Data sheet

Flow controller with integrated control valve (PN 16, 25, 40*)

AFQM, AFQM 6 - return and flow mounting

Description

AFQM 6 DN 40, 50

AFQM DN 65-125

AFQM DN 150-250

AFQM(6) is a self-acting flow controller with integrated control valve primarily for use in district heating systems. The controller closes when set max. flow is exceeded. In combination with Danfoss electrical actuators AMV(E) can be controlled by ECL electronic controllers.

The controller has a control valve with adjustable flow restrictor, connection neck for electrical actuator and an actuator with one control diaphragm. Further on control valve can be:
- not pressure relieved (AFQM 6 DN 40-50) or
- pressure relieved (AFQM DN 65-250).

Controllers are used together with Danfoss electrical actuators:
- AFQM 6 PN 16/25, AFQM PN25 DN 40-80
  - AMV(E) 410 [1]

  manual operation:
  - AMV(E) 65x + adapter 065B3527

  spring return function:
  - AMV(E) 413 [1]
  - AMV(E) 658 SD [2] + adapter 065B3527
- AFQM PN 25 DN 65-125
  - AMV(E) 610 [1]
  - AMV(E) 65x + adapter 065B3527

  spring return function:
  - AMV(E) 613 [1]

  spring return function and manual operation:
  - AMV(E) 613 H [1]
  - AMV(E) 658 SD [2] + adapter 065B3527

[1] *in a discontinuing process*
[2] *not DIN approved*

- AFQM PN 16 DN 65-125 with
  - AMV(E) 55, 56,
  - AMV(E) 65x
- AFQM PN 16 DN 150-250 with
  - AMV(E) 85, 86

AFQM 6 and AFQM PN 25 combined with AMV(E) 413 or AMV(E) 613 have been approved according to EN 14597.

Main data:
- DN 40-250
- k_{VS} 20-400 m^3/h
- Flow range 2,2-420 m^3/h
- PN 16, 25
  ** PN 40 on special request*
- Flow restrictor Δp_b: 0,2 or 0,5 bar
- Temperature:
  - Circulation water / glycolic water up to 30 %:
    2 … 150 °C for DN 40-125
    2 … 140 °C for DN 150-250
- Connections:
  - Flange

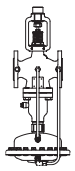
Ordering

Example:
Flow controller with integrated control valve, DN 65, k_{VS} 50, PN 16, flow restrictor Δp_b 0,2 bar, t_{max} 150 °C, flange

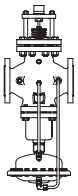
- *1× AFQM DN 65 controller Code No.:* ***003G6056***

The controller will be delivered completely assembled, inclusive impulse tubes between valve and actuator. Electrical actuator AMV(E) must be ordered separately.

AFQM 6 Controller

Picture	DN	k_{VS} m³/h	PN	Connection	Code No.
	40	20	16	Flange EN 1092-1	**003G1082**
	50	32			**003G1083**
	40	20	25		**003G1084**
	50	32			**003G1085**

AFQM Controller

Picture	DN	k_{VS} (m³/h)	PN	Connection	Code No.	
					ΔP_b=0,2 bar	ΔP_b=0,5 bar
	65	50	16	Flange EN 1092-1	**003G6056**	**003G6063**
	80	80			**003G6057**	**003G6064**
	100	125			**003G6058**	**003G6065**
	125	160			**003G6059**	**003G6066**
	150	280			**003G6060**	**003G6067**
	200	320			**003G6061**	**003G6068**
	250	400			**003G6062**	**003G6069**
	65	50	25		**003G1088**	—
	80	80			**003G1089**	
	100	125			**003G1090**	
	125	160			**003G1091**	

Service kits

Picture	Type designation	DN	k_{VS} (m³/h)	Code No.
	Valve insert	65/80	50/80	**065B2794**
		100/125	125/160	**065B2795**
	Control valve insert	65	50	**065B2972**
		80	80	**065B2973**

Picture	Type designation	For controller	Δp_b (bar)	Code No.
	Actuator	AFQM 6	0,2	**003G1024**
		AFQM		**003G1026**
			0,5	**003G1027**

Technical data

AFQM 6 valve

Nominal diameter			DN	40	50
k_{VS} value			m³/h	20	32
Range of max. flow setting	Δp_b [1] = 0,2 bar	from		2,2	3,2
		to		11	16
Stroke			mm	8	12
Control ratio				> 1:20	
Control characteristic				Linear	
Cavitation factor z				0,55	0,5
Leakage acc. to standard IEC 534			% of k_{VS}	≤ 0,01	
Nominal pressure			PN	16, 25	
Min. differential pressure			bar	see remark [2]	
Max. differential pressure PN 16				16	
Max. differential pressure PN 25				20	
Medium				Circulation water / glycolic water up to 30%	
Medium pH				Min.7, max.10	
Medium temperature			°C	2 … 150	
Connections				Flange	
Materials					
Valve body			PN 16	Grey cast iron EN-GJL-250 (GG-25)	
			PN 25	Ductile cast iron EN-GJS-400-18-LT (GGG-40.3)	
Valve seat DP, CV				Stainless steel mat. No. 1.4021	
Valve cone DP, CV				Stainless steel mat. No. 1.4404	
Sealing DP				EPDM	
Sealing CV				Metal	
Pressure relieve system	Control valve insert			-	
	Valve insert			Bellows (Stainless steel mat. No. 1.4571)	

Note:
DP - diff. pressure controller, CV - control valve

[1] *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 $Q_{set} < Q_{max}$ ->* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

AFQM 6 Actuator

For valve	DN	40	50
Actuator size	cm²	250	
Max. operational pressure	bar	25	
Flow restrictor diff. pressure ΔP_b		0,2	
Materials			
Housing		Stainless steel M. No. 1.0338	
Diaphragm		EPDM (Rolling; fibre enforced)	
Impulse tube		Stainless steel tube Ø10 × 0,8 mm	

Technical data *(continuous)*

AFQM valve

Nominal diameter			**DN**	**65**	**80**	**100**	**125**	**150**	**200**	**250**
k_{VS} value			m^3/h	50	80	125	160	280	320	400
Range of max. flow setting	Δp_b [1] = 0,2 bar	from	m^3/h	5.6	8,0	12,6	16	30	38	56
		to		28	40	63	80	145	190	280
	Δp_b [1] = 0,5 bar	from		5.6	8,0	12,6	16	30	38	56
		to		40	58	76	91	220	285	420
Stroke			mm	12	18	20		25	27	
Control ratio				> 1:20	> 1:25			> 1:30		
Control characteristic				Linear						
Cavitation factor z				0,5	0,4	0,35	0,3	0,3	0,2	0,2
Leakage acc. to standard IEC 534			% of k_{VS}	≤ 0,01						
Nominal pressure			PN	16, 25				16		
Min. differential pressure			bar	see remark [2]						
Max. differential pressure PN 16				16	16	15	15	12	10	10
Max. differential pressure PN 25				20	20	15	15	12	10	10
Medium				Circulation water / Glycolic water up to 30 %						
Medium pH				Min.7, max.10						
Medium temperature			°C	2 … 150				2 … 140		
Connections				Flange						
Materials										
Valve body			PN 16	Grey cast iron EN-GJL-250 (GG-25)						
			PN 25	Ductile iron EN-GJS-400-18-LT (GGG-40.3)				-		
Valve seat DP, CV				Stainless steel M. No. 1.4021						
Valve cone DP, CV				Stainless steel mat No. 1.4404				Stainless steel mat. No. 1.4021		
Sealing DP, CV				EPDM						
Pressure relieve system	Control valve insert			Bellows (stainless steel mat No. 1.4571)				Piston		
	Valve insert							Diaphragm (EPDM)		

Note:
DP - diff. pressure controller, CV - control valve

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

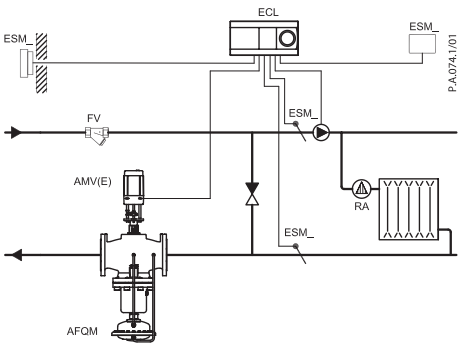
[2] *Depends on the flow rate and valve k_{VS}; For $Q_{set} = Q_{max}$ -> $\Delta p_{min} \geq 0,5$ bar; For $Q_{set} < Q_{max}$ ->* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

AFQM actuator

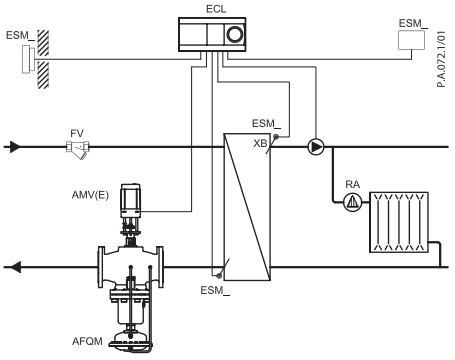
For valve	**DN**	**65**	**80**	**100**	**125**	**150**	**200**	**250**
Actuator size	cm^2	250						
Max. operational pressure	bar	16 or 25						
Flow restrictor diff. pressure Δp_b		0,2 or 0,5						
Materials								
Housing		Stainless steel M. No. 1.0338						
Diaphragm		EPDM (Rolling; fibre enforced)						
Impulse tube		Stainless steel tube Ø10 × 0,8 mm						

Application principles

- Return mounting

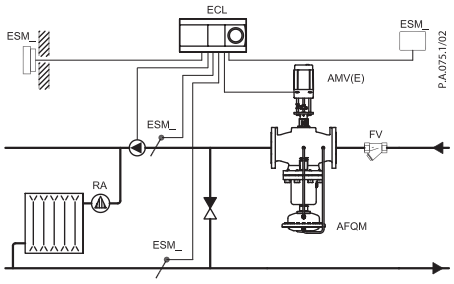


Direct-connected heating system

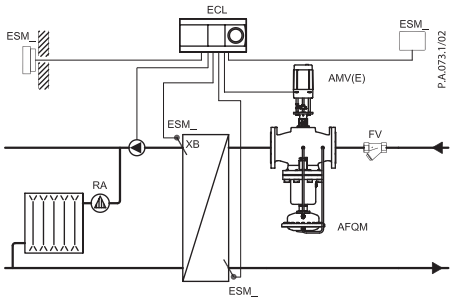


Indirectly connected heating system

- Flow mounting



Direct-connected heating system



Indirectly connected heating system

Installation positions

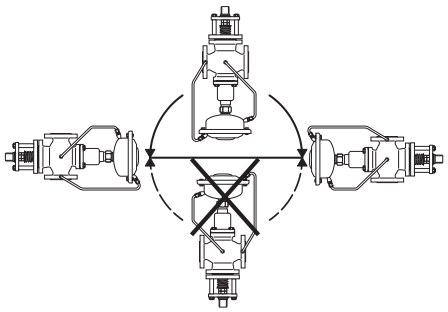
DN 40-80 T_{max} ≤ 120 °C

The controllers can be installed with (connection neck for) electrical actuator oriented horizontal or upwards.

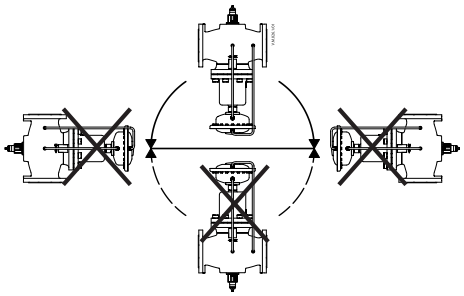
DN 40-80 T_{max} > 120 °C
DN 100-250

The controllers can be installed with (connection neck for) electrical actuator oriented upwards.

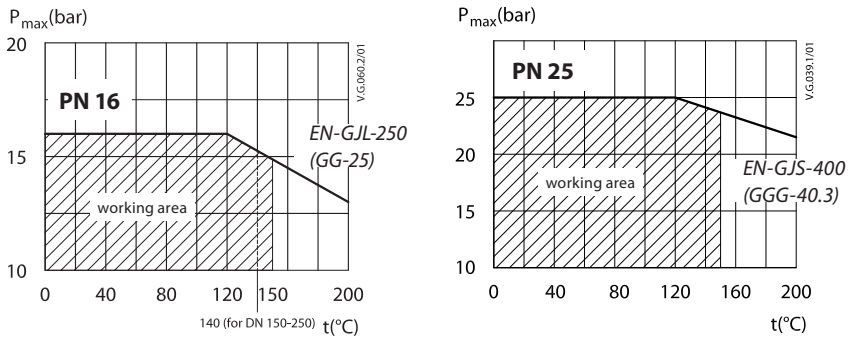
DN 40-80 T_{max} ≤ 120 °C



DN 40-80 T_{max} > 120 °C
DN 100-250



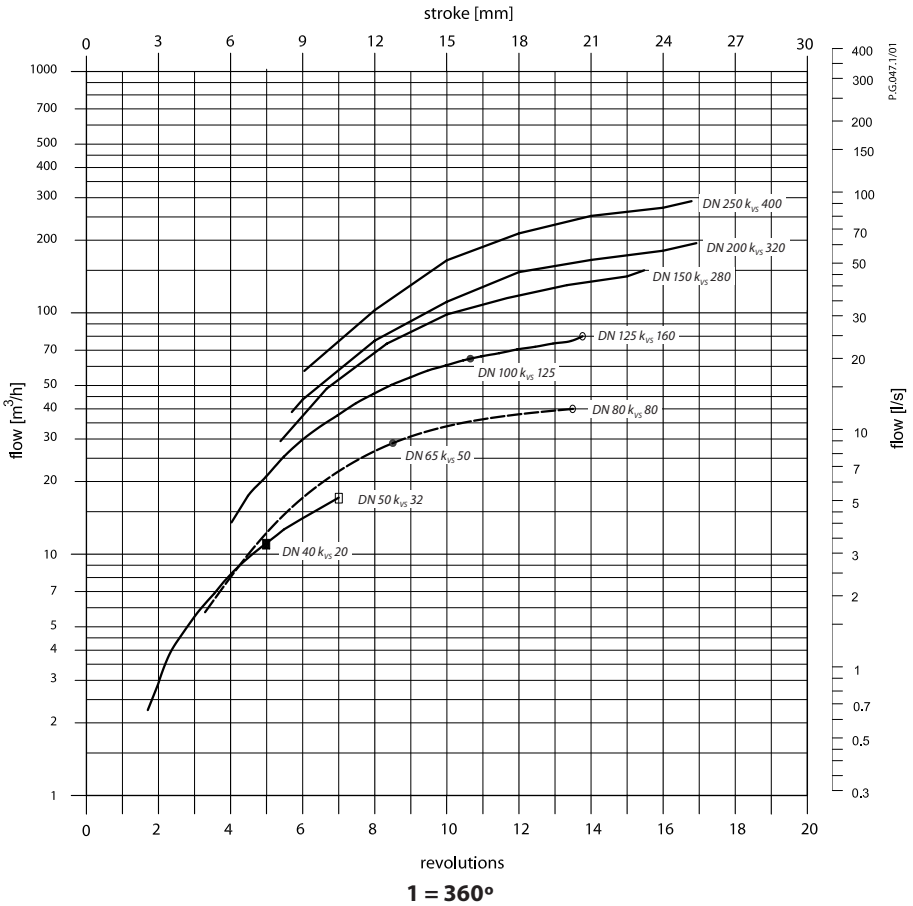
Pressure temperature diagram



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

Flow diagram

Sizing and setting diagram
Relation between actual flow and number of revolutions on flow restictor. Values given are approximate.



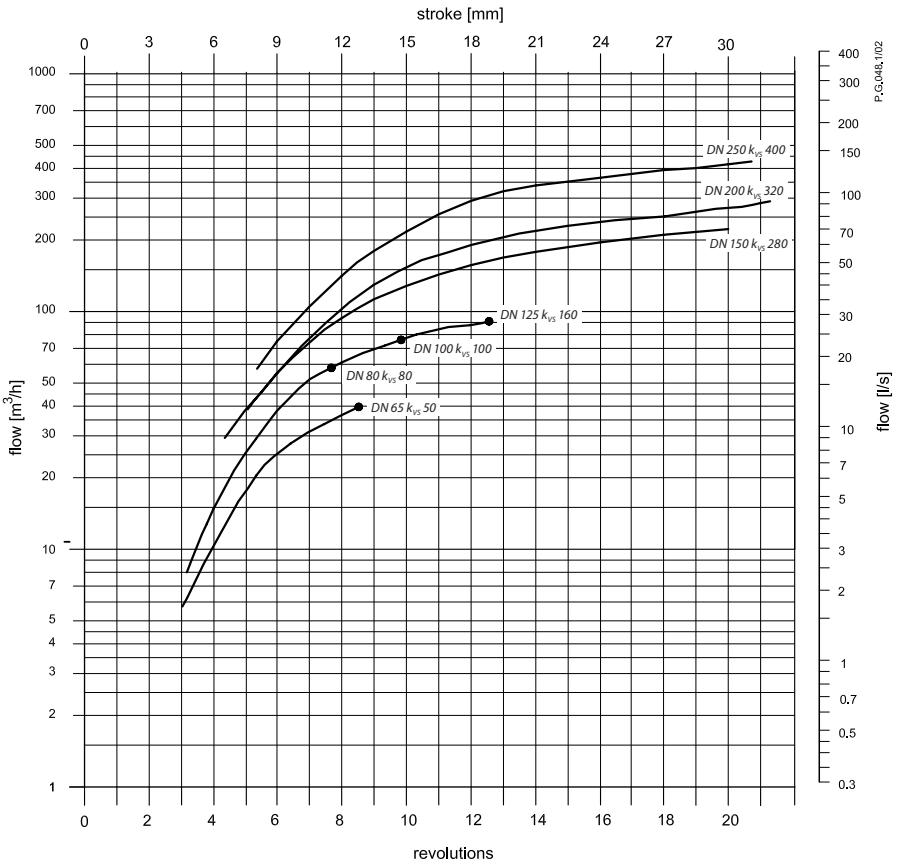
Flow can be adjusted by turning flow restrictor screw counter-clockwise as shown in this diagram

*Water flow shown at differential pressure across flow restrictor **0,2 bar** (20 kPa) and across the controller from 0,5 bar (50 kPa) to max. diff. pressure.*

Flow diagram

Sizing and setting diagram

Relation between actual flow and number of revolutions on flow restictor. Values given are approximate.



1 = 360°

Flow can be adjusted by turning flow restrictor screw counter-clockwise as shown in this diagram

*Water flow shown at differential pressure across flow restrictor **0,5 bar** (50 kPa) and across the controller from 0,5 bar (50 kPa) to max diff. pressure.*

Sizing

- *Directly connected heating system*

Example 1

Motorised control valve (MCV) for mixing circuit in direct-connected heating systems requires differential pressure of 0,2 bar (20 kPa) and flow less than 8000 l/h.

Given data:

Q_{max} = 8,0 m³/h (8000 l/h)
Δp_{min} = 0,8 bar (80 kPa)
$\Delta p_{circuit}$ [1)] = 0,1 bar (10 kPa)
Δp_{MCV} = 0,2 bar (20 kPa) selected

Remark:

[1)] *$\Delta p_{circuit}$ corresponds to the required pump pressure in the heating circuit and is not to be considered when sizing the AFQM.*

The total (available) pressure loss across the controller is:

$\Delta p_{AFQM,A} = \Delta p_{min}$
$\Delta p_{AFQM,A}$ = 0,8 bar (80 kPa)

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

Select controller from flow diagram, page 7, with the smallest possible k_{VS} value considering available flow ranges.

k_{VS} = 20 m³/h

The min. required differential pressure across the selected controller is calculated from the formula:

$$\Delta p_{AFQM,MIN} = \left(\frac{Q_{max}}{k_{VS}}\right)^2 + \Delta p_{MCV} = \left(\frac{8,0}{20}\right)^2 + 0,2$$

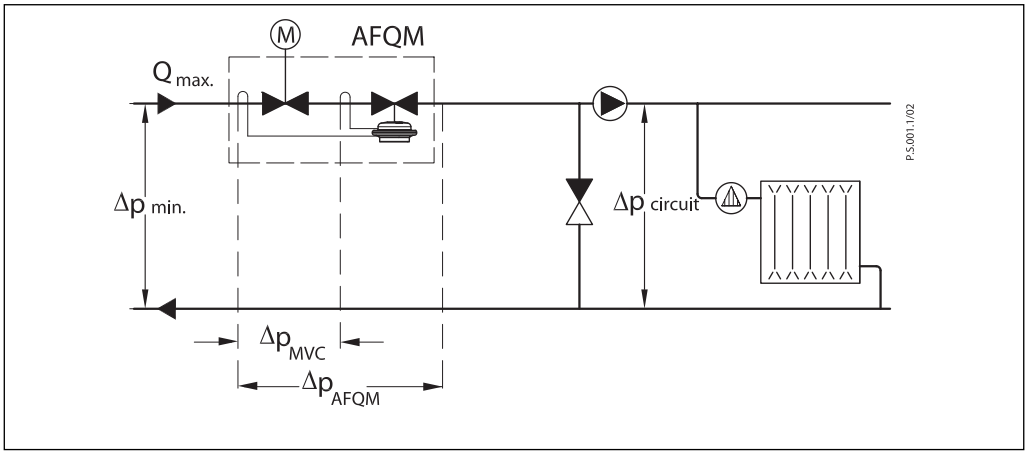
$\Delta p_{AFQM,MIN}$ = 0,36 bar (36 kPa)

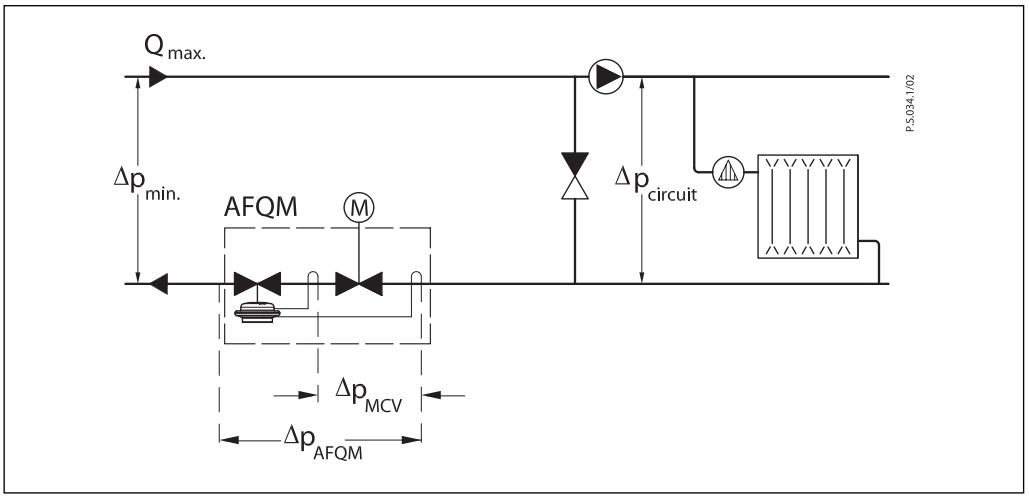
$\Delta p_{AFQM,A} > \Delta p_{AFQM,MIN}$

0,8 bar > 0,36 bar

Solution:

The example selects AFQM 6 DN 40, k_{VS} value 20, flow setting range 2,2-11 m³/h.





Sizing *(continuous)*

- *Indirectly connected heating system*

Example 2

Motorised control valve (MCV) for indirectly connected heating system control requires differential pressure of 0,2 (20 kPa) bar and flow less than 22.000 l/h.

Given data:

Q_{max} = 22 m³/h (22.000 l/h)
Δp_{min} = 0,8 bar (80 kPa)
$\Delta p_{exchanger}$ = 0,1 bar (10 kPa)
Δp_{MCV} = 0,2 bar (20 kPa) selected

The total (available) pressure loss across the controller is:
$\Delta p_{AFQM,A} = \Delta p_{min} - \Delta p_{exchanger} = 0{,}8 - 0{,}1$

$\Delta p_{AFQM,A}$ = 0,7 bar (70 kPa)

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

Select controller from flow diagram, page 7, with the smallest possible k_{VS} value considering available flow ranges.

k_{VS} = 50 m³/h

The min. required differential pressure across the selected controller is calculated from the formula:

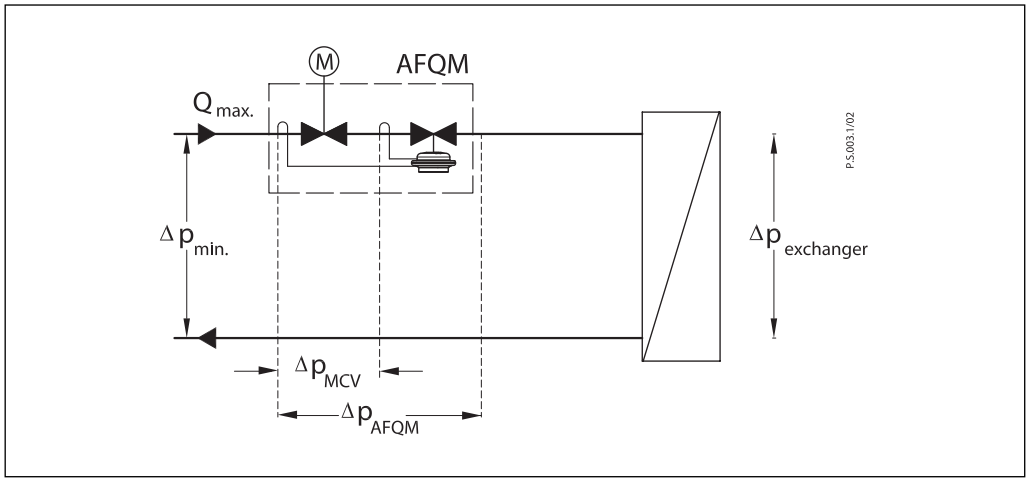
$$\Delta p_{AFQM,MIN} = \left(\frac{Q_{max.}}{k_{VS}}\right)^2 + \Delta p_{MCV} = \left(\frac{22}{50}\right)^2 + 0{,}2$$

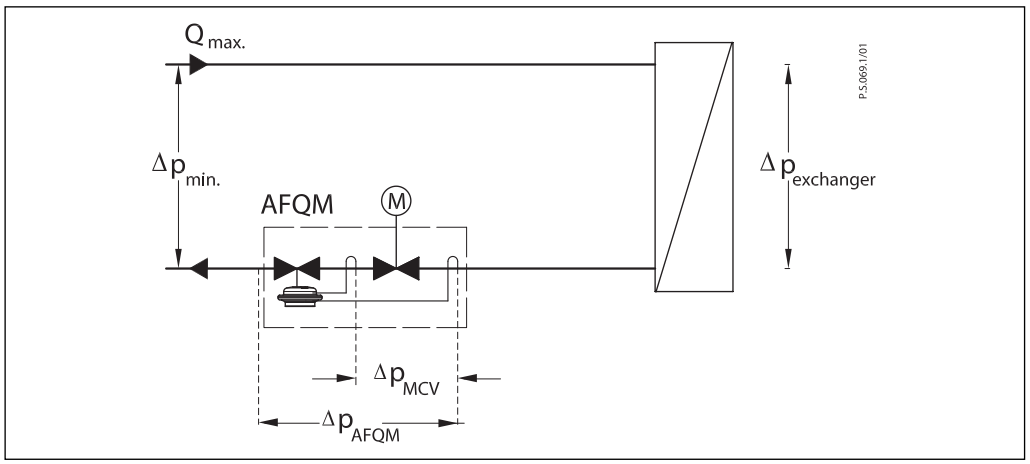
$\Delta p_{AFQM,MIN}$ = 0,39 bar (39 kPa)

$\Delta p_{AFQM,A} > \Delta p_{AFQM,MIN}$

0,7 bar > 0,39 bar

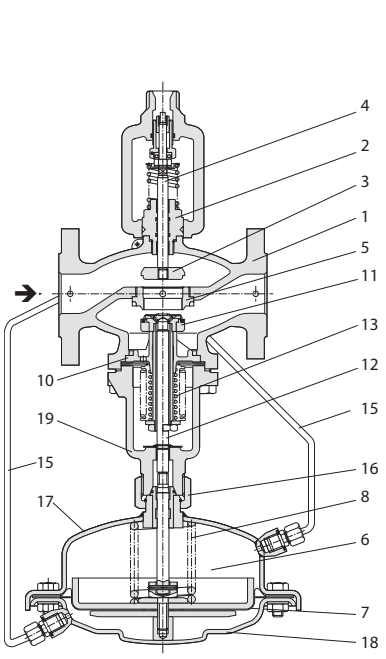
Solution:
The example selects AFQM DN 65, k_{VS} value 50, flow setting range 5.6-28 m³/h.



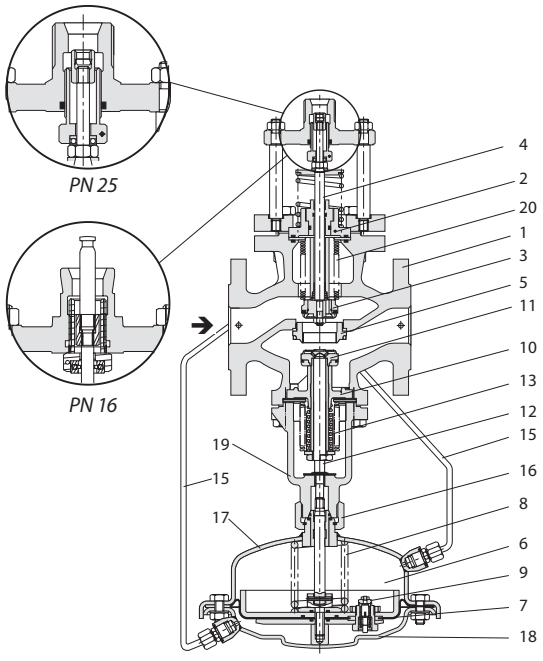


Design

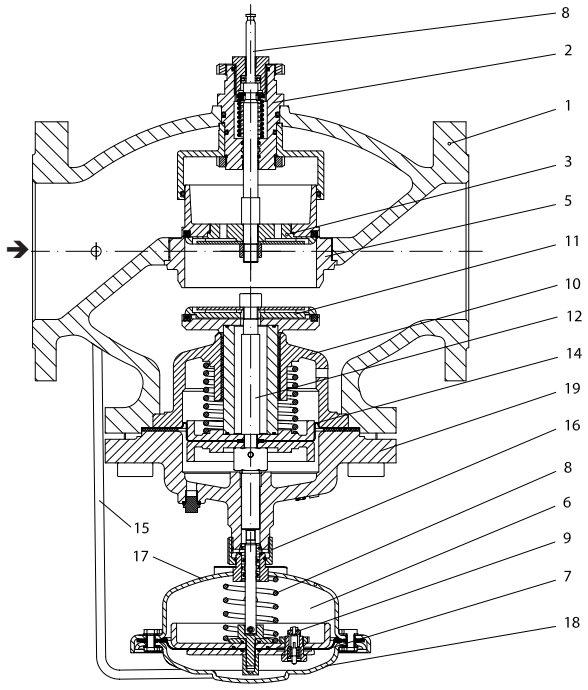
1. Valve body
2. Control valve insert
3. Adjustable flow restrictor
4. Control valve stem
5. Valve seat
6. Actuator
7. Control diaphragm for flow control
8. Built-in spring for flow rate control
9. Excess pressure safety valve
10. Valve insert
11. Pressure relieved valve cone
12. Valve stem
13. Bellows for pressure relief of valve cone
14. Diaphragm for pressure relief of valve cone
15. Impulse tube
16. Union nut
17. Upper casing of diaphragm
18. Lower casing of diaphragm
19. Cover
20. Bellows for pressure relieve of control valve cone



AFQM 6 DN 40, 50



AFQM DN 65-125



AFQM DN 150-250

Function

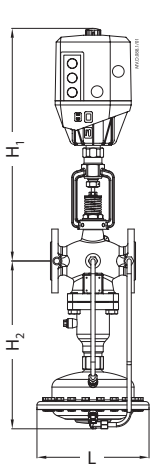
Flow volume causes pressure drop across the adjustable flow restrictor. Resulting pressures are being transferred through the impulse tubes to the actuator chambers and act on control diaphragm for flow control. The flow restrictor diff. pressure is controlled and limited by means of built-in spring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

Controller AFQM is equipped with excess pressure safety valve, which protect control diaphragm for flow control from too high differential pressure.

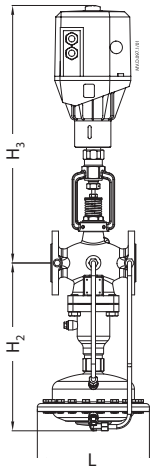
Settings

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.

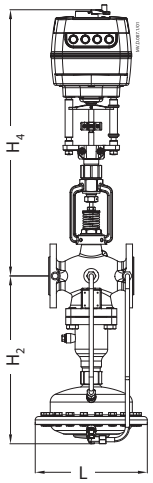
Dimensions



AMV(E) 410/AFQM 6
DN 40, 50



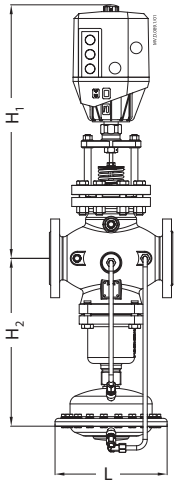
AMV(E) 413/AFQM 6
DN 40, 50



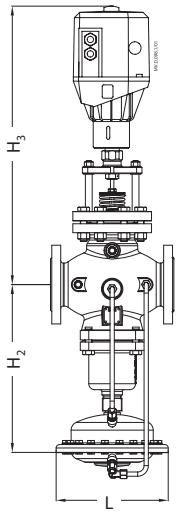
AMV(E) 65X/AFQM 6 +
adapter 065B3527

DN	L	H_1	H_2	H_3	H_4	Valve weight
	mm					(kg)
40	200	538	390	588	716	17
50	230	538	390	588	716	22

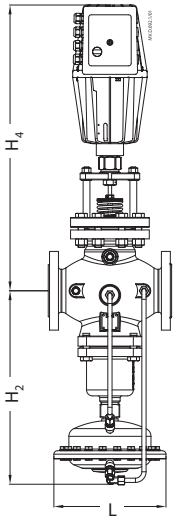
Dimensions *(continuous)*



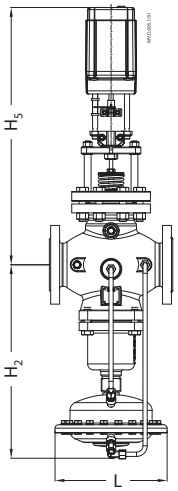
AMV(E) 410/AFQM DN 65-80, PN 25



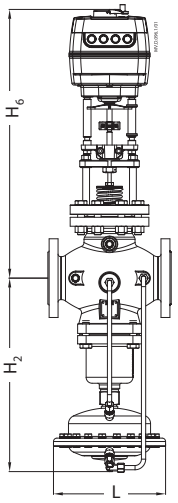
AMV(E) 413/AFQM DN 65-80, PN 25



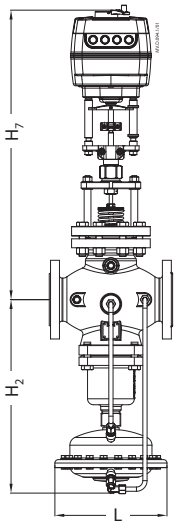
AMV(E) 61X/AFQM DN 65-125, PN 25



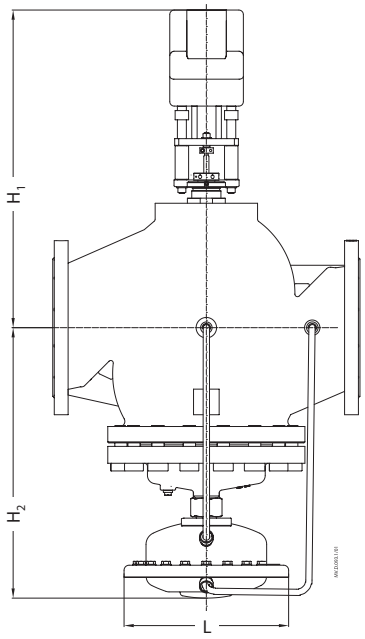
AMV(E) 55, 56/AFQM DN 65-125, PN 16



AMV(E) 65X/AFQM DN 65-125, PN 16



AMV(E) 65X/AFQM DN 65-125, PN 25 + adapter 065B3527



AMV(E) 85, 86/AFQM DN 150-250, PN 16

DN	L	H_1	H_2	H_3	H_4	H_5	H_6	H_7	Valve weight (kg)	
	mm								PN 16	PN 25
65	290	600	425	650	685	650	775	819	52	58,5
80	310	610	425	660	695	670	785	829	61	60,5
100	350	-	530	-	715	680	805	849	93,6	96
125	400	-	530	-	740	710	830	874	117,2	139

DN	L	H_1	H_2	Valve weight
	mm			(kg)
150	480	576	455	142
200	600	652	483	219
250	730	656	533	342