

Data sheet

Differential pressure and flow controller

AFPQ 2 / VFQ 22(1) – return mounting, adjustable setting

AFPQ 24 / VFQ 22(1) – flow mounting, adjustable setting

Description



virtus.danfoss.com



The controller is a self-acting differential pressure and flow controller primarily for use in district heating systems. Direct operated, reliable and high precise 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 22 with metallic sealing cone
- VFQ 221 with soft sealing cone

Together with Danfoss intelligent electrical actuator AMEi 6 intelligent optimization functions are available:

- iSET-intelligent substation efficiency optimization
- iNET-intelligent network balancing

Main data:

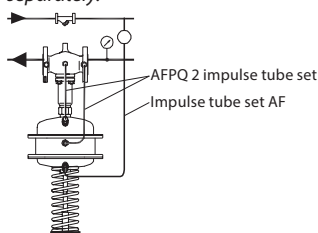
- DN 65-250
- k_{vs} 60-800 m³/h
- Flow range 5.6-500 m³/h
- PN 16, 25, 40
- Setting range: 0.2-1 bar / 0.5-1.5 bar
- Flow restrictor Δp_b : 0.2 bar or 0.5 bar
- Temperature: – Circulation water / glycolic water up to 30%: 2 ... 150°C
- Connections: – Flange

Ordering

Example 1:
Differential pressure controller,
return mounting, DN 65, k_{vs} 60,
PN 16, metallic sealing, setting
range 0.5-1.5 bar, flow restrictor
 Δp_b 0.2 bar, T_{max} 150 °C, flange

- 1x VFQ 22 DN 65 valve
Code no: **065B5570**
- 1x AFPQ 2 actuator
Code no: **003G5712**
- 1x AFPQ 2 DN 65 impulse tube set
Code no: **003G1838**
- 1x Impulse tube set AF
Code no: **003G1391**

Products will be delivered
separately.

**VFQ 22 Valve (metallic sealing cone)**

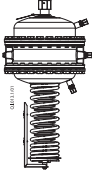
Picture	DN (mm)	k_{vs} (m ³ /h)	Connections	T_{max} (°C)	Code No.		
					PN 16	PN 25	PN 40
	65	60	Flanges acc. to EN 1092-1	150	065B5570	065B5577	065B5584
	80	80			065B5571	065B5578	065B5585
	100	160			065B5572	065B5579	065B5586
	125	250			065B5573	065B5580	065B5587
	150	380			065B5574	065B5581	065B5588
	200	650			065B5575	065B5582	065B5589
	250	800			065B5576	065B5583	065B5590

VFQ 221 Valve (soft sealing cone)

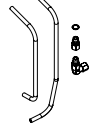
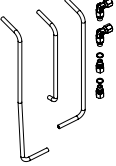
Picture	DN (mm)	k_{vs} (m ³ /h)	Connections	T_{max} (°C)	Code No.		
					PN 16	PN 25	PN 40
	65	60	Flanges acc. to EN 1092-1	150	065B5600	065B5607	065B5614
	80	80			065B5601	065B5608	065B5615
	100	160			065B5602	065B5609	065B5616
	125	250			065B5603	065B5610	065B5617
	150	380			065B5604	065B5611	065B5618
	200	650			065B5605	065B5612	065B5619
	250	800			065B5606	065B5613	065B5620

Ordering (continuous)

AFPQ 2 / AFPQ 24 Actuators

Picture	Actuator size (cm ²)	Δp setting range (bar)	Flow restrictor Δp_b (bar)	for DN	Code No.	
					AFPQ 2 (return)	AFPQ 24 (flow)
	160	0.2 - 1	0.2	65-125	003G5710	003G5718
			0.5		003G5711	003G5719
		0.5 - 1.5	0.2		003G5712	003G5720
			0.5		003G5713	003G5721
	320	0.2 - 1	0.2	150-250	003G5714	003G5722
			0.5		003G5715	003G5723
		0.5 - 1.5	0.2		003G5716	003G5724
			0.5		003G5717	003G5725

Accessories - Impulse tube set

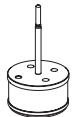
Picture AFPQ 2 (return)	Picture AFPQ 24 (flow)	Actuator size (cm ²)	Valve (DN)	Code No.	
				AFPQ 2 (return)	AFPQ 24 (flow)
		160	65	003G1838	003G1839
			80	003G1844	003G1847
			100	003G1845	003G1848
			125	003G1846	003G1849
		320	150	003G1865	003G1871
			200	003G1866	003G1872
			250	003G1867	003G1873

Accessories

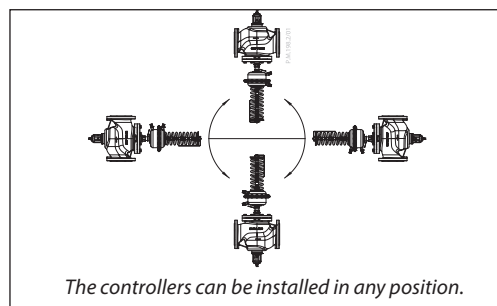
Picture	Type designation	Description	Connections	Code No.
	Impulse tube set AF	– 1x Copper tube Ø10 × 1 × 1500 mm – 1x compression fitting for imp. tube connection to pipe (G ¼) – 2x socket	–	003G1391
	Compression fitting ¹⁾	For impulse tube Ø10 connections to controller	G ¼	003G1468
	Shut off valve	For impulse tube Ø10	–	003G1401
	Static throttle valve			065B2909
	Adapter	For combination of new Virtus pressure actuators AFx 2, with old generation of valves VFx 2 (DN15-250)	–	003G1780
	AMEi 6 iSET el. actuator 230 V	Intelligent Δp actuator with iSET function		082G4300
	AMEi 6 iSET el. actuator 24 V			082G4301
	AMEi 6 iNET el. actuator 230 V	Intelligent Δp actuator with iNET function		082G4302
	AMEi 6 iNET el. actuator 24 V			082G4303

¹⁾ Consist of a nipple, compression ring and nut

Service kits

Picture	Type	k_{vs} (m³/h)	PN	DN	Code No.
	Pressure control insert VFG/Q 22	60	16/25/40	65	003G1800
		80		80	003G1801
		160		100	003G1802
		250		125	003G1803
		380		150	003G1804
		650		200	003G1805
		800		250	003G1806
	Pressure control insert VFG/Q 221	60		65	003G1807
		80		80	003G1808
		160		100	003G1809
		250		125	003G1810
		380		150	003G1811
		650		200	003G1812
		800		250	003G1813
	Pressure stuffing box VFG/Q 221			65-125	003G1730
				150-250	003G1731

Installation position



Technical data

VFQ 22 (1) Valve

Nominal diameter			DN	65	80	100	125	150	200	250
k _{vs} value of Δp controller			m³/h	60	80	160	250	380	650	800
Range of max. flow setting	Δp _b ¹⁾ = 0.2 bar	from		3	4	8	12	19	27	36
		to		28	40	63	100	160	270	360
	Δp _b ¹⁾ = 0.5 bar	from		4	6	11	18	24	31	45
		to		42	60	95	150	240	340	500
Cavitation factor z			0.65	0.55	0.4	0.4	0.4	0.35	0.3	
Leakage acc. to standard IEC 534 (% of k _{vs})		VFQ 22	≤ 0.03					≤ 0.05		
		VFQ 221	≤ 0.01							
Nominal pressure			PN	16, 25, 40						
Min. differential pressure			bar	see remark ²⁾						
Max. differential pressure PN 16				16	15	15	12	10	10	
Max. differential pressure PN 25/40				20						
Pressure relieve system			Chamber relieved							
Pressure relieve system			Circulation water / glycolic water up to 30%							
Media pH			Min. 7, max. 10							
Media temperature			°C	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 / Valve cone			Stainless steel, mat. No. 1.4021							
Sealing			EPDM							

¹⁾ Δp_b – differential pressure over flow restrictor

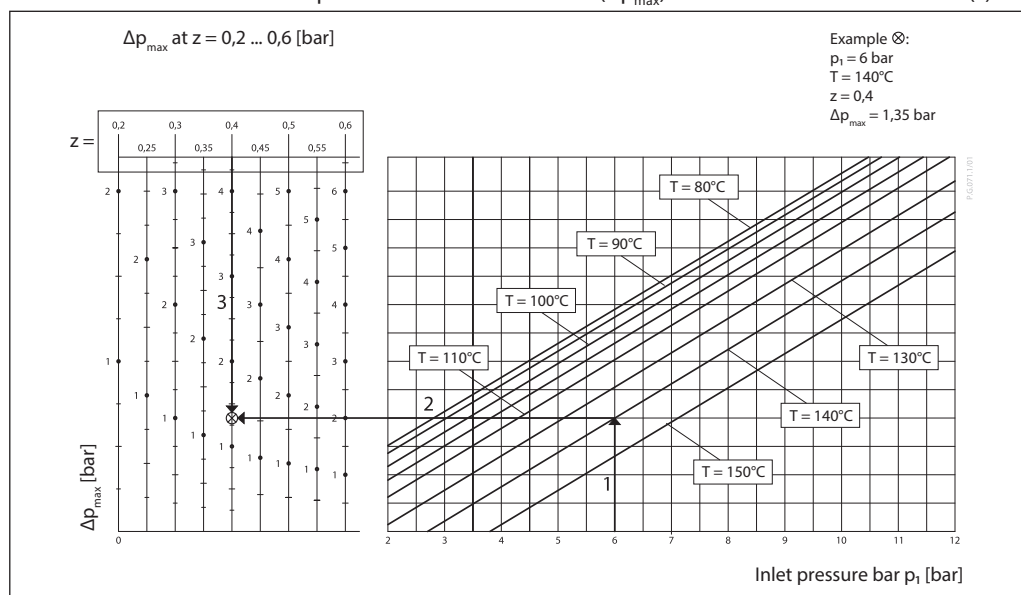
²⁾ For flows smaller than Q_{max}. -> Δp_{min} = $\left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

AFPQ 2(4) Actuator

Actuator size	cm ²	160		320	
Max. operating pressure	bar	40			
Flow restrictor differential pressure Δp _b	bar	0.2/0.5			
Diff. pressure setting ranges and spring colours		0.2-1	0.5-1.5	0.2-1	0.5-1.5
		blue	yellow	orange	red
For valve DN		65-125		65-250	
Materials					
Actuator housing		Steel, mat. No. 1.0345, zinc plated			
Control diaphragm		EPDM (Rolling; fibre enforced)			
Impulse tube set AFPQ 2(4)		Stainless steel, mat. No. 1.4571			

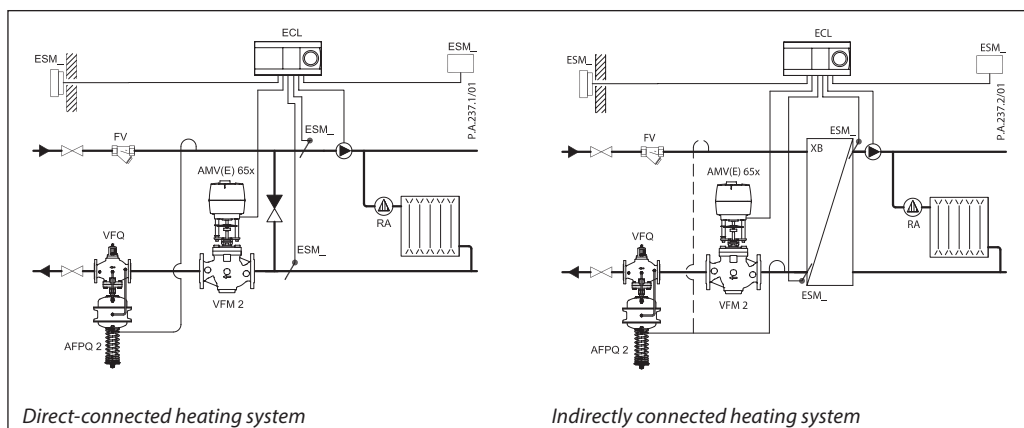
Operating area

Maximum allowed differential pressure over the controller (Δp_{max}) at different cavitation factors (z)

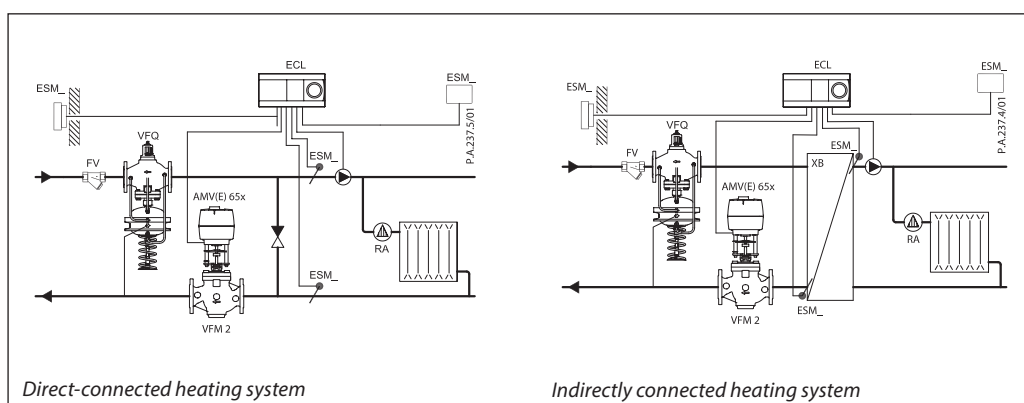


Application principles

– Return mounting

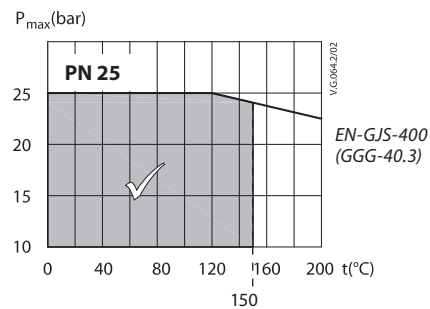
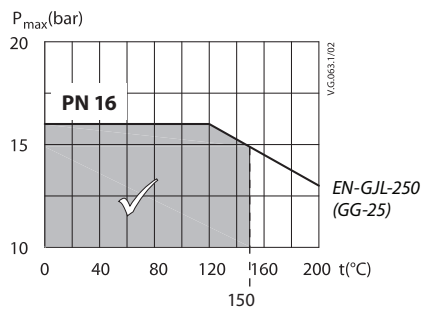


– Flow mounting

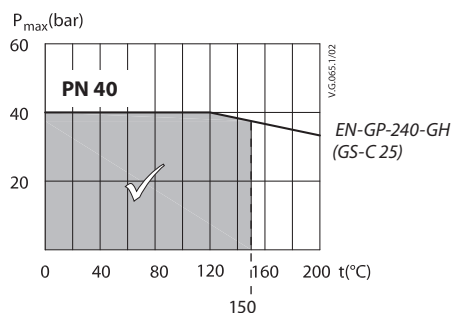


Pressure temperature diagram

Working area is below P-T line and it ends at T_{max} 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 1092-1)

Sizing

- Directly connected heating system

Example 1

Motorised control valve (MCV) for mixing circuit in direct-connected heating system requires differential pressure of 0.5 bar (50 kPa) and flow less than 25.000 l/h.

Given data:

$Q_{\max} = 25 \text{ m}^3/\text{h}$ (25.000 l/h)
 $\Delta p_{\min} = 1 \text{ bar}$ (100 kPa)
 $\Delta p_{\text{circuit}}^{1)} = 0.1 \text{ bar}$ (10 kPa)
 $\Delta p_{\text{MCV}} = 0.5 \text{ bar}$ (50 kPa) selected
 $\Delta p_b^{2)} = 0.2 \text{ bar}$ (20 kPa)

Remark:

¹⁾ $\Delta p_{\text{circuit}}$ 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:

$\Delta p_{\text{set value}} = \Delta p_{\text{MCV}}$
 $\Delta p_{\text{set value}} = 0.5 \text{ bar}$ (50 kPa)

The total pressure loss across the controller is:

$\Delta p_{\text{AFPQ}} = \Delta p_{\min} - \Delta p_{\text{MCV}} = 1 - 0.5$
 $\Delta p_{\text{AFPQ}} = 0.5 \text{ bar}$ (50 kPa)

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

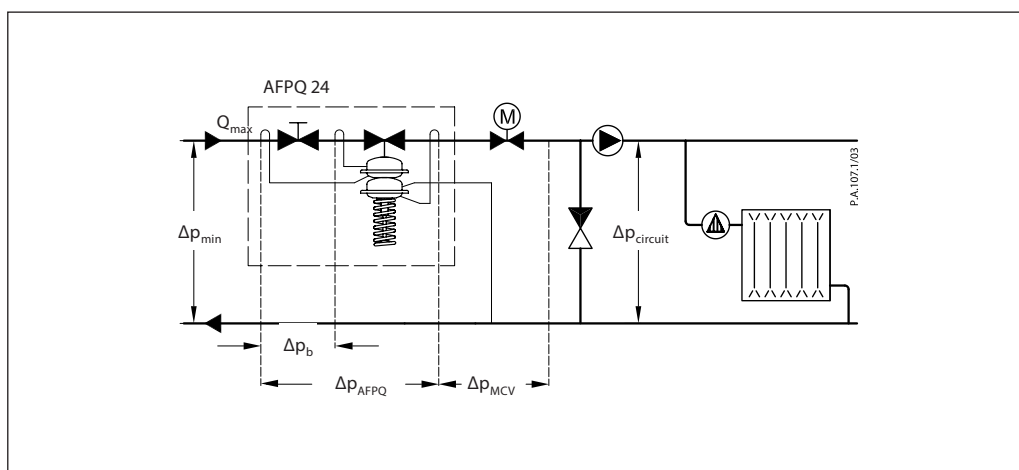
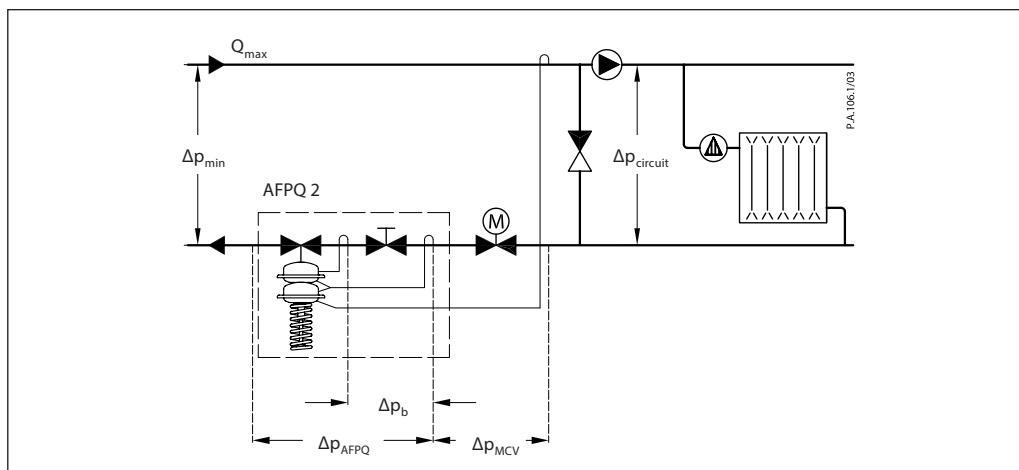
k_v value is calculated according to formula:

$$k_v = \frac{Q_{\max}}{\sqrt{\Delta p_{\text{AFPQ}} - \Delta p_b}} = \frac{25}{\sqrt{0.5 - 0.2}}$$

$k_v = 45.6 \text{ m}^3/\text{h}$

Solution:

The example selects AFPQ 2 (return mounting) or AFPQ 24 (flow mounting) DN 65, k_{v5} value 60, with differential pressure setting range 0.2-1 bar, flow setting range 5.6-28 m³/h.



Sizing (continuous)

- Indirectly connected heating system

Example 2

Motorised control valve (MCV) for indirectly connected heating system requires differential pressure of 0.5 (50 kPa) bar and flow less than 24.000 l/h.

Given data:

$Q_{\max} = 24 \text{ m}^3/\text{h}$ (24.000 l/h)
 $\Delta p_{\min} = 1.0 \text{ bar}$ (100 kPa)
 $\Delta p_{\text{exchanger}} = 0.1 \text{ bar}$ (10 kPa)
 $\Delta p_{\text{MCV}} = 0.5 \text{ bar}$ (50 kPa) selected
 $\Delta p_b^{1)} = 0.2 \text{ bar}$ (20 kPa)

Remark:

¹⁾ Δp_b is differential pressure over flow restrictor

The differential pressure set value is:

$\Delta p_{\text{set value}} = \Delta p_{\text{exchanger}} + \Delta p_{\text{MCV}}$
 $\Delta p_{\text{set value}} = 0.1 + 0.5$
 $\Delta p_{\text{set value}} = 0.6 \text{ bar}$ (60 kPa)

The total pressure loss across the controller is:

$\Delta p_{\text{AFPQ}} = \Delta p_{\min} - \Delta p_{\text{exchanger}} - \Delta p_{\text{MCV}}$
 $\Delta p_{\text{AFPQ}} = 1.0 - 0.1 - 0.5$
 $\Delta p_{\text{AFPQ}} = 0.4 \text{ bar}$ (40 kPa)

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

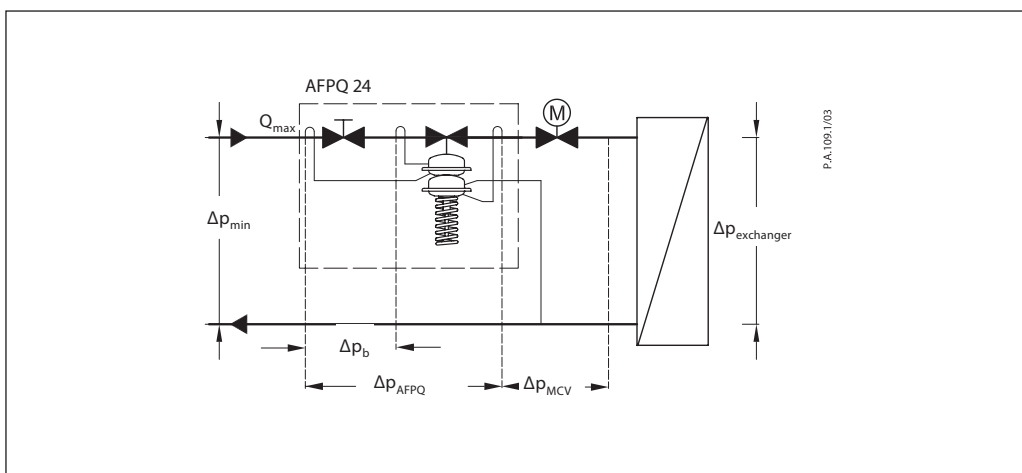
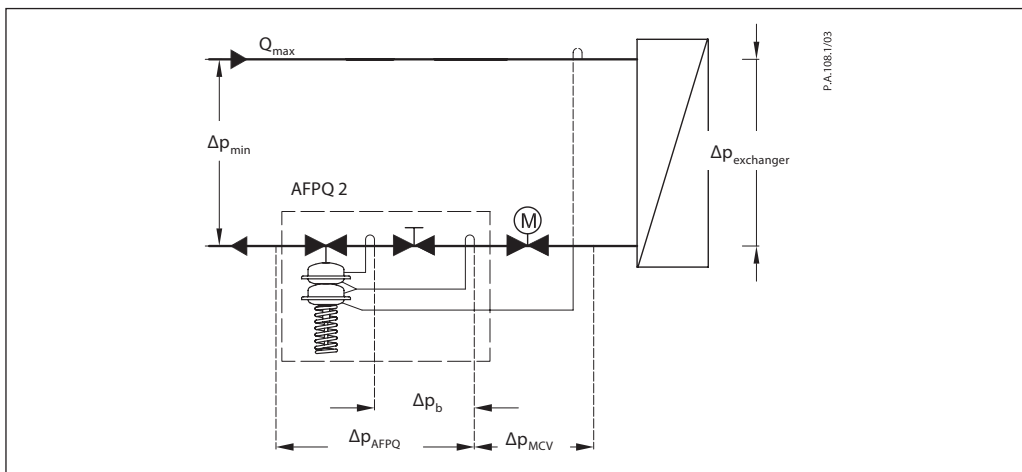
k_v value is calculated according to formula:

$$k_v = \frac{Q_{\max}}{\sqrt{\Delta p_{\text{AFPQ}} - \Delta p_b}} = \frac{24}{\sqrt{0.4 - 0.2}}$$

$k_v = 53.7 \text{ m}^3/\text{h}$

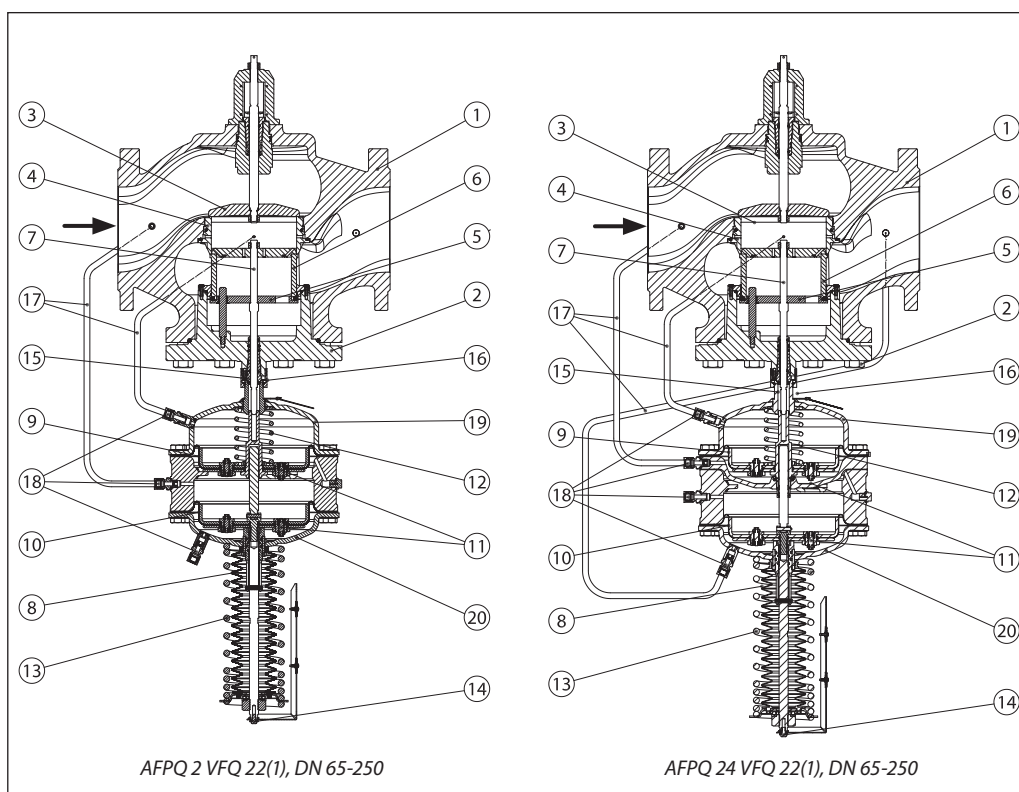
Solution:

The example selects AFPQ 2 (return mounting) or AFPQ 24 (flow mounting) DN 65, k_{vs} value 60, with differential pressure setting range 0.2-1 bar, flow setting range 5.6-28 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. Stem thread protection bellow
9. Control diaphragm for flow control
10. Control diaphragm for diff. pressure control
11. Excess pressure safety valve
12. Built-in spring for 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

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.

Settings

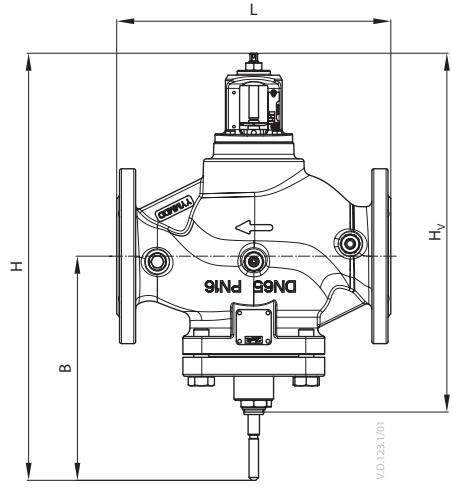
Differential pressure setting

Differential pressure setting is being done by the adjustment of the setting spring for diff. pressure control. This is done by rotating the differential pressure setting nut. Set differential pressure should be checked by observing the pressure indicators.

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.

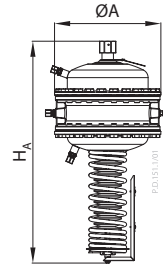
Dimensions



VFQ 22(1) DN 65-250

VFQ 22, VFQ 221 Valves

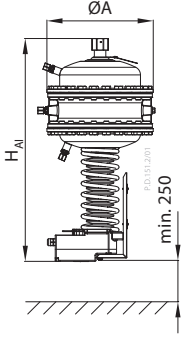
DN	L	B	H	H _v	Weight		
					PN 16	PN 25	PN 40
					mm		
65	290	237	473	396	28	29	31
80	310	237	473	396	33	34	36
100	350	272	547	472	52	53	57
125	400	268	582	514	71	72	79
150	480	326	670	610	123	126	135
200	600	361	773	713	230	236	286
250	730	419	843	783	382	392	441



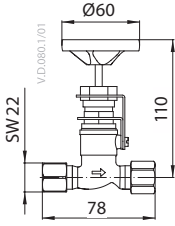
AFPQ 2, AFPQ 24 Actuators

Type	Size	ØA	H _A	H _{AI}	Weight (kg)	
					AFPQ 2(4)	AFPQ 2(4) + AMEi 6
AFPQ 2	160	230	630	730	26	29
	320	300	630	730	38	41
AFPQ 24	160	230	650	750	33	36
	320	300	650	750	45	48

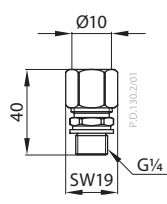
Total installation height of the controller (VFQ 22(1) valve + AFPQ 2 pressure actuator) is sum of H_v and H_A (H_{AI})



AMEi 6 intelligent actuator with iSET/ iNET functionality should be ordered separately



Shut off valve



Compression fitting



Danfoss A/S

Climate Solutions • danfoss.com • +45 7488 2222

Any information, including, but not limited to information on selection of product, its application or use, product design, weight, dimensions, capacity or any other technical data in product manuals, catalogues descriptions, advertisements, etc. and whether made available in writing, orally, electronically, online or via download, shall be considered informative, and is only binding if and to the extent, explicit reference is made in a quotation or order confirmation. Danfoss cannot accept any responsibility for possible errors in catalogues, brochures, videos and other material. Danfoss reserves the right to alter its products without notice. This also applies to products ordered but not delivered provided that such alterations can be made without changes to form, fit or function of the product.

All trademarks in this material are property of Danfoss A/S or Danfoss group companies. Danfoss and the Danfoss logo are trademarks of Danfoss A/S. All rights reserved.