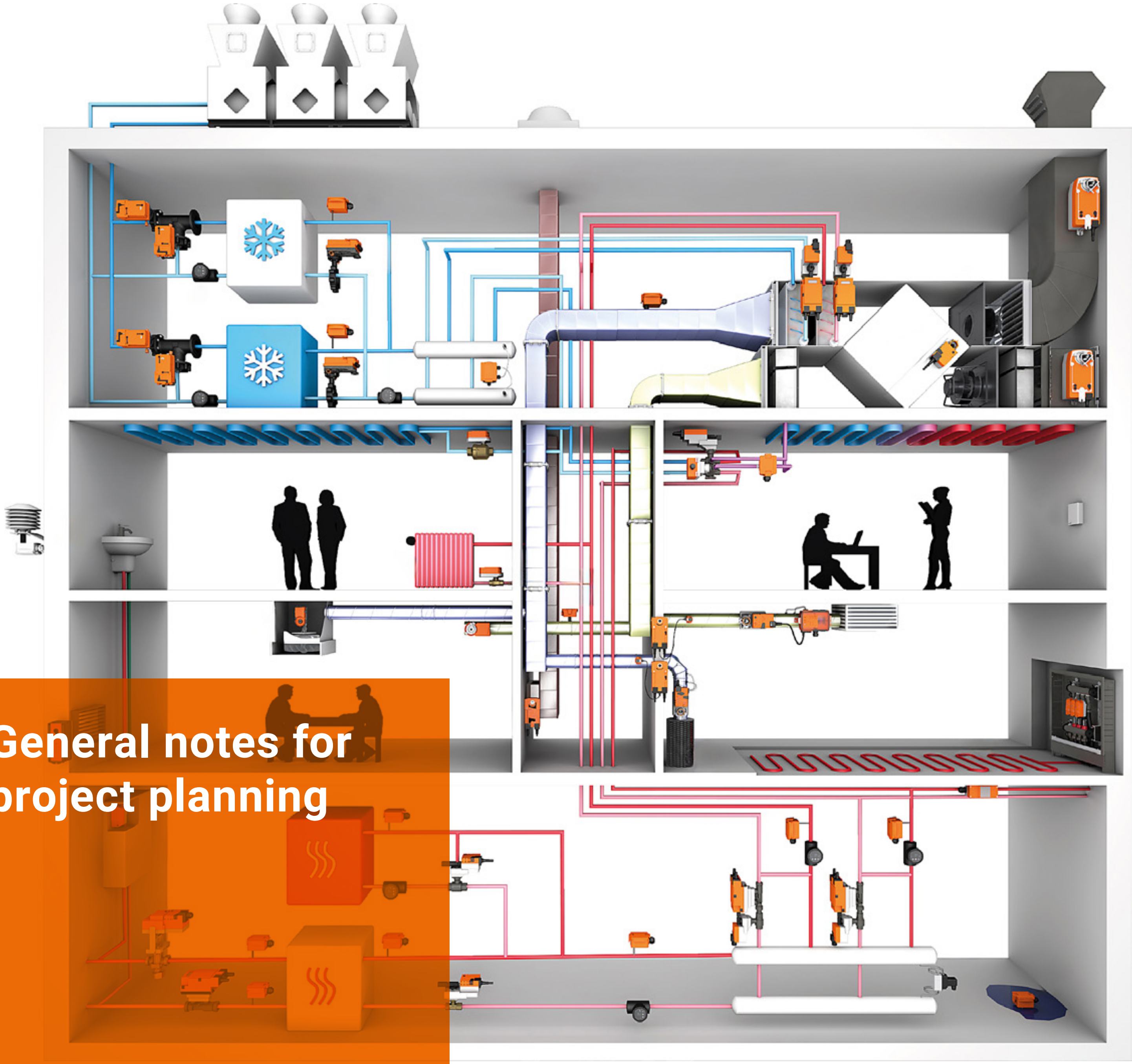

General notes for project planning

Selection and dimensioning of control, open/close and changeover valves

Edition 2025-03/B

BELIMO

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BELIMO

Introduction

Relevant information for project planning

These general notes for project planning help with the selection and dimensioning of Belimo valves. Please also observe the product-specific notes for project planning and data sheets for the respective valves.
Belimo valves are suitable as open/close, changeover or control valves in heating, ventilation and air conditioning systems. To ensure low-noise and long-lasting operation, it is important to comply with the specified fields of application.
For the project planning of valves, we recommend that provision be made for a sufficient number of open/close valves in order to facilitate later revisions, e.g. of heat exchangers.

Valve-actuator combination, scope of delivery

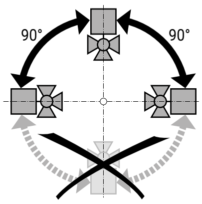
Depending on the product, the valve and actuator can be supplied assembled or separately. Valves and actuators can also be ordered individually (e.g. for replacement or RetroFIT+ projects).
Order examples can be found in the current Belimo Product and Price Catalogue www.belimo.com .

Mounting the actuator

The actuator can be easily mounted on the valve on site and installation instructions are supplied for each actuator. The instructions are also available online.

Installation regulations

The control devices valve-actuator combination can be installed upright or horizontally. However, it is not permissible to install them in a suspended position, i.e., with the spindle pointing downwards.



Commissioning

Commissioning may not occur until after the valve and actuator have been assembled and installed per the regulations.

Servicing

Ball valves, rotary actuators and sensors are maintenance-free.
The power supply to the actuator must be switched off for all service work on the actuator (disconnect electrical cables if necessary). All pumps in the relevant pipeline element must be switched off and the associated slide valves closed (if necessary, allow all components to cool down first and always reduce the system pressure to ambient pressure).
The system may not be recommissioned until after the ball valve and actuator have been correctly installed in accordance with the instructions and the pipeline has been filled by qualified personnel.

Later de-installation

For applications that require subsequent removal, we recommend taking appropriate precautions, e.g., by using additional detachable pipe connectors.

Disposal

Valves and actuators must be disposed of and recycled in accordance with national and local regulations.

General

Dimensions

The dimensions of the valve-actuator combination depend on the valve's nominal diameter and the actuator used. The dimensions can be found in the associated data sheets.

Pipeline clearances

The minimum clearances between the pipelines and the walls and ceilings required for project planning depend on the valve dimensions and the design. The dimensions can be found in the associated data sheets.

Water quality

Follow the regulations according to VDI 2035 regarding water quality.

Strainers

Control valves from Belimo are regulating devices. Central strainers are recommended to ensure the control task in the long term.

Dimensioning steps for control valves

1. Determining the basic hydronic circuit and Δp_{v100}

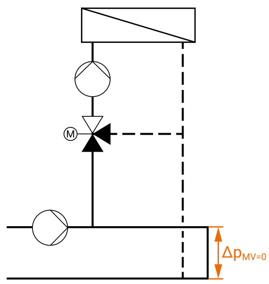
In order for a valve to achieve good control characteristics and to ensure a long service life, the valve must be correctly sized with the correct valve authority P_V. The valve authority is a measure of the control characteristics of the valve in interaction with the hydronic network. The valve authority is the ratio between the differential pressure of the fully open valve (Δp_{v100}) at nominal flow and the maximum occurring differential pressure of the closed valve. The higher the valve authority, the better the control characteristics. The lower the valve authority, the more the valve's operational behaviour deviates from the characteristic curve, i.e., the worse the flow control is. A valve authority >0.5 is desired in everyday practice.

3-way control valves

3-way control valves from Belimo are mixing devices. The direction of flow must be maintained under all loads. Whether installation is in the supply or return is dependent on the hydronic circuit selected. The prescribed direction of flow can be found in the further notes for project planning for characterised control valves and globe valves.

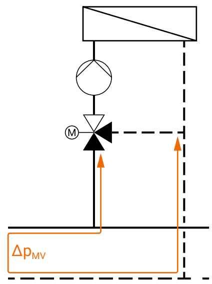
Mixing circuit (unpressurised manifold)

$\Delta p_{v100} > \Delta p_{MV}$
Typical values:
$\Delta p_{v100} > 3$ kPa



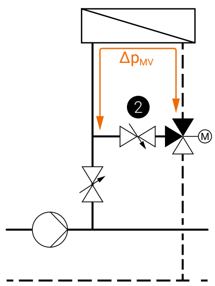
Mixing circuit (low loss header)

$\Delta p_{v100} > \Delta p_{MV}$
Typical values of individual groups:
5 kPa < Δp_{v100} < 20 kPa
Typical values for multiple groups:
20 kPa < Δp_{v100} < 50 kPa



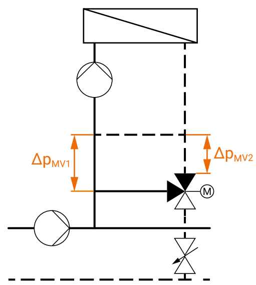
Diverting circuit

$\Delta p_{v100} > \Delta p_{MV}$
Typical values:
5 kPa < Δp_{v100} < 50 kPa



Injection circuit with 3-way valve

$\Delta p_{MV1} + \Delta p_{MV2} \approx 0$
Typical values:
$\Delta p_{v100} > 3$ kPa

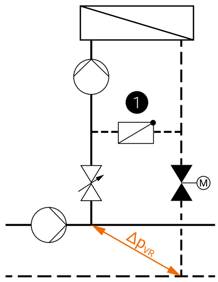


2-way control valves

2-way control valves from Belimo are throttling devices. Installation in the return is recommended for very high or very low supply temperatures. This ensures less thermal stress on the sealing elements in the fitting. The prescribed direction of flow can be found in the further notes for project planning for characterised control valves and globe valves.

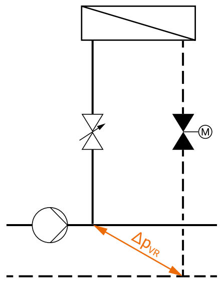
Injection circuit with 2-way valve

$\Delta p_{v100} > \Delta p_{VR}/2$
Typical values:
$10\ kPa < \Delta p_{v100} < 200\ kPa$



Throttling circuit

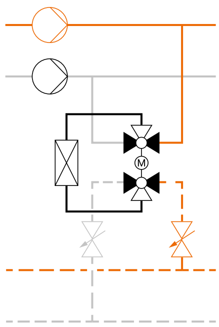
$\Delta p_{v100} > \Delta p_{VR}/2$
Typical values:
$10\ kPa < \Delta p_{v100} < 200\ kPa$



6-way characterised control valves

6-way characterised control valves from Belimo have been specially developed for combined heating and cooling elements. One 6-way characterised control valve performs the function of four 2-way control valves or two 2-way control valves and one changeover valve. The following sizing is carried out for each sequence (heating and cooling) for the 6-way characterised control valve.

Typical values:
$\Delta p_{v100} \leq 100\ kPa$
For low-noise operation:
$\Delta p_{v100} \leq 50\ kPa$



Legend

	2-way control valve		Supply	Δp_{VR}	Differential pressure at the respective branch (supply/return) at nominal load
	3-way control valve		Return	Δp_{MV}	Differential pressure in the variable-flow part at nominal load (e.g. heat exchanger)
	6-way characterised control valve		Check valve / non-return valve		Balancing valve
	Pump	1	Mandatory in some countries	2	Thanks to the reduced flow rate in the bypass, the balancing valve is not necessary with the 3-way characterised control valve.

2. Determining the flow V'_{100}

If the thermal output of a consumer and the corresponding differential temperature between the supply and the return are known, then the flow can be calculated using the following formula. The density and heat capacity of the water are taken into account as constant values by the factor 0.86.

$$V'_{100} = 0.86 \cdot \frac{Q_{100}}{\Delta T}$$

V'_{100}: [m³/h]
Q_{100}: [kW]
ΔT : [K]

3. Calculating the K_v value

Once the flow has been calculated, the flow factor K_v can be determined at a differential pressure of 100 kPa (1 bar).

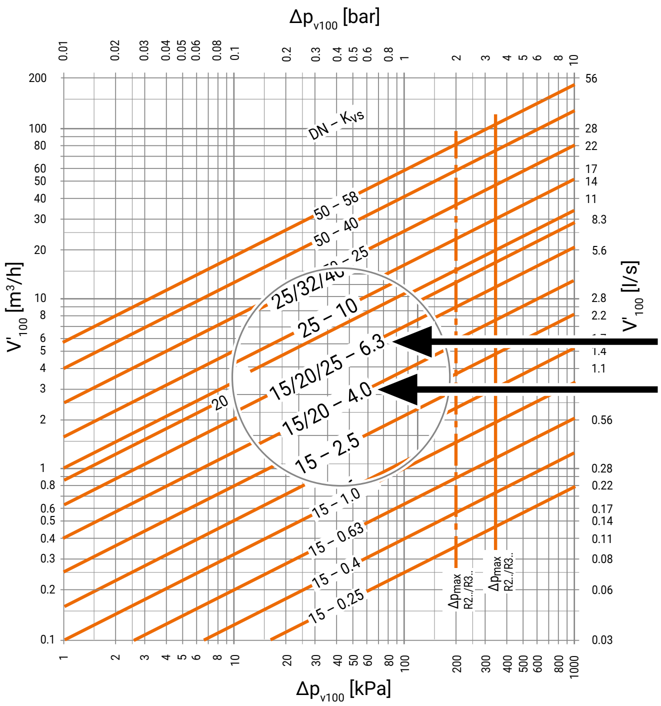
$$K_v = \frac{V'_{100}}{\sqrt{\frac{\Delta p_{v100}}{100}}}$$

Δp_{v100}: [kPa]
V'_{100} : [m³/h]
K_v : [m³/h]

4. Selecting the correct valve (selecting the K_{VS} value)

The calculated K_v value from step 3 can be used to determine a K_{VS} value in the flow diagram (see product-specific notes for project planning). If the K_v value lies between two K_v lines in the flow diagram, the following applies:

- If the calculated K_v value is closer to the lower K_v line, select the lower K_{VS} value.
- If the calculated K_v value is closer to the upper K_v line, select the higher K_{VS} value.
- If the K_v value is halfway between two K_v lines, select the lower K_{VS} value for a 2-way control valve and the higher K_{VS} value for a 3-way control valve.
- If the K_v value is above the upper K_v line, select the highest possible K_{VS} value. If the K_v value is below the lowest K_v line, select the lowest possible K_{VS} value. Here is an example with calculated K_v = 5.15 m³/h:



5. Checking the resulting differential pressure Δp_{v100}

Once a valve has been selected, the resulting differential pressure Δp_{v100} can be checked.
The resulting differential pressure Δp_{v100} is relevant for the calculation of the valve authority P_v:

$$\Delta p_{v100} = \left(\frac{V'_{100}}{K_{vs}}\right)^2 \cdot 100 \qquad \begin{array}{ll} \Delta p_{v100}: & [\mathrm{kPa}] \\ V'_{100}\ : & [\mathrm{m^3/h}] \\ K_{vs}\ : & [\mathrm{m^3/h}] \end{array}$$

6. Checking the valve authority P_v (control stability)

Check P_v with the differential pressure Δp_{v100} that results. The aim is to achieve a valve authority ≥0.5:

– Pressurised manifold with variable flow (2-way control valves)

$$P_v = \frac{\Delta p_{v100}}{\Delta p_{VR}}$$

– Low loss header with variable flow or pressurised manifold with constant flow (3-way control valves)

$$P_V = \frac{\Delta p_{v100}}{\Delta p_{v100} + \Delta p_{MV}}$$






K_{vs} [m³/h]	0.1...8	0.1...8	0.25...6.3	15...49	8.6...49	15...49
Valve type	Zone valves		Characterised control valves			
Pipe connection	Internal thread	External thread	Internal thread	Internal thread	External thread	Flange
2-way	C2..Q-..	C4..Q-..		R2..	R4..	R6..R [1] R6..W [2]
3-way				R3..	R5..	R7..R [1]
6-way			R30..-..-B1/B2/B3			
DN	15...25	15/20	15...25	15...50	15...50	15...150
PN	25	25	16	25/40	25/40	6/16
Permissible operating pressure p_s	1600 kPa	1600 kPa	1600 kPa	1600 kPa	1600 kPa	600 kPa
Fluid temperature	2...90°C	2...90°C	6...80°C	−10...120°C	−10...100°C	[3]
Further notes for project planning	2-way and 3-way zone valves (QCV)		6-way characterised control valves	2-way and 3-way characterised control valves		

[1] PN 6
[2] PN 16
[3] 5...110°C: R6..R, −10...120°C: R6..W, −10...100°C: R7..R

K_{vs} [m^3/h]	**1.6...40**	**0.63...40**	**0.4...320**	**630...1000**	**24...11760**
K_{vmax} [m^3/h]					**50...42800**
Valve type	Globe valves				Butterfly valves
Pipe connection	Internal thread	External thread	Flange		
2-way	H2..S-..	H4..B	H6..R [1] H6..N [2] H6..S/H6..SP [2] H6..X..-S2 [3] H6..X..-SP2 [3]	H6..W..-S7	D6..
3-way	H3..S-..	H5..B	H7..R [1] H7..N [2] H7..S H7..X..-S [3]	H7..W..-S7	D7.. [4]
DN	15...50	15...50	15...150	200/250	25...700
PN	25	16	6/16/25	16	6/10/16 [5]
Permissible operating pressure p_s	2500 kPa	1600 kPa	600/1600/2500 kPa	1600 kPa	1600/1600 kPa
Fluid temperature	0...130°C	−10...120°C	[6]	[6]	−20...120°C [7]
Further notes for project planning	Globe valves				Butterfly valves

[1] PN 6
[2] PN 16
[3] PN 25
[4] Available in DN 100...300
[5] D6..N, D6..W: DN 25...300: Flange PN 6/10/16
DN 250...350: Flange PN 10/16
DN 400...700: Flange PN 16
D6..NL, D6..WL: DN 25...150: Flange PN 10/16
DN 200...700: Flange PN 16
[6] 5...120°C: H6..W..-S7
−10...120°C: H6..R, H7..R, H6..N, H7..N, H7..W..-S7
5...150°C: H6..S, H6..SP, H6..X..-S.., H7..S
5...200°C: H7..X..-S..
[7] −10...120°C: DN 25...80, DN 200...700
−20...120°C: DN 100...150

Dimensioning steps for pressure-independent control valves

Fluctuating differential pressures are automatically equalised with pressure-independent control valves and do not affect the flow. To ensure perfect function, the differential pressure must be within a defined range. Specifications regarding minimum and maximum differential pressure can be found in the respective data sheets.

1. Determining the flow V'_{max}

If the thermal output of a consumer and the corresponding differential temperature between the supply and the return are known, then the flow can be calculated using the following formula. The density and heat capacity of the water are taken into account as constant values by the factor 0.86.

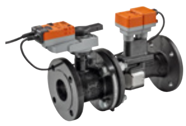
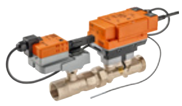
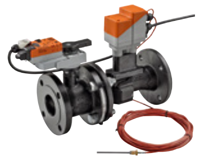
$$V'_{100} = 0.86 \cdot \frac{Q_{100}}{\Delta T}$$

V'_{100}: [m³/h]
Q_{100}: [kW]
ΔT : [K]

2. Selecting the correct valve

Using the information from step 1, the correct valve can already be selected. The following overview shows the pressure-independent characterised control valves from Belimo and refers to further documentation. You will find information on V'_{nom} in the respective data sheets. Please note that V'_{max} must be ≤ V'_{nom}. The permissible setting range is specified in the respective data sheets.

V'_{nom} [m³/h]	0.29...3.6	0.02...2.1
Valve type	PIFLV	PIQCV
Pipe connection	Internal thread	Internal thread
2-way	C2..QFL-.. R225FL-..	C2..QP(T)..
DN	15...25	15...25
PN	25	25
Permissible operating pressure p_s	1600 kPa	1600 kPa
Fluid temperature	2...60°C	2...90°C

V'_{nom} [m³/h]	1.5...3.5	1.5...15	28.8...162	1.5...15	1.5...15	28.8...162
Designation	6-way EPIV	EPIV	EPIV	Belimo Energy Valve™	Belimo Energy Valve™	Belimo Energy Valve™
Valve type	Electronic pressure-independent 6-way characterised control valve	Electronic pressure-independent characterised control valve with sensor-operated flow control		Electronic pressure-independent characterised control valve with sensor-operated flow, power or differential pressure control and energy monitoring function	Electronic pressure-independent characterised control valve with sensor-operated flow or power control and energy monitoring function	
Pipe connection	Internal thread	Internal thread	Flange	Internal thread	Internal thread	Flange
2-way	–	EP..R2+BAC EP..R2+KBAC	EP..F+MOD EP..F+MP EP..F+KMP	EV..R2+BAC EV..R2+KBAC EV..R2+MID	–	EV..F+BAC EV..F+KBAC
3-way	–	–	–	–	EV..R3+BAC	–
6-way	EP..R6+BAC EP..R6+BAC+HH1 EP..R6+BAC+HH2 EP..R6+BAC+HHM	–	–	–	–	–
DN	15/20/25	15...50	65...150	15...50	15...50	65...150
PN	16	25	16	25	25	16
Permissible operating pressure p_s	1600 kPa	1600 kPa	1600 kPa	1600 kPa	1600 kPa	1600 kPa
Fluid temperature	6...80°C	−10...120°C	−10...120°C	−10...120°C	−10...120°C	−10...120°C

Dimensioning steps for open/close and changeover valves

1. Determining the K_{VS} value

- Prerequisite: Nominal pipeline diameter is known.
- Selection of a possible valve based on the nominal diameter of the pipe (nominal diameter of valve ≤ nominal diameter of pipe)
- You can find the K_{VS} values for the desired nominal diameter in the Belimo data sheets.

2. Determining the flow V'_{100}

If the thermal output of a consumer and the corresponding differential temperature between the supply and the return are known, then the flow can be calculated using the following formula. The density and heat capacity of the water are taken into account as constant values by the factor 0.86.

$$V'_{100} = 0.86 \cdot \frac{Q_{100}}{\Delta T}$$

V'_{100}: [m³/h]
Q_{100}: [kW]
ΔT : [K]

3. Calculating the differential pressure Δp_{V100}

$$\Delta p_{V100} = \left(\frac{V'_{100}}{K_{VS}}\right)^2 \cdot 100$$

Δp_{V100}: [kPa]
V'_{100} : [m³/h]
K_{VS} : [m³/h]

4. Selecting the correct valve

Using the information from steps 1 to 3, the correct valve can be selected. For open/close valves, the same nominal diameter is usually selected for the valve as for the pipe. The following overview shows the open/close valves from Belimo and refers to further documentation.





K_{VS} [m³/h]	0.1...8	0.1...8	15...49	8.6...49	15...49
Valve type	Zone valves		Open/close or changeover ball valves		
Pipe connection	Internal thread	External thread	Internal thread	External thread	Flange
2-way	C2..Q-..	C4..Q-..	R2..	R4..	R6..R
3-way	C3..Q-..	C5..Q-..	R3..	R5..	R7..R
DN	15...25	15/20	15...50	15...50	15...50
PN	25	25	25/40	25/40	6
Permissible operating pressure p_s	1600 kPa	1600 kPa	1600 kPa	1600 kPa	600 kPa
Fluid temperature	2...90°C	2...90°C	−10...120°C	−10...100°C	−10...100°C
Further notes for project planning	2-way and 3-way zone valves (QCV)		2-way and 3-way characterised control valves		

K_{vs} [m³/h]	1.6...40	0.63...40	0.4...320	630...1000	24...11760
K_{vmax} [m³/h]					50...42800
Valve type	Globe valves				Butterfly valves
Pipe connection	Internal thread	External thread	Flange		
2-way	H2..S-..	H4..B	H6..R [1] H6..N [2] H6..S/H6..SP [2] H6..X..-S2 [3] H6..X..-SP2 [3]	H6..W..-S7	D6..
3-way	H3..S-..	H5..B	H7..R [1] H7..N [2] H7..S H7..X..-S [3]	H7..W..-S7	D7.. [4]
DN	15...50	15...50	15...150	200/250	25...700
PN	25	16	6/16/25	16	6/10/16 [5]
Permissible operating pressure p_s	2500 kPa	1600 kPa	600/1600/2500 kPa	1600 kPa	1600/1600 kPa
Fluid temperature	0...130°C	−10...120°C	[6]	[6]	−20...120°C [7]
Further notes for project planning	Globe valves				Butterfly valves

[1] PN 6
[2] PN 16
[3] PN 25
[4] Available in DN 100...300
[5] D6..N, D6..W: DN 25...300: Flange PN 6/10/16
DN 250...350: Flange PN 10/16
DN 400...700: Flange PN 16
D6..NL, D6..WL: DN 25...150: Flange PN 10/16
DN 200...700: Flange PN 16
[6] 5...120°C: H6..W..-S7
−10...120°C: H6..R, H7..R, H6..N, H7..N, H7..W..-S7
5...150°C: H6..S, H6..SP, H6..X..-S.., H7..S
5...200°C: H7..X..-S..
[7] −10...120°C: DN 25...80, DN 200...700
−20...120°C: DN 100...150

Definitions

Formula symbols

K_V	The flow coefficient K_V [m^3/h] is the specific flow of a valve at a specified valve position in relation to 100 kPa (1 bar). The K_V value changes, depending on the valve position. The flow coefficient is determined at a water temperature of 5...40°C.
K_{VS}	The K_V value related to the nominal valve position is referred to as the K_{VS} value. The manufacturer defines the maximum valve opening. Characterised control valves (CCV): Flow coefficient at 100% valve opening Zone valve (QCV): Flow coefficient with corresponding position of the end stop clip (variable) Globe valves: Flow coefficient at 100% valve opening Butterfly valves: Flow coefficient at 100% valve opening for open/close applications Flow coefficient at 60% valve opening for control applications
Δp_{v0}	Maximum permissible differential pressure in the opening range of the valve
Δp_{v100}	Differential pressure across the fully open valve at V'_{100}
Δp_{max}	Maximum permissible differential pressure across the control path A – AB in relation to the entire opening range
Δp_{MV}	Differential pressure across the variable-flow part (e.g., heat exchanger) at nominal load
Δp_{VR}	Differential pressure at the respective branch (supply/return) at nominal load
Δp_{VS}	Close-off pressure: The specified tightness of the valve is ensured up to this value.
p_S	Permissible operating pressure kPa
Q_{100}	Heating or cooling power of the consumer
ΔT	Differential temperature between supply and return
P_V	Valve authority: The benchmark for the control characteristics of the valve in combination with the hydronic network. The valve authority is the ratio at nominal load between the differential pressure across the fully open valve (Δp_{v100}) at nominal flow and the maximum occurring differential pressure across the closed valve.
V'_{100}	Nominal flow at Δp_{v100} (design case)
V'_{max}	Set maximum flow rate of a pressure-independent valve with the largest control signal, e.g., 10 V
V'_{nom}	Maximum possible flow rate of a pressure-independent valve, catalogue value, delivery condition

Further documentation

- Notes for project planning:
  Butterfly valves for control, open/close and changeover applications
- Notes for project planning:
  EXT-H6..
- Notes for project planning:
  Belimo ZoneTight™
  QCV 2-way characterised control valve and 3-way changeover ball valve
- Notes for project planning:
  Pressure-independent zone valve PIQCV
- Notes for project planning:
  Mechanical pressure-independent 6-way characterised control valve
- Notes for project planning:
  Electronic pressure-independent 6-way characterised control valve
- Notes for project planning:
  6-way characterised control valves DN 15 / DN 20 / DN 25
- Notes for project planning:
  Electronic pressure-independent characterised control valve with energy monitoring Belimo Energy Valve™
- Notes for project planning:
  Electronic pressure-independent characterised control valve with energy monitoring Belimo Energy Valve™ 4
- Notes for project planning:
  Electronic pressure-independent characterised control valve EPIV
- Notes for project planning:
  Electronic pressure-independent 3-way characterised control valve with energy monitoring Belimo Energy Valve™
- Notes for project planning:
  2- and 3-way globe valves
- Notes for project planning:
  2-way and 3-way characterised control valves

All inclusive.

Belimo is the global market leader in the development, production, and sales of field devices for the energy-efficient control of heating, ventilation and air-conditioning systems. The focus of our core business is on damper actuators, control valves, sensors and meters.

Always focusing on customer value, we deliver more than only products. We offer you the complete product range for the regulation and control of HVAC systems from a single source. At the same time, we rely on tested Swiss quality with a five-year warranty. Our worldwide representatives in over 80 countries guarantee short delivery times and comprehensive support through the entire product life. Belimo does indeed include everything.

The "small" Belimo devices have a big impact on comfort, energy efficiency, safety, installation and maintenance.

In short: Small devices, big impact.

- 5-year warranty
- On site around the globe
- Complete product range
- Tested quality
- Short delivery times
- Comprehensive support

EN – 2025-03/B – Subject to technical modifications

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