ENGINEERING
TOMORROW

Data sheet

Differential pressure controller with flow limitation
AFPB 2 / VFQ 22(1) – return mounting, adjustable setting
AFPB-F 2 / VFQ 22(1) – return mounting, fixed setting

Description

virtus.danfoss.com

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 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

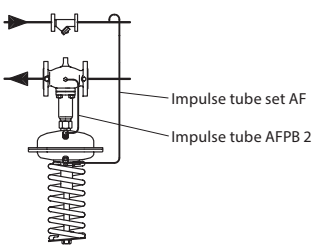
Main data:
- DN 65-250
- k_{VS} 60-800 m³/h
- Flow limitation range 3.8-500 m³/h
- PN 16, 25, 40
- Setting range: 0.1-1 bar / 0.4 (0.5)-1.5 bar
- Temperature: – Circulation water / glycolic water up to 30%: 2 … 150°C
- Connections: Flange

Ordering

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

– 1× *VFQ 22 DN 65 valve*
*Code no: **065B5570***
– 1× *AFPB 2 actuator*
*Code no: **003G5608***
– 1× *AFPB 2 DN 65 impulse tubes*
*Code no: **003G1842***
– 1× *Impulse tube set AF*
*Code no: **003G1391***

Products will be delivered separately.



VFQ 22 Valve (metallic sealing cone)

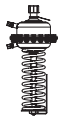
Picture	DN (mm)	k_{VS} (m³/h)	Connections	$T_{max.}$ (°C)	Code No.		
					PN 16	PN 25	PN 40
	65	60	Flanges acc. to EN 1092-1	150	**065B5570**	**065B5577**	**065B5584**
	80	80			**065B5571**	**065B5578**	**065B5585**
	100	160			**065B5572**	**065B5579**	**065B5586**
	125	250			**065B5573**	**065B5580**	**065B5587**
	150	380			**065B5574**	**065B5581**	**065B5588**
	200	650			**065B5575**	**065B5582**	**065B5589**
	250	800			**065B5576**	**065B5583**	**065B5590**

VFQ 221 Valve (soft sealing cone)

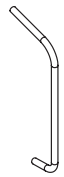
Picture	DN (mm)	k_{VS} (m³/h)	Connections	$T_{max.}$ (°C)	Code No.		
					PN 16	PN 25	PN 40
	65	60	Flanges acc. to EN 1092-1	150	**065B5600**	**065B5607**	**065B5614**
	80	80			**065B5601**	**065B5608**	**065B5615**
	100	160			**065B5602**	**065B5609**	**065B5616**
	125	250			**065B5603**	**065B5610**	**065B5617**
	150	380			**065B5604**	**065B5611**	**065B5618**
	200	650			**065B5605**	**065B5612**	**065B5619**
	250	800			**065B5606**	**065B5613**	**065B5620**

Ordering *(continuous)*

AFPB 2 / AFPB-F 2 Actuators

Picture	Δp setting range (bar)	Possible combinations with DN							Actuator size (cm²)	Spring colour	Code No.	
		65	80	100	125	150	200	250			PN16	PN40
	0.5-1.5	✓	✓	✓	✓	-	-	-	160	yellow	**003G5608**	**003G5618**
	0.4-1.5	-	-	-	-	✓	✓	✓	320	red	**003G5609**	**003G5619**
	0.1-1	✓	✓	✓	✓	-	-	-	160	blue	**003G5612**	**003G5622**
	0.1-1	-	-	-	-	✓	✓	✓	320	orange	**003G5610**	**003G5620**
	0.2	✓	✓	✓	✓	-	-	-	160	-	**003G5600**	**003G5602**
	0.5	✓	✓	✓	✓	-	-	-	160	-	**003G5601**	**003G5603**
	0.2	-	-	-	-	✓	✓	✓	320	-	**003G5596**	**003G5598**
	0.5	-	-	-	-	✓	✓	✓	320	-	**003G5597**	**003G5599**

Impulse tubes

Picture AFPB(-F) 2	Actuator size (cm²)	Valve (DN)	Code No.
	160	65	**003G1842**
		80	**003G1856**
		100	**003G1857**
		125	**003G1858**
	320	150	**003G1859**
		200	**003G1860**
		250	**003G1861**

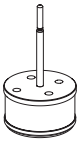
Accessories

Picture	Type designation	Description	Connections	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**
	Compression fitting [1]	For impulse tube Ø10 connections to controller	G¼	**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**

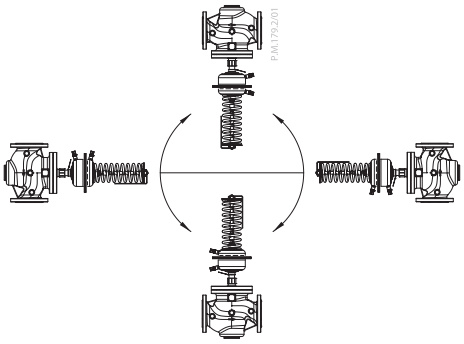
[1] *Consist of a nipple, compression ring and nut*

Ordering *(continuous)*

Service kits

Picture	Type	k_{VS} (m^3/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



The controllers can be installed in any 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 [1]	Δp_{SP}	Δp_{SISTEM}	Δp_b								
	0.2	0.1	0.1	m³/h	19	25	51	79	120	206	253
	0.5	0.3	0.2		28	40	63	100	160	270	360
	1.0	0.5	0.5		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})					≤ 0.03				≤ 0.05		
					≤ 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 relievement system					Chamber relieved						
Media					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] *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 sprecified for 3 different situations.*
$\Delta p_{SP} = \Delta p_{SYSTEM} + \Delta p_b$
Δp_{SP} -differential pressure set point
Δp_{SYSTEM} -system diferential pressure
Δp_b -differential pressure over flow restrictor

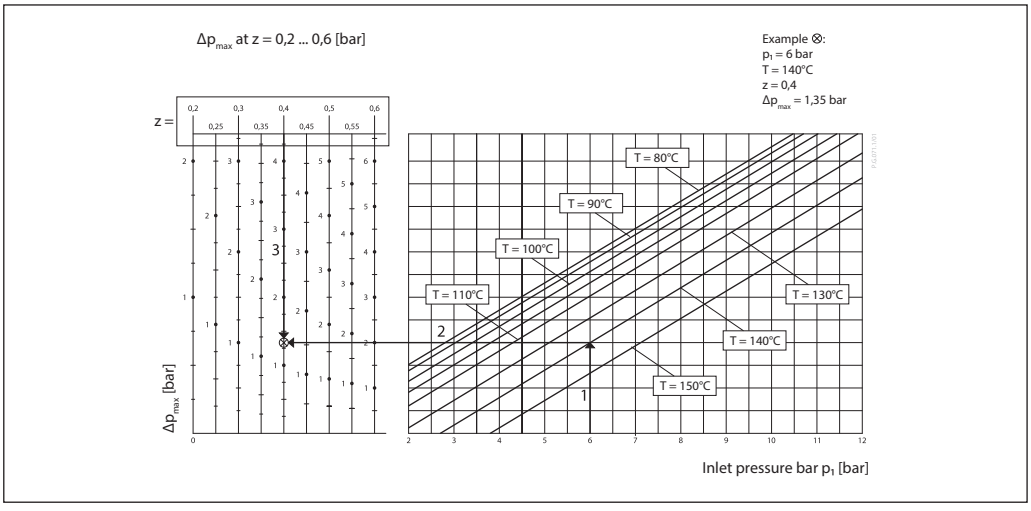
[2] *Depends on the flow rate and valve k_{VS}; For $Q_{set} = Q_{max}$ –> $\Delta p_{min} \geq 0.5$ bar; For $Q_{set} < Q_{max}$ –>* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

AFPB(-F) 2 Actuator

Type		**AFPB 2**				**AFPB-F 2**	
Actuator size	cm^2	160		320		160	320
Max. operating pressure	bar	16, 40					
Diff. pressure setting ranges and spring colour		0.1-1	0.5-1.5	0.1-1	0.4-1.5	0.2/0.5	
		blue	yellow	orange	red	-	-
For valve DN		65-125		150-250		65-125	150-250
Materials							
Actuator housing		Steel, mat. No. 1.0345, zinc plated					
Control diaphragm		EPDM (Rolling; fibre enforced)					

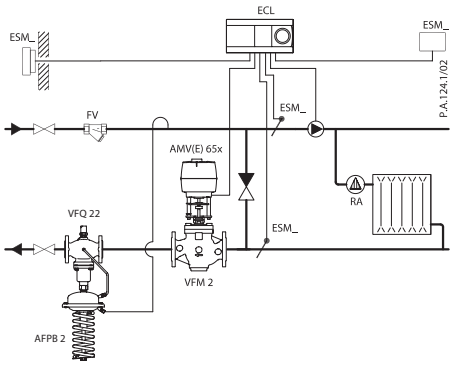
Operating area

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

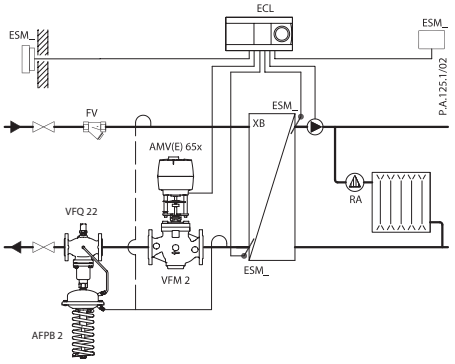


Application principles

– Return mounting



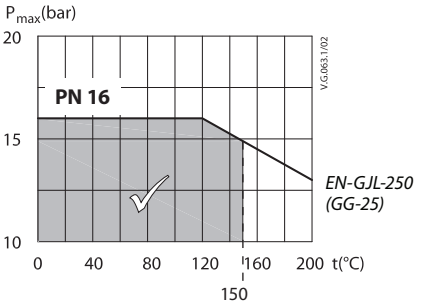
Direct-connected heating system

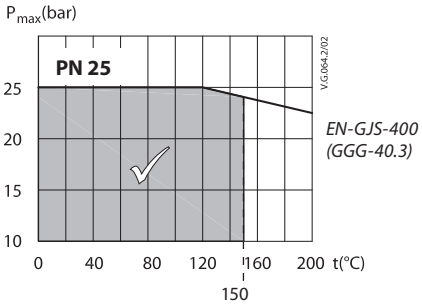


Indirectly connected heating system

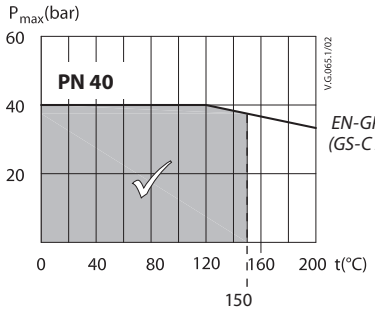
Pressure temperature diagram

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 0.3 bar (30 kPa) and flow less than 25.000 l/h.

Given data:
Q_{max} = 25 m³/h (25.000 l/h)
Δp_{min} = 0.7 bar (70 kPa)
$\Delta p_{circuit}$ [1)] = 0.1 bar (10 kPa)
Δp_{MCV} = 0.3 bar (30 kPa) selected
Δp_b [2)] = 0.1 bar (10 kPa) assumption
Remark:
[1)] *$\Delta p_{circuit}$ corresponds to the required pump pressure in the heating circuit and is not to be considered when sizing the AFPB.*
[2)] *Δp_b is differential pressure over flow restrictor.*

is differential pressure over flow restrictor.
$\Delta p_{set\ value} = \Delta p_b - \Delta p_{MCV} = 0.1 - 0.3$
$\Delta p_{set\ value} = 0.4$ 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)

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:

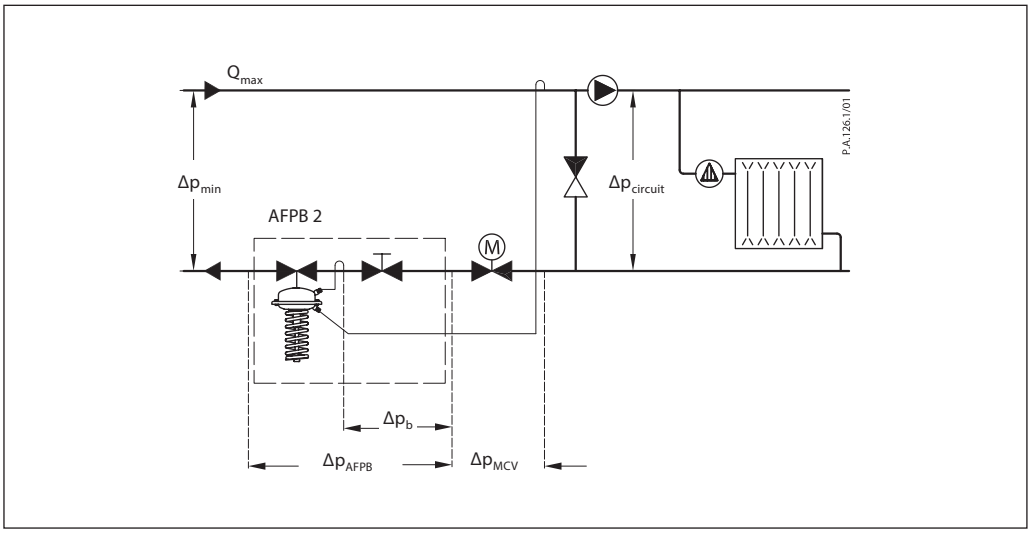
$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AFPB} - \Delta p_b}} = \frac{25}{\sqrt{0.4 - 0.1}}$$

$k_v = 45.6$ m³/h

Solution:
The example selects AFPB 2/VFQ 22 DN 80; k_{VS} value 80 m³/h; with differential pressure setting range 0.1-1 bar; maximum flow 25 m³/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 0.5 (50 kPa) bar and flow less than 24.000 l/h.

Given data:
Q_{max} = 24 m³/h (24.000 l/h)
Δp_{min} = 1 bar (100 kPa)
$\Delta p_{exchanger}$ = 0.1 bar (10 kPa)
Δp_{MCV} = 0.5 bar (50 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:
$\Delta p_{set\ value} = \Delta p_b + \Delta p_{exchanger} + \Delta p_{MCV} = 0.2 + 0.1 + 0.5$
$\Delta p_{set\ value}$ = 0.8 bar (80 kpa)

The total pressure loss across the controller is:
$\Delta p_{AFPB} = \Delta p_{min} - \Delta p_{exchanger} - \Delta p_{MCV} = 1 - 0.1 - 0.5$
Δp_{AFPB} = 0.4 bar (40 kpa)

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

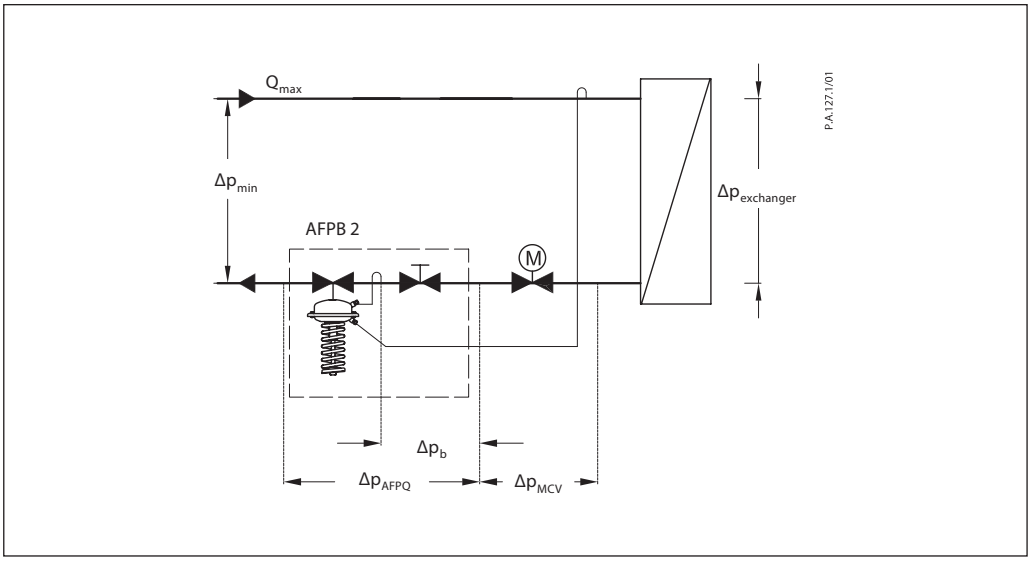
kv value is calculated according to formula:

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

k_v = 53.7 m³/h

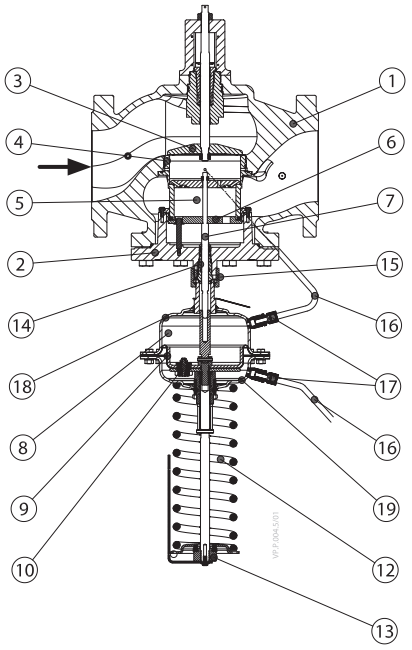
Solution:
The example selects AFPB 2/VFQ 22 DN 65; k_{VS} value 60 m³/h; with differential pressure setting range 0.1-1 bar; maximum flow 28 m³/h. If other differential pressure is assumed than Δp_b = 0.1 bar, in order to maintain the k_{VS} value, the flow has to be adjusted using the flow restrictor screw. The new set value (Q-setting) of the assumed differential pressure ($\Delta p_{b\ NEW}$ = 0.2 bar) is calculated according to formula:

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

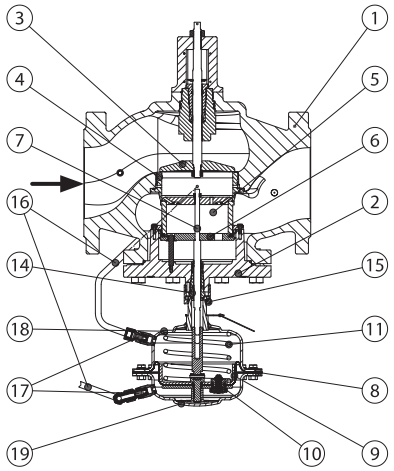


Design

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



AFPB 2 VFQ 22(1), DN 65-250



AFPB-F 2 VFQ 22(1), DN 65-250

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.

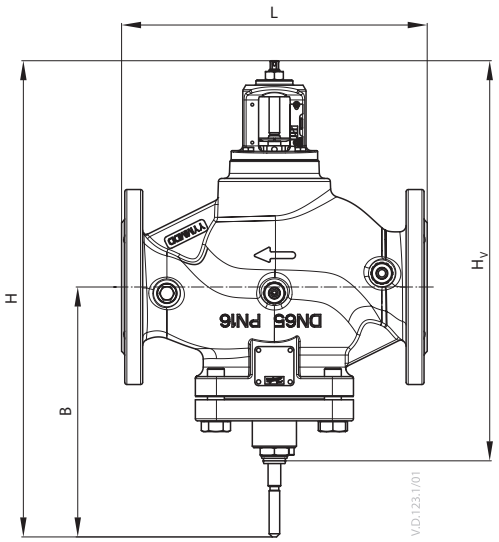
Settings

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.

Data sheet **AFPB(-F) 2/VFQ 22(1)**

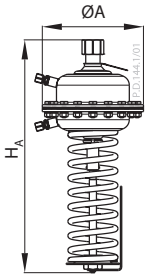
Dimensions



VFQ 22(1) DN 65-250

VFQ 22, VFQ 221 Valves

DN	L	B	H	H_V	Weight		
	mm				PN 16	PN 25	PN 40
					kg		
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

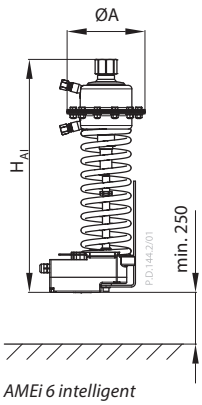


AFPB 2 Actuator

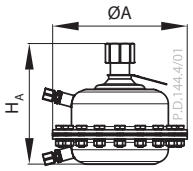
AFPB 2 Actuator

Size	ØA	H_A	H_{AI}	Weight (kg)			
(cm^2)	mm			AFPB 2 PN 16	AFPB 2 PN 16 + AMEi 6	AFPB 2 PN 40	AFPB 2 PN 40 + AMEi 6
160	230	490	590	12,5	15	25	27,5
320	300	490	590	17	19,5	37	39,5

Total installation height of the controller (VFG 22(1) valve + AFP 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

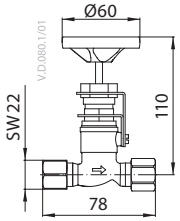


AFPB-F 2 Actuator

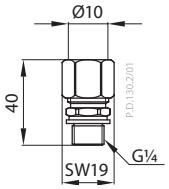
AFPB-F 2 Actuator

Size	ØA	H_A	Weight	
			PN 16	PN 40
cm^2	mm		kg	
160	230	200	8	10
320	300	200	13	19

Total installation height of the controller (VFQ 22(1) valve+ AFPB-F 2 pressure actuator) is sum of H_V and H_A



Shut off valve



Compression fitting

Danfoss A/S
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