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 $\Delta p_b$: 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***

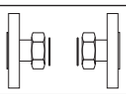
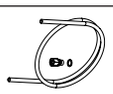
*The controller will be delivered completely assembled, inclusive impulse tube between valve and actuator. External impulse tube (AV) must be ordered separately.*

**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:<br>- 1× copper tube Ø6 × 1 × 1500 mm<br>- 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 | | | m³/h | 1.6 | 2.5 | 4.0 | 6.3 | 8.0 | 10 |
| Range of max. flow setting | $\Delta p_b$ [1] = 0.2 bar | from | | 0.06 | 0.08 | 0.09 | 0.1 | 0.1 | 0.15 |
| | | to | | 1.4 | 1.8 | 2.7 | 4.5 | 6.0 | 7.3 |
| 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] *$\Delta p_b$ - differential pressure over flow restrictor*

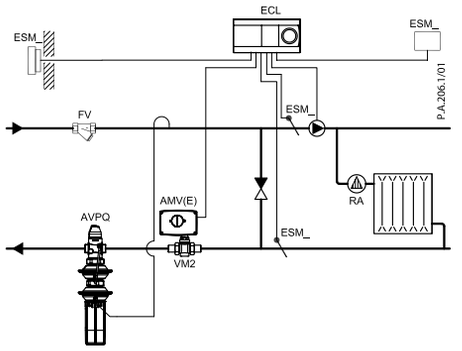
[2] *Depends on the flow rate and valve $k_{VS}$; For $Q_{set} = Q_{max}$ -> $\Delta p_{min} \geq 0.5$ bar; For $Q_{set} < Q_{max}$ ->* $\Delta p_{min} = \left(\frac{Q}{k_{VS}}\right)^2 + \Delta p_b$

### Actuator

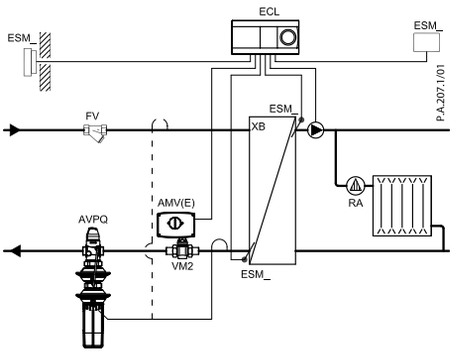
| **Type** | | **AVPQ** | |
|---|---|---|---|
| Actuator size | cm² | 39 | |
| Nominal pressure | PN | 16 | |
| Flow restrictor diff. pressure, $\Delta p_b$ | bar | 0.2 | |
| Diff. pressure setting ranges and spring colours | | 0.1-0.5 | 0.2-1.0 |
| | | grey | black |
| **Materials** | | | |
| Actuator 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.*



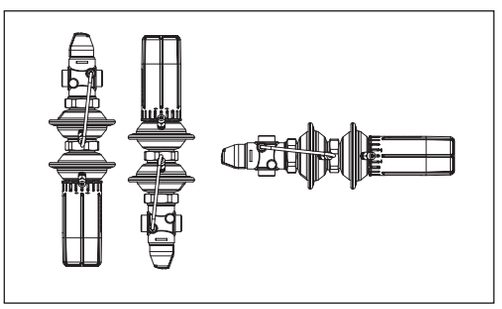

*Direct-connected heating system*



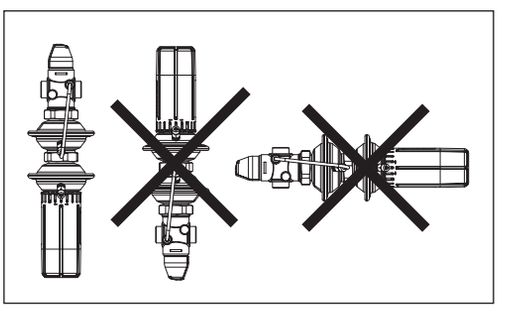

*Indirectly connected heating system*

## Installation positions

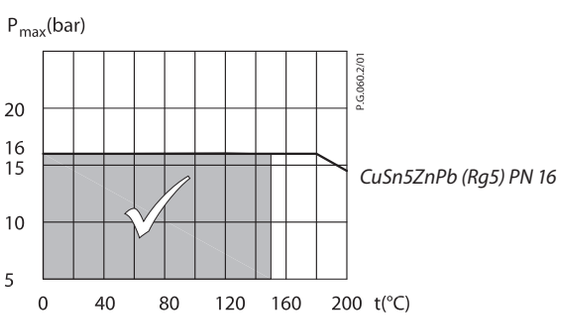
Up to medium temperature of 100°C the controllers can be installed in any position.



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



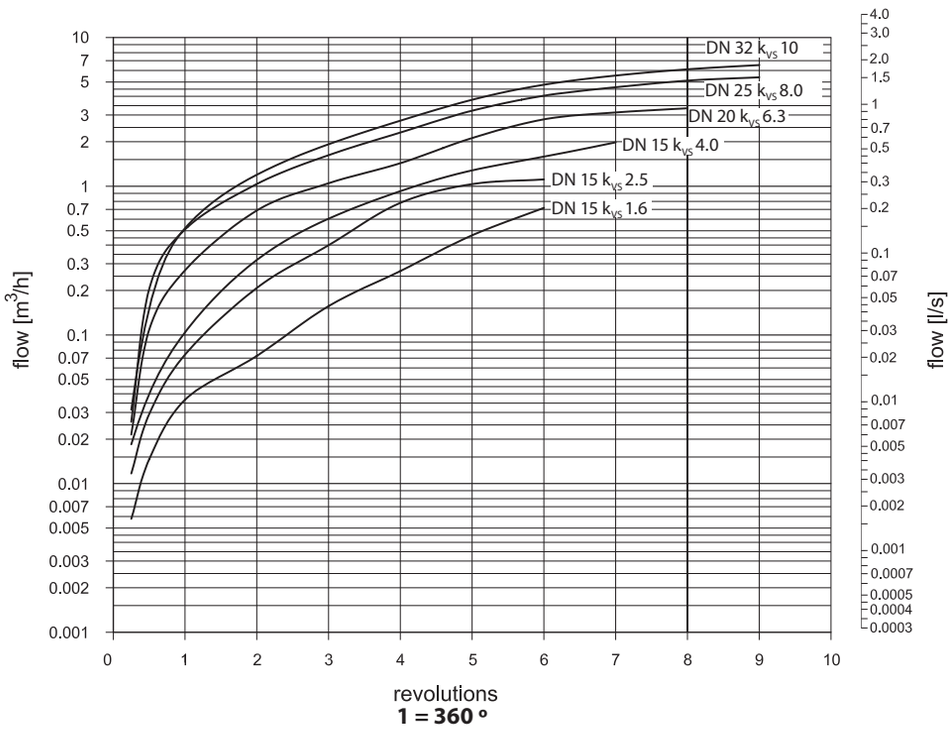
## Pressure temperature diagram




*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)
$\Delta p_{min}$ = 0.8 bar (80 kPa)
$\Delta p_{circuit}$ [1] = 0.1 bar (10 kPa)
$\Delta p_{MCV}$ = 0.2 bar (20 kPa) selected
$\Delta p_b$ [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] *$\Delta p_b$ 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:
$\Delta p_{AVPQ} = \Delta p_{min} - \Delta p_{MCV} = 0.8 - 0.2$
$\Delta p_{AVPQ}$ = 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:

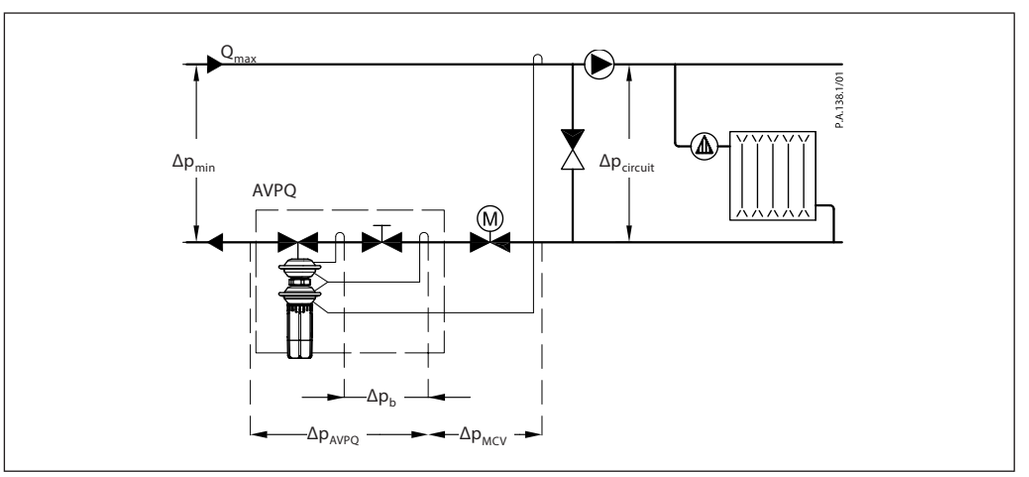
$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AVPQ} - \Delta p_b}} = \frac{1.3}{\sqrt{0.6 - 0.2}}$$

$k_v$ = 2.0 m³/h

or read from the sizing diagram, page 8, by taking a line from Q-scale (1.3 m³/h) through $\Delta p_v$-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)
$\Delta p_{min}$ = 1.1 bar (110 kPa)
$\Delta p_{exchanger}$ = 0.05 bar (5 kPa)
$\Delta p_{MCV}$ = 0.3 bar (30 kPa) selected
$\Delta p_b$ [1)] = 0.2 bar (20 kPa)
*Remark:*
*[1)] $\Delta p_b$ 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:

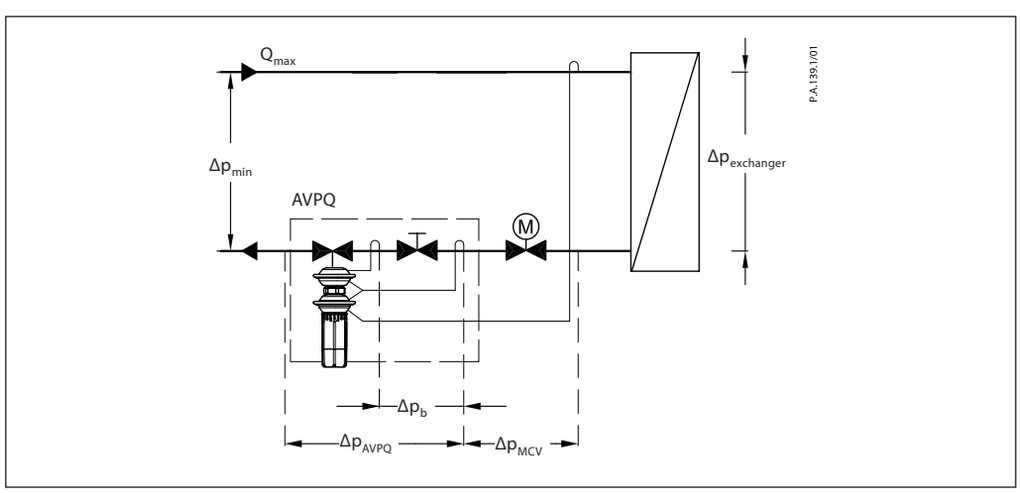
$$k_v = \frac{Q_{max}}{\sqrt{\Delta p_{AVPQ} - \Delta p_b}} = \frac{0.8}{\sqrt{0.75 - 0.2}}$$

$k_v = 1.1$ m³/h

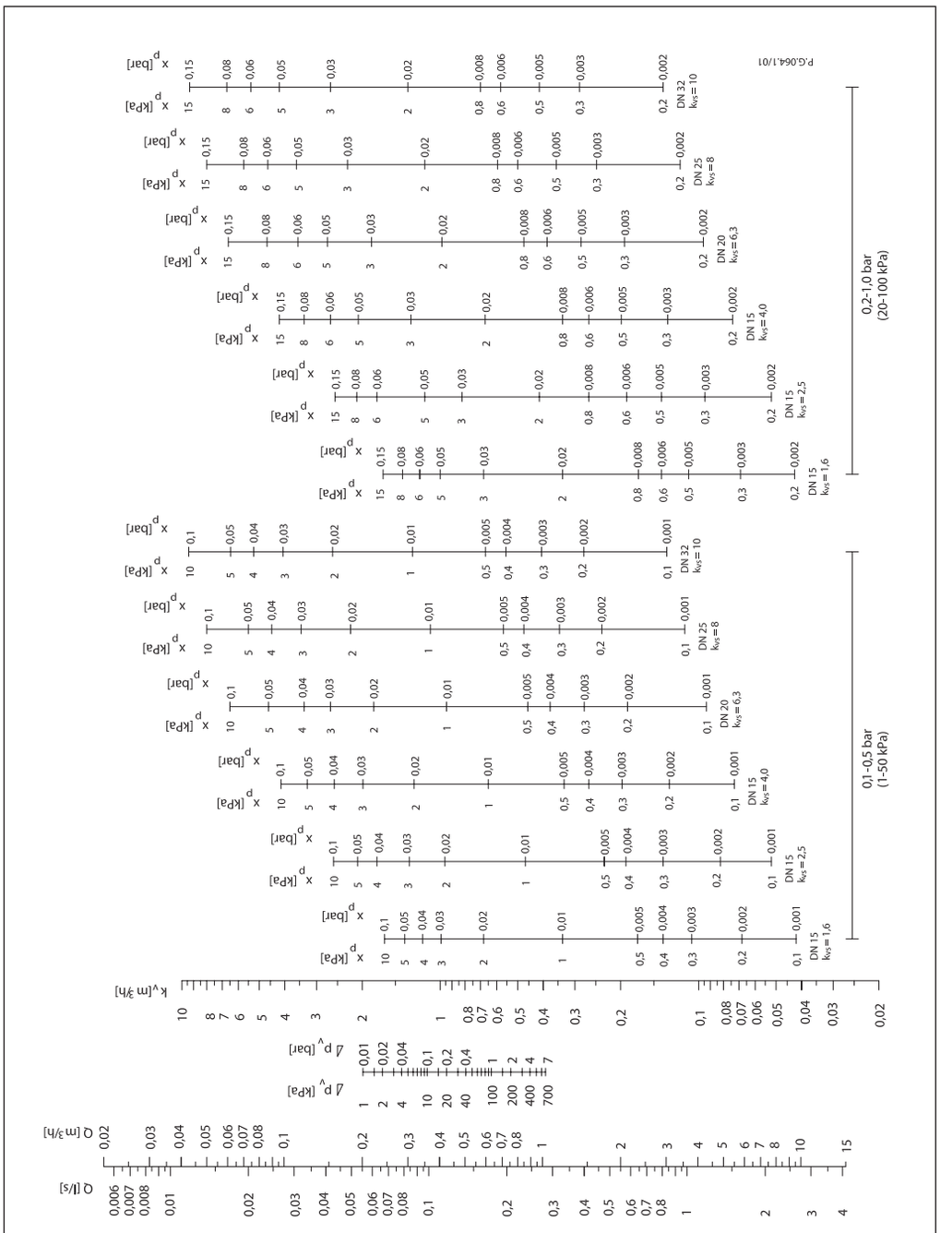
or read from the sizing diagram, page 8, by taking a line from Q-scale (0.8 m³/h) through $\Delta p_v$-scale ($\Delta p_v = \Delta p_{AVPQ} - \Delta p_b = 0.75 - 0.2 = 0.55$ bar) to intersect $k_v$-scale at 1.1 m³/h.

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).



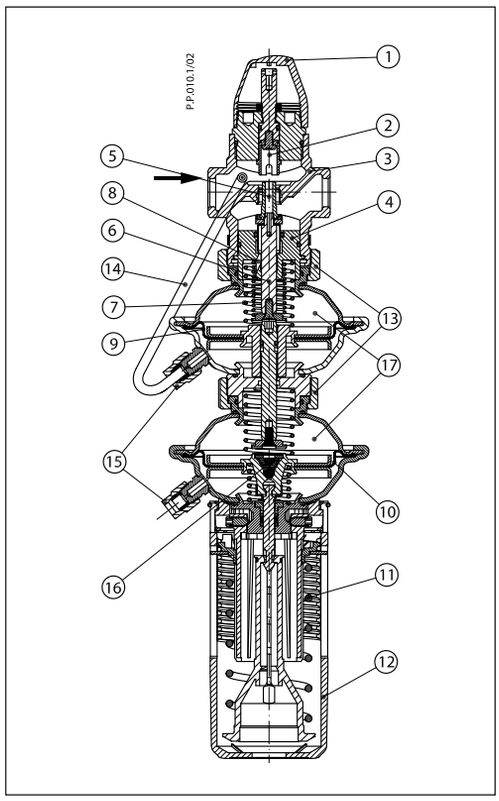
**Sizing** *(continued)*




*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.

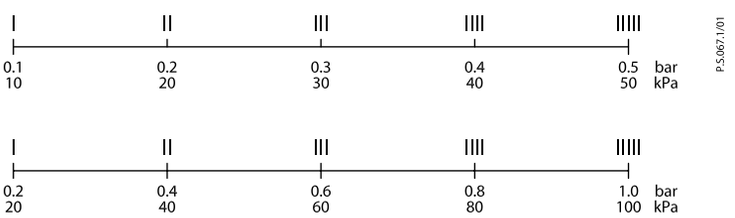
## Settings

*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.

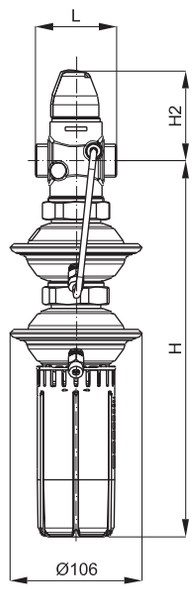
*Differential pressure setting*
Differential pressure setting (valid for AVPQ controller only) is being done by the adjustment of the setting spring for diff. pressure control. The adjustment can be done by means of handle for diff. pressure setting and/or pressure indicators.

## Adjustment diagram

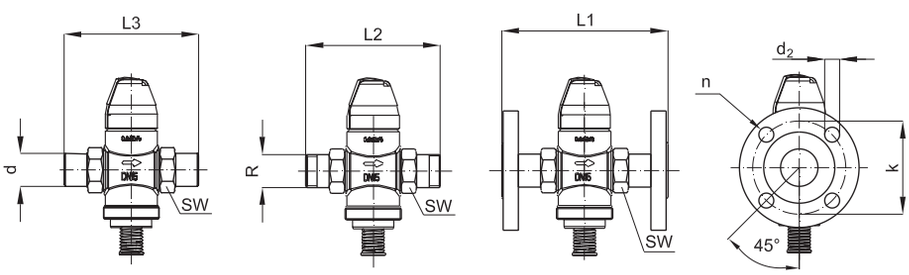
*Relation between scale figures and differential pressure. Values given are approximate.*



## 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