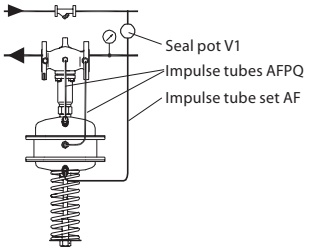
[1] *At temperatures above 150 °C only with seal pots (see Accessories)*

Ordering *(continued)*

Example 2:
Differential pressure and flow controller; return mounting; DN 15; k_{VS} 4.0; PN 25; metallic sealing; setting range 0.1-0.7 bar; flow restrictor Δp_b 0.2 bar; T_{max} 200 °C; flange;

- *1× VFQ 2 DN 15 valve*
  *Code no: **065B2667***
- *1× AFPQ actuator*
  *Code no: **003G1029***
- *1× AFPQ DN 15 impulse tubes*
  *Code no: **003G1365***
- *1× Impulse tube set AF*
  *Code no: **003G1391***
- *1× Seal pot V1*
  *Code no: **003G1392***

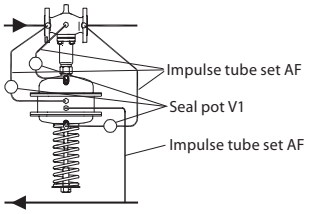
Products will be delivered separatly.



Example 3:
Differential pressure and flow controller; flow mounting; DN 15; k_{VS} 4.0; PN 25; metallic sealing; setting range 0.1-0.7 bar; flow restrictor Δp_b 0.2 bar; T_{max} 200 °C; flange;

- *1× VFQ 2 DN 15 valve*
  *Code no: **065B2667***
- *1× AFPQ actuator*
  *Code no: **00G1033***
- *4× Impulse tube set AF*
  *Code no: **003G1391***
- *3× Seal pot V1*
  *Code no: **003G1392***

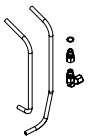
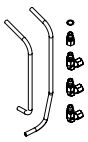
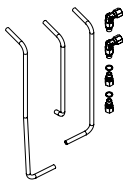
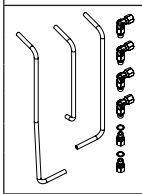
Products will be delivered separatly.

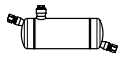
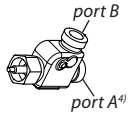


AFPQ / AFPQ 4 Actuators

Picture	Δp setting range (bar)	Flow restrictor Δp_b (bar)	Nominal pressure (PN)	Code No.	
				AFPQ (return)	AFPQ 4 (flow)
	0.1-0.7	0.2	40	**003G1029**	**003G1033**
		0.5		**003G1030**	**003G1034**
	0.15-1.5	0.2		**003G1031**	**003G1035**
		0.5		**003G1032**	**003G1036**

Accessories

Picture	Type designation	For controller	DN (mm)	PN	Code No.
	Impulse tubes [3] (Stainless steel)	AFPQ	15	16, 25, 40	**003G1365**
			20		
			25		**003G1367**
			32		
			40		**003G1369**
			50		**003G1370**
			65		**003G1371**
			80		
			100		**003G1373**
			125		**003G1374**
			150		**003G1375**
			200	16	**003G1416**
				40	**003G1376**
			250	16	**003G1417**
				40	**003G1405**
		AFPQ 4	15	16, 25, 40	**003G1378**
			20		
			25		**003G1380**
			32		
			40		**003G1382**
			50		**003G1383**
			65		**003G1384**
			80		
			100		**003G1386**
			125		**003G1387**
			150		**003G1388**
			200	16	**003G1418**
				40	**003G1389**
			250	16	**003G1419**
				40	**003G1406**

Picture	Type designation	Description	Ordering number		Code No.
	Impulse tube set AF	– 1× Copper tube Ø10 × 1 × 1500 mm – 1 × compression fitting for imp. tube connection to pipe (G ¼) – 2 × socket	–		**003G1391**
	Seal pot V1 [1]	Capacity 1 liter; with compression fittings for imp. tube Ø10	AFPQ	1×	**003G1392**
			AFPQ 4	3×	
	Compression fitting [2]	For impulse tube Ø10 connections to controller	G ¼		**003G1468**
	Combination piece KF3	For combination with pressure actuators. Electrical actuator connected on side (port B) only for ON/OFF function	G 1¼ / 2× G 1¼		**003G1441**
	Combination piece KF2	For combination with thermostat - side connection to port B			**003G1440**
	Shut off valve	For impulse tube Ø10	–		**003G1401**
	Throttle valve				**065B2909**

[1] *Seal pot has to be used on impulse tubes always when $T_{max} \geq 150$ °C*
[2] *Consist of a nipple, compression ring and nut*
[3] *With combination piece KF2 or KF3 use 2× **003G1391** at PN 16 and T<150 °C. Otherwise impulse tubes on special request.*
[4] *Port A - for connection of any type of actuator*

Ordering *(continuous)*

Service kits

Picture	Type designation	For valve	DN (mm)	k_{VS} (m^3/h)	Code No.
	Valve insert	VFQ 2	15	4.0	**065B2796**
			20	6.3	**065B2797**
			25	8	**065B2798**
			32	16	
			40	20	**065B2799**
			50	32	
			65	50	**065B2800**
			80	80	
			100	125	**065B2801**
			125	160	
			150	280	**065B2964**
			250	400	**065B2965**
	Stuffing cone (with EPDM O-rings)				**003G1464**

Technical data

Valve

Nominal diameter			**DN**	**15**	**20**	**25**	**32**	**40**	**50**	**65**	**80**	**100**	**125**	**150**	**200**	**250**
k_{VS} value of Δp controller				4.0	6.3	8.0	16	20	32	50	80	125	160	280	320	400
Range of max. flow setting	Δp_b [1] = 0.2 bar	from		0.1	0.2	0.2	0.4	0.6	0.8	3	4	6	8	12	15	18
		to	m^3/h	2	3	4	7	11	16	28	40	63	80	125	150	180
	Δp_b [1] = 0.5 bar	from		0.2	0.3	0.3	0.5	0.8	1.2	4	6	9	12	18	22	25
		to		3	4.5	6	10	16	24	40	58	90	120	180	220	250
Cavitation factor z				0.6	0.6	0.6	0.55	0.55	0.5	0.5	0.45	0.4	0.35	0.3	0.2	0.2
Leakage acc. to standard IEC 534 (% of k_{VS})		VFQ 2		≤ 0.03										≤ 0.05		
		VFQ 21		≤ 0.01												
Nominal pressure			PN	16, 25, 40												
Min. differential pressure for max flow [2]	Δp_b [1] = 0.2			0.5	0.4	0.5	0.4	0.5						0.4		
	Δp_b [1] = 0.5		bar	0.8	0.7	0.8	0.7	0.8						0.7		
Max. differential pressure		PN 16		16								15		12		10
		PN 25, 40		20												
Media				Circulation water / glycolic water up to 30 %												
Media pH				Min. 7, max. 10												
Media temperature		VFQ 2	°C	2 … 150/2 … 200 [3]										2 … 150		
		VFQ 21		2 … 150												
Connections				Flange												
Materials																
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										Stainless steel, mat. No. 1.4313		
Valve cone				Stainless steel, mat. No. 1.4404										Stainless steel, mat. No. 1.4021		
Sealing		VFQ 2		Metal												
		VFQ 21		EPDM												
Pressure relieve system				Bellows (Stainless steel, mat. No. 1.4571)										Diaphragm (EPDM)		

[1] *Δp_b – differential pressure over flow restrictor*

[2] *For flows smaller than Q_{max} ->* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

[3] *at temperatures above 150 °C only with seal pots (see Accessories)*

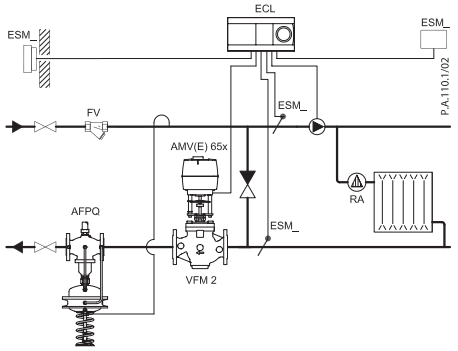
Technical data *(continuous)*

Actuator

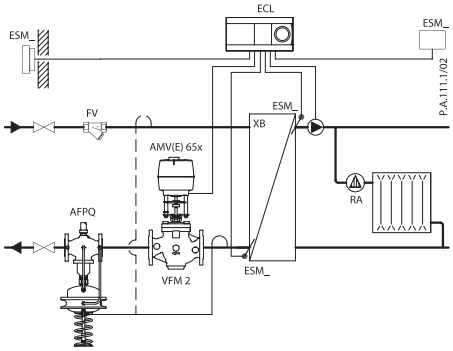
Type		AFPQ, AFPQ 4	
Actuator size	cm^2	250	
Nominal pressure	PN	40	
Flow restrictor diff. pressure Δp_b	bar	0.2 / 0.5	
Diff. pressure setting ranges and spring colours	bar	0.1-0.7	0.15-1.5
		yellow	red
Materials			
Actuator housing		Steel, mat. No.1.0338, zinc plated	
Control diaphragm		EPDM (Rolling; fibre enforced)	

Application principles

– Return mounting

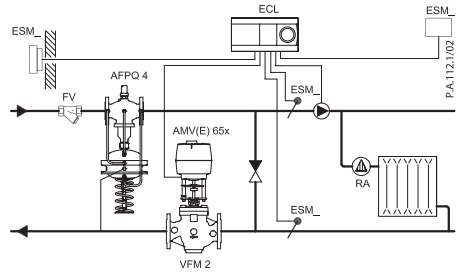


Direct-connected heating system

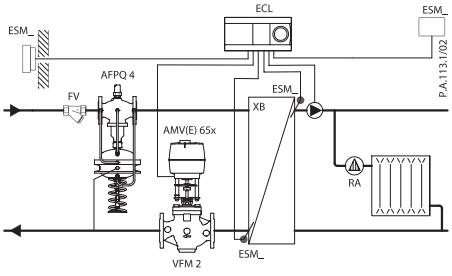


Indirectly connected heating system

– Flow mounting



Direct-connected heating system



Indirectly connected heating system

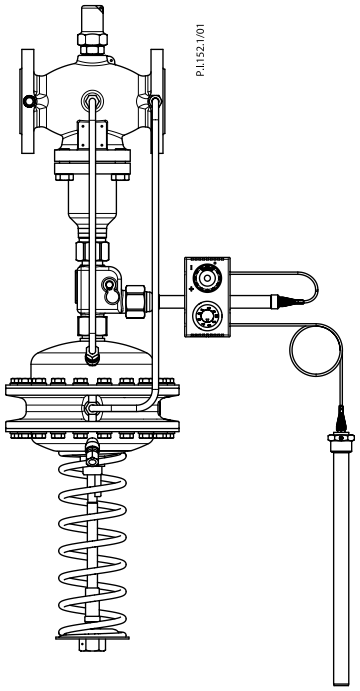
Combinations

Example:
Differential pressure, flow and temperature controller, return mounting; DN 15; k_{VS} 4.0; PN 16; metallic sealing; setting range 0.1-0.7 bar; flow restrictor Δp_b 0.2 bar; T_{max} 150 °C; flange;

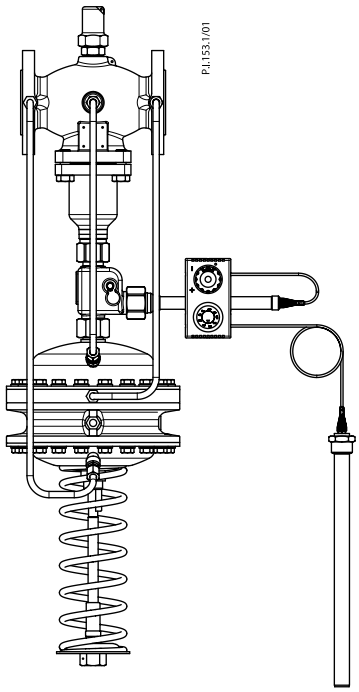
- *1× VFQ 2 DN 15 valve*
  Code no: **065B2654**
- *1× AFPQ actuator*
  Code no: **003G1029**
- *3× Impulse tube set AF*
  Code no: **003G1391**
- *1× AFT06 thermostat*
  Code no: **065-4390**
- *1× Combination piece KF2*
  Code no: **003G1398**

Products will be delievered separatelly.

Note:
For AFT 06 thermostat data see relevant data sheet



AFT 06 / KF2 / AFPQ / VFQ2
– Differential pressure, flow and temperature controller, return mounting



AFT 06 / KF2 / AFPQ 4 / VFQ2
– Differential pressure, flow and temperature controller, flow mounting

Installation positions

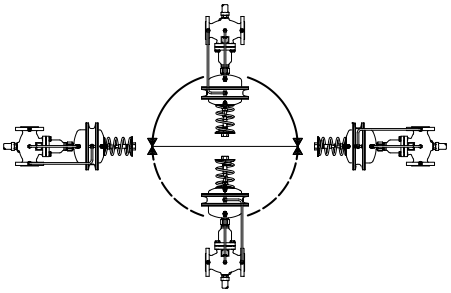
DN 15-80 T_{max} ≤ 120 °C

The controllers can be installed in any position.

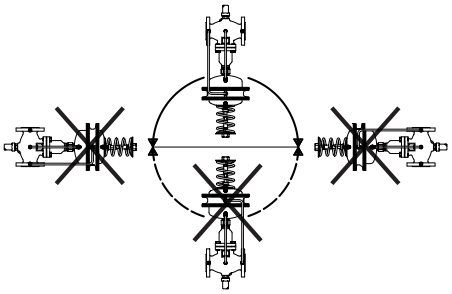
DN 15-80 T_{max} > 120 °C; DN 100-250

The controllers can be installed in horizontal pipes only, with a pressure actuator oriented downwards.

DN 15-80 T_{max} ≤ 120 °C

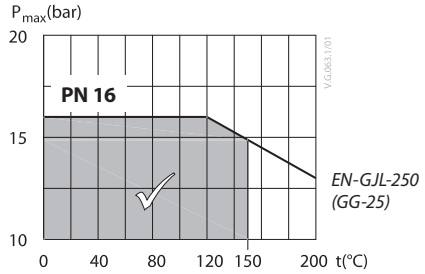


DN 15-80 T_{max} > 120 °C; DN 100-250

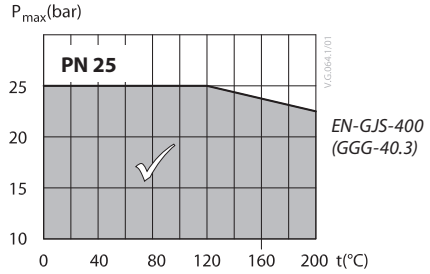


Pressure temperature diagram

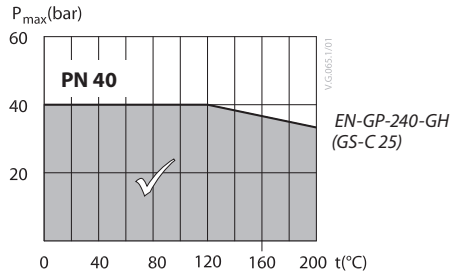
Working area is below P-T line and it ends at Tmax for each valve



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 1.900 l/h.

Given data:
Q_{max} = 1.9 m³/h (1.900 l/h)
Δp_{min} = 0.9 bar (90 kPa)
$\Delta p_{circuit}$ [1)] = 0.1 bar (10 kPa)
Δp_{MCV} = 0.3 bar (30 kPa) selected
Δp_b [2)] = 0.2 bar (20 kPa)
Remark:
[1)] *$\Delta p_{circuit}$ corresponds to the required pump pressure in the heating circuit and is not to be considered when sizing the AFPQ(4).*
[2)] *Δp_b is differential pressure over flow restrictor.*

The differential pressure set value is:
$\Delta p_{set\ value} = \Delta p_{MCV}$
$\Delta p_{set\ value}$ = 0.3 bar (30 kPa)

The total pressure loss across the controller is:
$\Delta p_{AFPQ} = \Delta p_{min} - \Delta p_{MCV} = 0.9 - 0.3$
Δp_{AFPQ} = 0.6 bar (60 kPa)

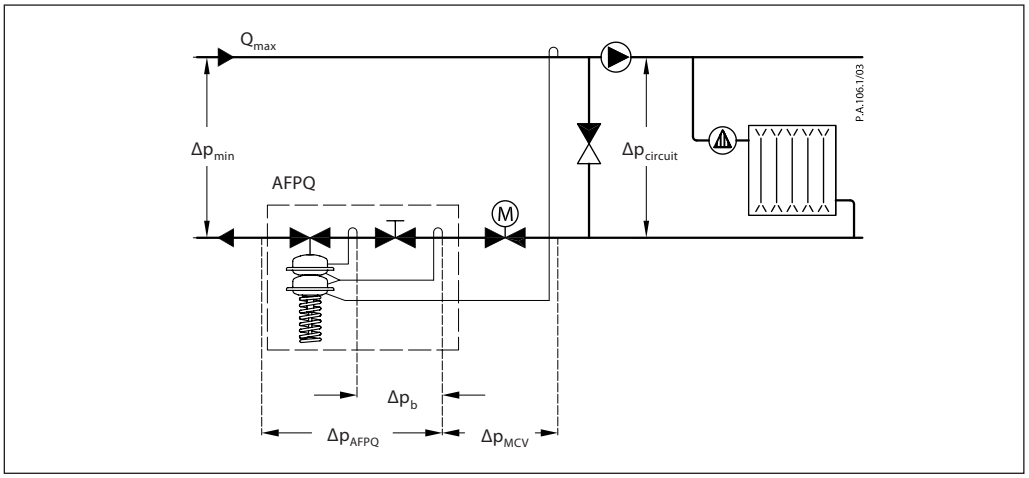
Possible pipe pressure losses in tubes, shut-off fittings, heatmeters, etc. are not included.

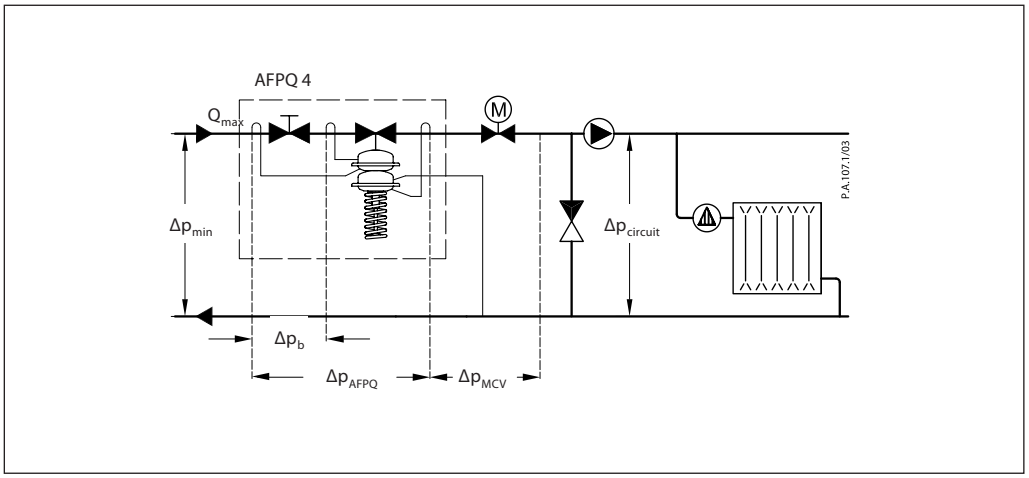
k_v value is calculated according to formula:

$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AFPQ} - \Delta p_b}} = \frac{1{,}9}{\sqrt{0{,}6 - 0{,}2}}$$

k_v = 3.0 m³/h

Solution:
The example selects AFPQ 4 DN 15, k_{VS} value 4.0, with differential pressure setting range 0.1-0.7 bar, flow setting range 0.1-2.0 m³/h.





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 1.800 l/h.

Given data:
Q_{max} = 1.8 m³/h (1.800 l/h)
Δp_{min} = 1.0 bar (100 kPa)
$\Delta p_{exchanger}$ = 0.05 bar (5 kPa)
Δp_{MCV} = 0.3 bar (30 kPa) selected
Δp_b [1)] = 0.2 bar (20 kPa)

Remark:
[1)] *Δp_b is differential pressure over flow restrictor*

The differential pressure set value is:
$\Delta p_{set\ value} = \Delta p_{exchanger} + \Delta p_{MCV}$
$\Delta p_{set\ value} = 0.05 + 0.3$
$\Delta p_{set\ value} = 0.35$ bar (35 kPa)

The total pressure loss across the controller is:
$\Delta p_{AFPQ} = \Delta p_{min} - \Delta p_{exchanger} - \Delta p_{MCV}$
$\Delta p_{AFPQ} = 1.0 - 0.05 - 0.3$
$\Delta p_{AFPQ} = 0.65$ bar (65 kPa)

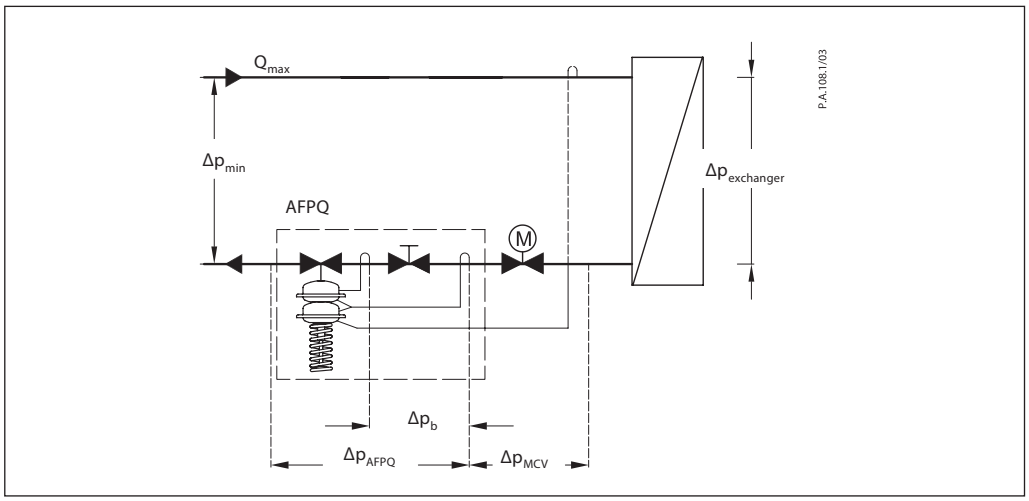
Possible pipe pressure losses in tubes, shut-off fittings, heatmeters, etc. are not included.

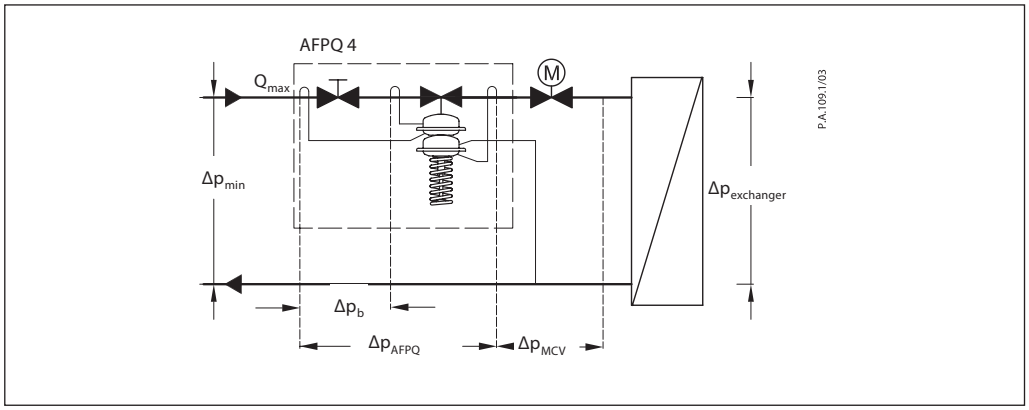
k_v value is calculated according to formula:

$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AFPQ} - \Delta p_b}} = \frac{1{,}8}{\sqrt{0{,}65 - 0{,}2}}$$

$k_v = 2.7$ m³/h

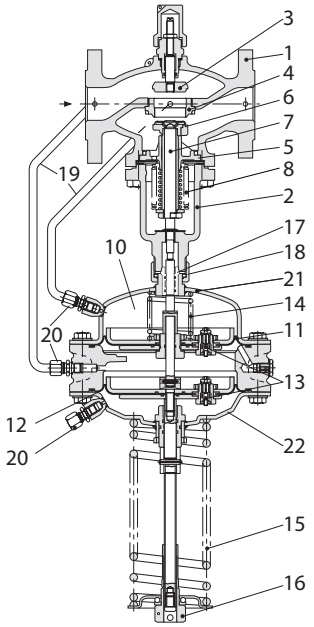
Solution:
The example selects AFPQ 4 DN 15, k_{VS} value 4.0, with differential pressure setting range 0.1-0.7 bar, flow setting range 0.1-2.0 m³/h.



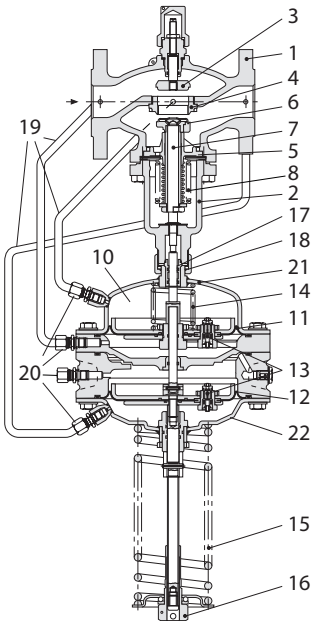


Design

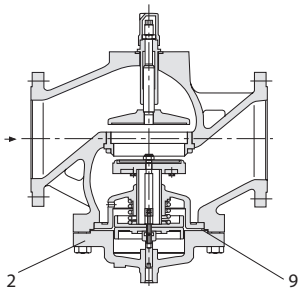
1. Valve body
2. Cover
3. Adjustable flow restrictor
4. Valve seat
5. Valve insert
6. Pressure relieved valve cone
7. Valve stem
8. Bellows for pressure relief of valve cone
9. Diaphragm for pressure relief of valve cone
10. Actuator
11. Control diaphragm for flow control
12. Control diaphragm for diff.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



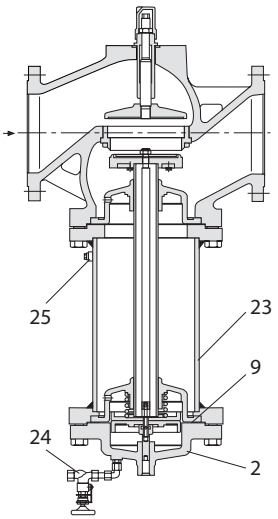
AFPQ VFQ 2(1), DN 15-125



AFPQ 4 VFQ 2(1), DN 15-125



VFQ 2(1) DN 150-250, T_{max} 150 °C



VFQ 2 DN 150-250, T_{max} 200 °C

Function

Flow volume causes pressure drop across the adjustable flow restrictor. Resulting pressures are being transferred through the impulse tubes to the actuator chambers and act on control diaphragm for flow control. The flow restrictor diff. pressure is controlled and limited by means of built-in spring for flow control. Control valve closes on rising differential pressure and opens on falling differential pressure to control max flow.

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 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.

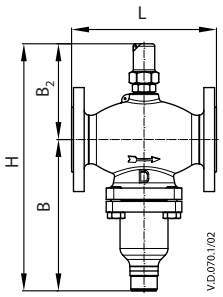
Controller is equipped with two excess pressure safety valves, which protect control diaphragms for flow and diff. pressure control from too high differential pressure.

Setting

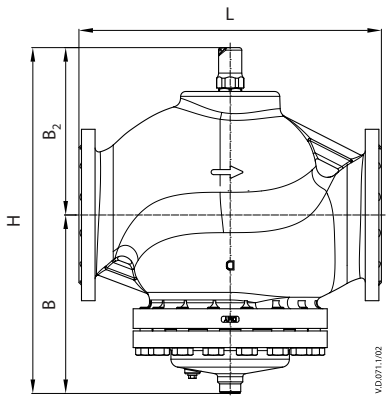
Flow setting
Flow setting is being done by the adjustment of the flow restrictor position. The adjustment can be performed on the basis of flow adjustment diagram (see relevant instructions) and/or by the means of heat meter.

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.

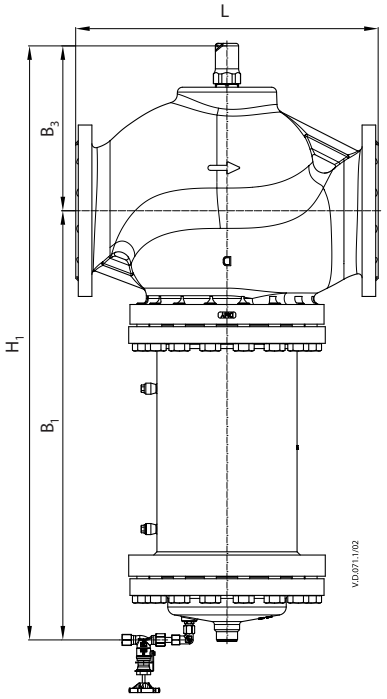
Dimensions



VFQ DN 15-125



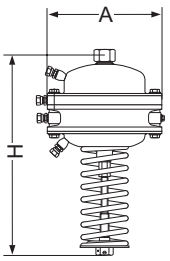
VFQ DN 150-250



VFQ DN 150-250
with valve body extension up to 200 °C

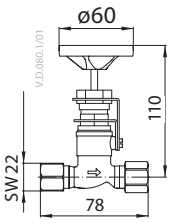
VFQ 2, VFQ 21 Valves

DN			15	20	25	32	40	50	65	80	100	125	150	200	250
L		mm	130	150	160	180	200	230	290	310	350	400	480	600	730
B		mm	213	213	239	239	241	241	276	276	381	381	326	354	401
B_2		mm	124	124	135	135	152	152	164	164	194	194	269	332	355
H		mm	337	337	374	374	393	393	440	440	575	575	595	686	756
Weight	PN 16 / 25	kg	8	9	10.5	12.5	15.5	18.5	28.5	31	61	71	120	193	337
	PN 40	kg							31	34	63	72	147	264	347
B_1		mm											620	852	1199
B_3		mm											269	332	356
H_1		mm											889	1184	1555
Weight (valve with body extension)	PN 16 / 25	kg											160	314	489
	PN 40	kg											187	350	526

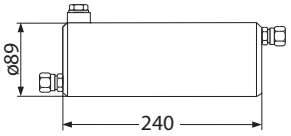


AFPQ, AFPQ 4 Actuators

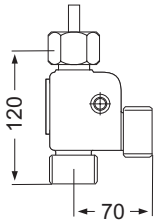
Actuator type		AFPQ / AFPQ 4
Ø A	mm	257
H for xs = 0.1-0.7 / 0.15-1.5	mm	520/540
Weight	kg	34



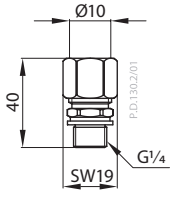
Shut off valve



Seal pot V1



Comb. piece KF2, KF3



Compression fitting

Danfoss A/S
Heating Segment • heating.danfoss.com • +45 7488 2222 • E-Mail: heating@danfoss.com