ENGINEERING
TOMORROW

Data sheet

Differential pressure and flow controller (PN 16)
AVPQ - return mounting, adjustable setting

Description

AVPQ 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 handle for differential pressure setting (fixed setting version (available on special request) is without handle).

Main data:
- DN 15-32
- k_{VS} 1.6-10 m^3/h
- Flow range: 0.06–7.3 m^3/h
- PN 16
- Setting range (AVPQ): 0.1-0.5 bar / 0.2-1.0 bar
- Flow restrictor Δp_b: 0.2 bar
- Temperature:
  Circ. water / glycolic water up to 30 %:
  2 … 150 °C
- Connections:
  - Ext. thread (weld-on, thread and flange tailpieces)

Ordering

Example:
Differential pressure and flow controller; return mounting; DN 15; k_{VS} 1.6; PN 16; setting range 0.2-1.0 bar; T_{max} 150 °C; ext. thread

- *1× AVPQ DN 15 controller*
  Code No: ***003H6483***
- *1× Impulse tube set AV, R ⅛*
  Code No: ***003H6852***

Option:
- *1× Weld-on tailpieces*
  Code No: ***003H6908***

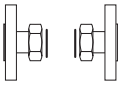
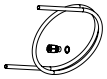
The controller will be delivered completely assembled, inclusive impulse tube between valve and actuator. External impulse tube (AV) must be ordered separately.

AVPQ Controller (return mounting)

Picture	DN (mm)	k_{VS} (m^3/h)	Connection		Δp setting range (bar)	Code No.	Δp setting range (bar)	Code No.
	15	1.6	Cylindr. ext. thread acc. to ISO 228/1	G ¾ A	0.1-0.5	**003H6477**	0.2-1.0	**003H6483**
		2.5				**003H6478**		**003H6484**
		4.0				**003H6479**		**003H6485**
	20	6.3		G 1 A		**003H6480**		**003H6486**
	25	8.0		G 1¼ A		**003H6481**		**003H6487**
	32	10		G 1¾ A		**003H6482**		**003H6488**

Ordering *(continuous)*

Accessories

Picture	Type designation	DN	Connection		Code No.
	Weld-on tailpieces	15	-		**003H6908**
		20			**003H6909**
		25			**003H6910**
		32			**003H6911**
	External thread tailpieces	15	Conical ext. thread acc. to EN 10226-1	R ½	**003H6902**
		20		R ¾	**003H6903**
		25		R 1	**003H6904**
		32		R 1¼	**003H6905**
	Flange tailpieces	15	Flanges PN 25, acc. to EN 1092-2		**003H6915**
		20			**003H6916**
		25			**003H6917**
	Impulse tube set AV	Description: - 1× copper tube Ø6 × 1 × 1500 mm - 1× compression fitting [1] for imp. tube connect. to pipe Ø6 × 1 mm		R ⅛	**003H6852**
				R ⅜	**003H6853**
				R ½	**003H6854**
	[1] 10 compression fittings for imp. tube connection to pipe, Ø6 × 1 mm R ⅛				**003H6857**
	[1] 10 compression fittings for imp. tube connection to pipe, Ø6 × 1 mm R ⅜				**003H6858**
	[1] 10 compression fittings for imp. tube connection to pipe, Ø6 × 1 mm R ½				**003H6859**
	[1] 10 compression fittings for imp. tube connection to actuator, Ø6 × 1 mm G ⅛				**003H6931**
	Shut off valve Ø6 mm				**003H0276**

[1] *Compression fitting consists of a nipple, compression ring and nut.*

Service kits

Picture	Type designation	DN	k_{VS} (m³/h)	Code No.
	Valve insert	15	1.6	**003H6863**
			2.5	**003H6864**
			4.0	**003H6865**
		20	6.3	**003H6866**
		25	8.0	**003H6867**
		32	10	

Picture	Type designation	Δp setting range (bar)	Code No.
	Lower actuator with adjustable handle (AVPQ), return mounting	0.1-0.5	**003H6821**
		0.2-1.0	**003H6822**
	Intermediate actuator, return mounting	-	**003H6827**

Technical data

Valve

Nominal diameter			**DN**	**15**			**20**	**25**	**32**
k_{VS} value				1.6	2.5	4.0	6.3	8.0	10
Range of max. flow setting	Δp_b [1] = 0.2 bar	from	m³/h	0.03	0.08	0.09	0.1	0.1	0.15
		to		0.9	1.4	1.8	2.7	4.5	6.0
Cavitation factor z				≥ 0.6				≥ 0.55	
Leakage acc. to standard IEC 534			% of k_{VS}	≤ 0.02					≤ 0.05
Nominal pressure			PN	25					
Min. differential pressure			bar	see remark [2]					
Max. differential pressure				12					
Medium				Circulation water / glycolic water up to 30 %					
Medium pH				Min. 7, max. 10					
Medium temperature			°C	2 …150					
Connections	valve			External thread					
	tailpieces			Weld-on and external thread					
				Flange					-
Materials									
Valve body				Red bronze CuSn5ZnPb (Rg5)					
Valve seat				Stainless steel, mat. No. 1.4571					
Valve cone				Dezincing free brass CuZn36Pb2As					
Sealing				EPDM					
Pressure relieve system				Piston					

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

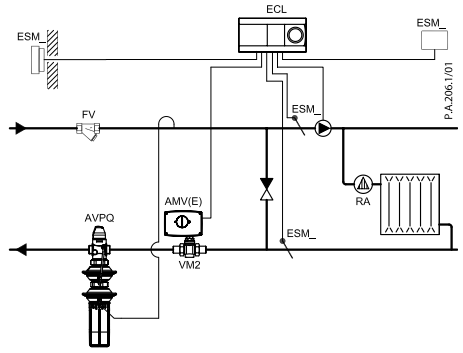
[2] *Depends on the flow rate and valve k_{VS}; For $Q_{set} = Q_{max}$ -> $\Delta p_{min} \geq 0.5$ bar; For $Q_{set} < Q_{max}$ ->* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

Actuator

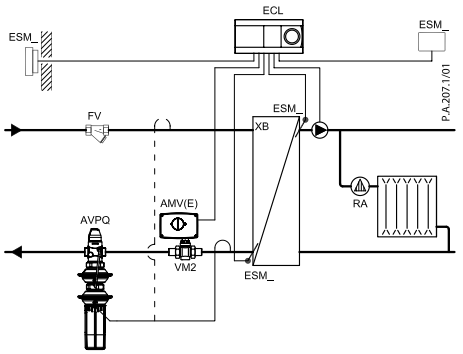
Type		**AVPQ**	
Actuator size	cm²	39	
Nominal pressure	PN	16	
Flow restrictor diff. pressure, Δp_b	bar	0.2	
Diff. pressure setting ranges and spring colours		0.1-0.5	0.2-1.0
		grey	black
Materials			
Actuator housing		Zinc plated, DIN 1624, No. 1.0338	
Control diaphragm		EPDM	
Impulse tube		Copper tube Ø6 × 1 mm	

Application principles

The controller AVPQ must be installed in the return pipe only.



Direct-connected heating system

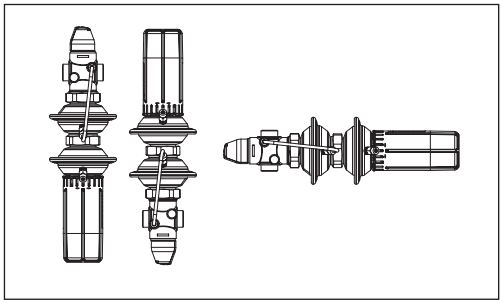


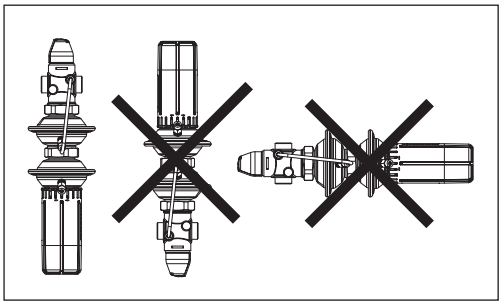
Indirectly connected heating system

Installation positions

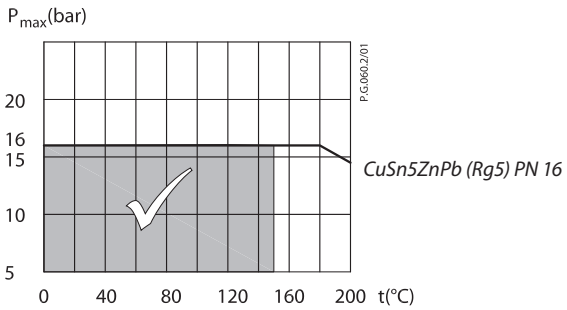
Up to medium temperature of 100°C the controllers can be installed in any position.

For higher temperatures the controllers have to be installed in horizontal pipes only, with a pressure actuator oriented downwards.





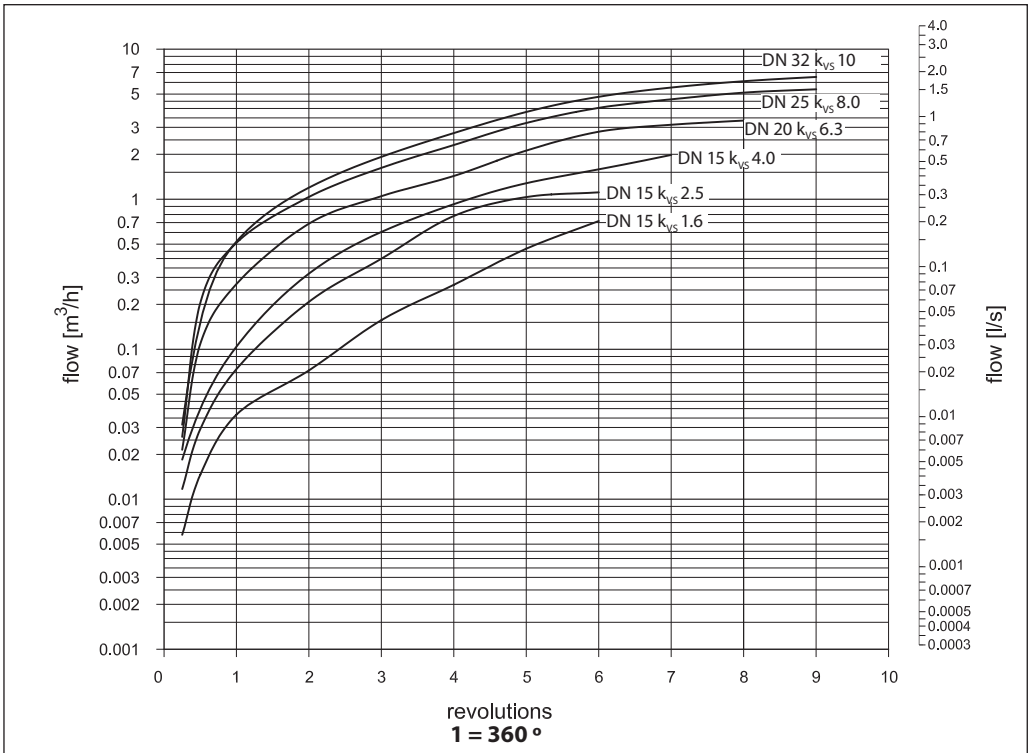
Pressure temperature diagram



Maximum allowed operating pressure as a function of medium temperature (according to EN 1092-3).

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 12 bar (1200 kPa).

Note:
For max flow setting on the controller diagrams from Instructions should be used.

Sizing

- *Directly connected heating system*

Example 1
Motorised control valve (MCV) for mixing circuit in direct-connected heating system requires differential pressure of 0.2 bar (20 kPa) and flow less than 1300 l/h.

Given data:
Q_{max} = 1.3 m³/h (1300 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
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 AVPQ.*
[2)] *Δp_b is differential pressure over flow restrictor.*

The differential pressure set value is:
$\Delta p_{set\ value} = \Delta p_{MCV}$
$\Delta p_{set\ value}$ = 0.2 bar (20 kPa)

The total pressure loss across the controller is:
$\Delta p_{AVPQ} = \Delta p_{min} - \Delta p_{MCV} = 0.8 - 0.2$
Δp_{AVPQ} = 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:

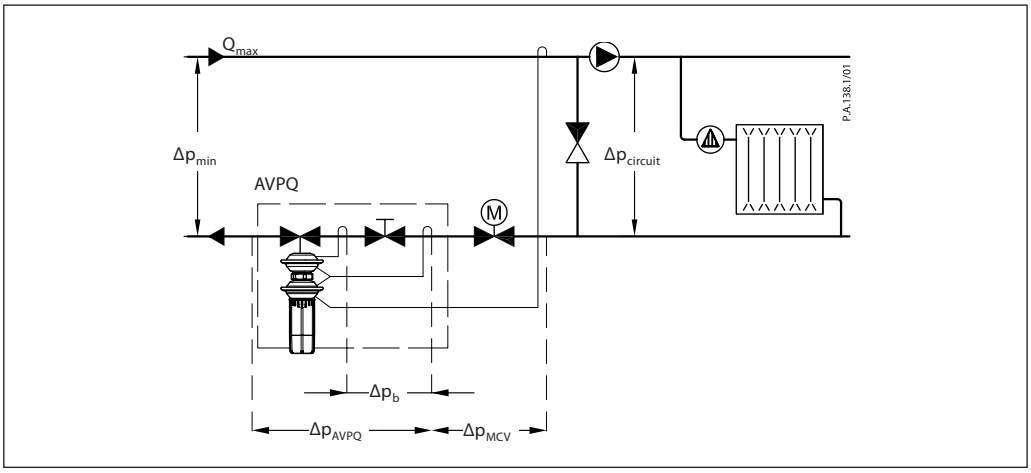
$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AVPQ} - \Delta p_b}} = \frac{1.3}{\sqrt{0.6 - 0.2}}$$

k_v = 2.0 m³/h

or read from the sizing diagram, page 8, by taking a line from Q-scale (1.3 m³/h) through Δp_v-scale ($\Delta p_v = \Delta p_{AVPQ} - \Delta p_b = 0.6 - 0.2$ = 0.4 bar) to intersect k_v-scale at 2.0 m³/h.

Solution:
The example selects AVPQ DN 15, k_{VS} value 2.5, with differential pressure setting range 0.1 - 0.5 bar, flow setting range 0.08-1.8 m³/h.

The P-band (Xp) can also be read from the sizing diagram. Take a horizontal line from the k_v-scale (2.0 m³/h) to the right to intersect the Xp-scale (0.045 bar). At a set value of 0.2 bar and a Xp of 0.045 bar the AVPQ controller controls between 0.2 bar with open motorised control valve and 0.2 + 0.045 = 0.245 bar at almost closed motorised control valve (i.e. total pressure loss across the motorised control valve).



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 800 l/h.

Given data:
Q_{max} = 0.8 m³/h (800 l/h)
Δp_{min} = 1.1 bar (110 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:
$\Delta p_{set\ value} = \Delta p + \Delta p_{MCV} = 0.05 + 0.3$
$\Delta p_{set\ value} = 0.35$ bar (35 kPa)

The total pressure loss across the controller is:
$\Delta p_{AVPQ} = \Delta p_{min} - \Delta p_{exchanger} - \Delta p_{MCV}$
$= 1.1 - 0.05 - 0.3$
$\Delta p_{AVPQ} = 0.75$ bar (75 kPa)

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

k_v value is calculated according to formula:

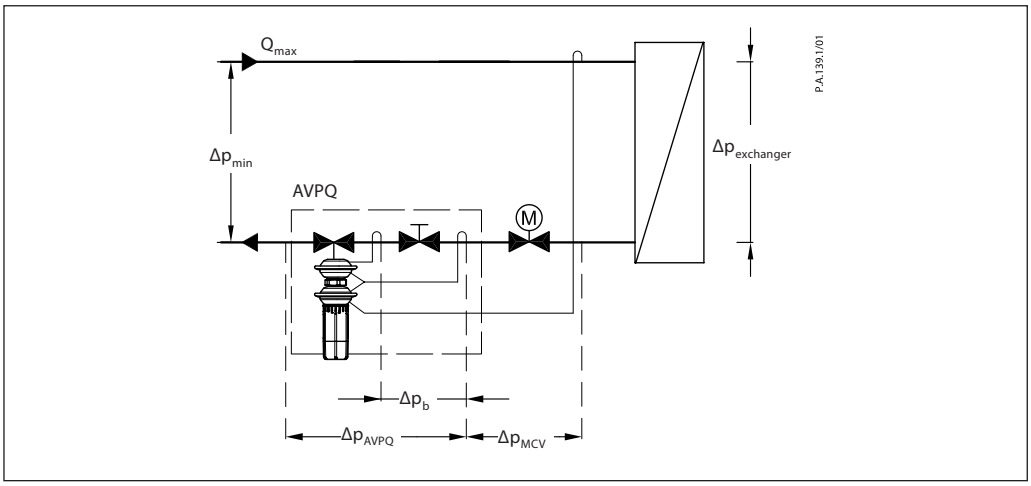
$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AVPQ} - \Delta p_b}} = \frac{0.8}{\sqrt{0.75 - 0.2}}$$

$k_v = 1.1$ m³/h

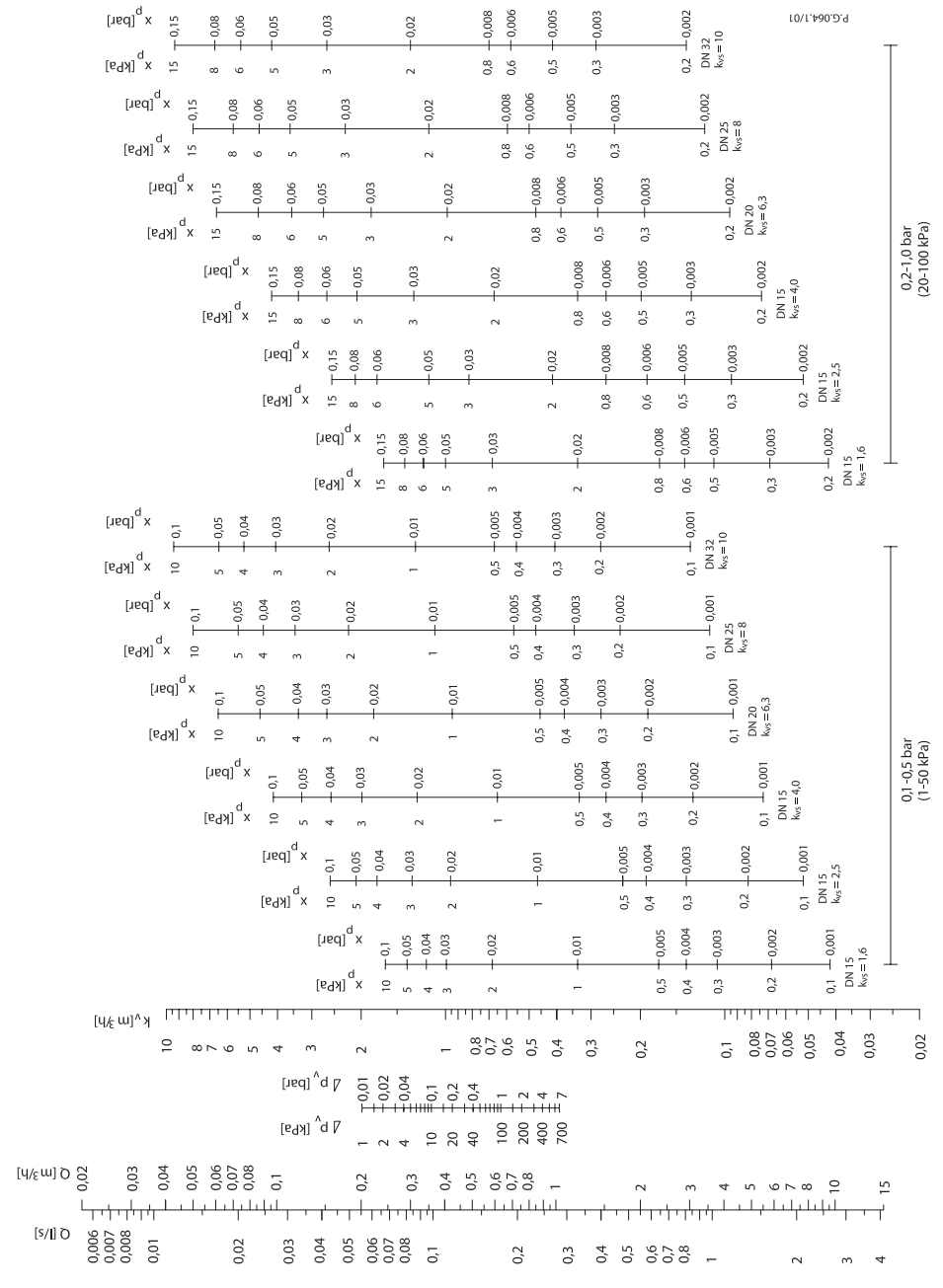
or read from the sizing diagram, page 8, by taking a line from Q-scale (0.8 m³/h) through Δp_v-scale ($\Delta p_v = \Delta p_{AVPQ} - \Delta p_b = 0.75 - 0.2 = 0.55$ bar) to intersect k_v-scale at 1.1 m³/h.

Solution:
The example selects AVPQ DN 15, k_{VS} value 1.6, with differential pressure setting range 0.1-0.5 bar, flow setting range 0.06-1.4 m³/h.

The P-band (Xp) can also be read from the sizing diagram. Take a horizontal line from the k_v-scale (1.0 m³/h) to the right to intersect the Xp-scale (0.035 bar). At a set value of 0.35 bar and a Xp of 0.035 bar the AVPQ controller controls between 0.35 bar with open motorised control valve and 0.35 + 0.035 = 0.385 bar at almost closed motorised control valve (i.e. total pressure loss across the motorised control valve).



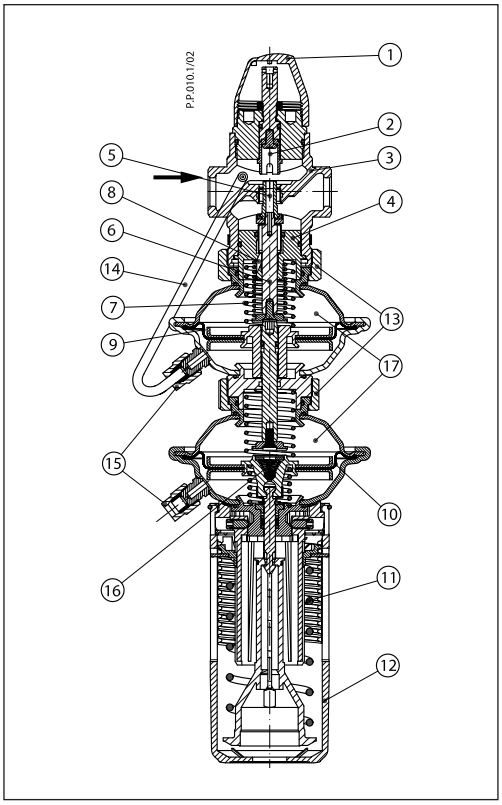
Sizing *(continued)*



Select suitable controller size. Xp should not exceed 50 % of the controller differential pressure setting.

Design

1. Cover
2. Adjustable flow restrictor
3. Valve body
4. Valve insert
5. Pressure relieved valve cone
6. Valve stem
7. Built-in spring for flow control
8. Control drain
9. Control diaphragm for flow control
10. Control diaphragm for diff. pressure control
11. Setting spring for diff. pressure control
12. Handle for diff. pressure setting, prepared for sealing
13. Union nut
14. Impulse tube
15. Compession fitting for impulse tube
16. Excess pressure safety valve
17. Actuator



Function

Flow volume causes pressure drop across the adjustable flow restrictor. Resulting pressures are being transferred through the impulse tubes and/or control drain in the actuator stem 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 excess pressure safety valve, which protect control diaphragm for diff. pressure control from too high differential pressure.

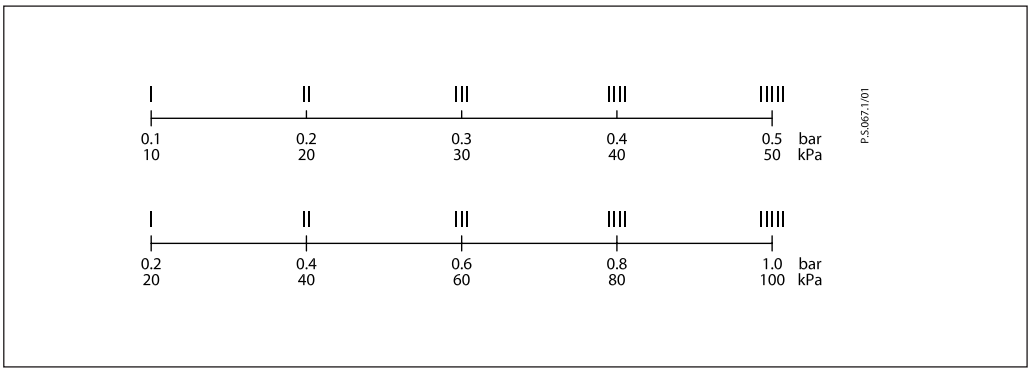
Settings

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.

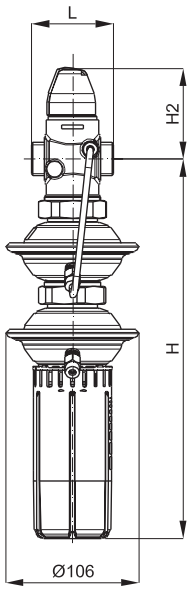
Differential pressure setting
Differential pressure setting (valid for AVPQ controller only) is being done by the adjustment of the setting spring for diff. pressure control. The adjustment can be done by means of handle for diff. pressure setting and/or pressure indicators.

Adjustment diagram

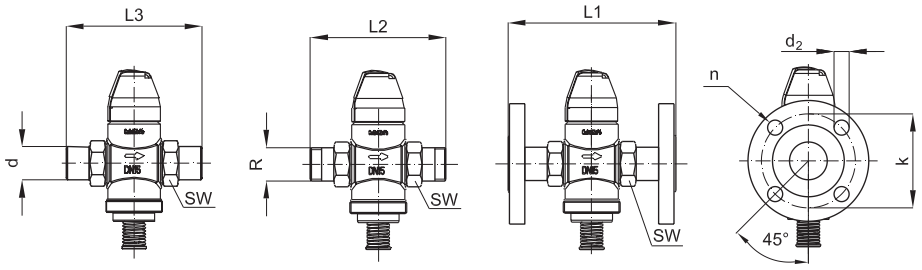
Relation between scale figures and differential pressure. Values given are approximate.



Dimensions



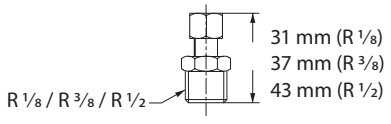
DN		15	20	25	32
L	mm	65	70	75	100
H		301	301	301	301
H2		73	73	76	77
Weight	kg	2.6	2.6	2.8	3.1



DN		15	20	25	32
SW	mm	32 (G ¾A)	41 (G 1A)	50 (G 1¼A)	63 (G 1¾A)
d		21	26	33	42
R [1]		½	¾	1	1 ¼
L1 [2]		130	150	160	-
L2		120	131	145	177
L3		139	154	159	184
k		65	75	85	-
d_2		14	14	14	-
n		4	4	4	-

[1] Conical ext. thread acc. to EN 10226-1
[2] Flanges PN 25, acc. to EN 1092-2

Compression fittings



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