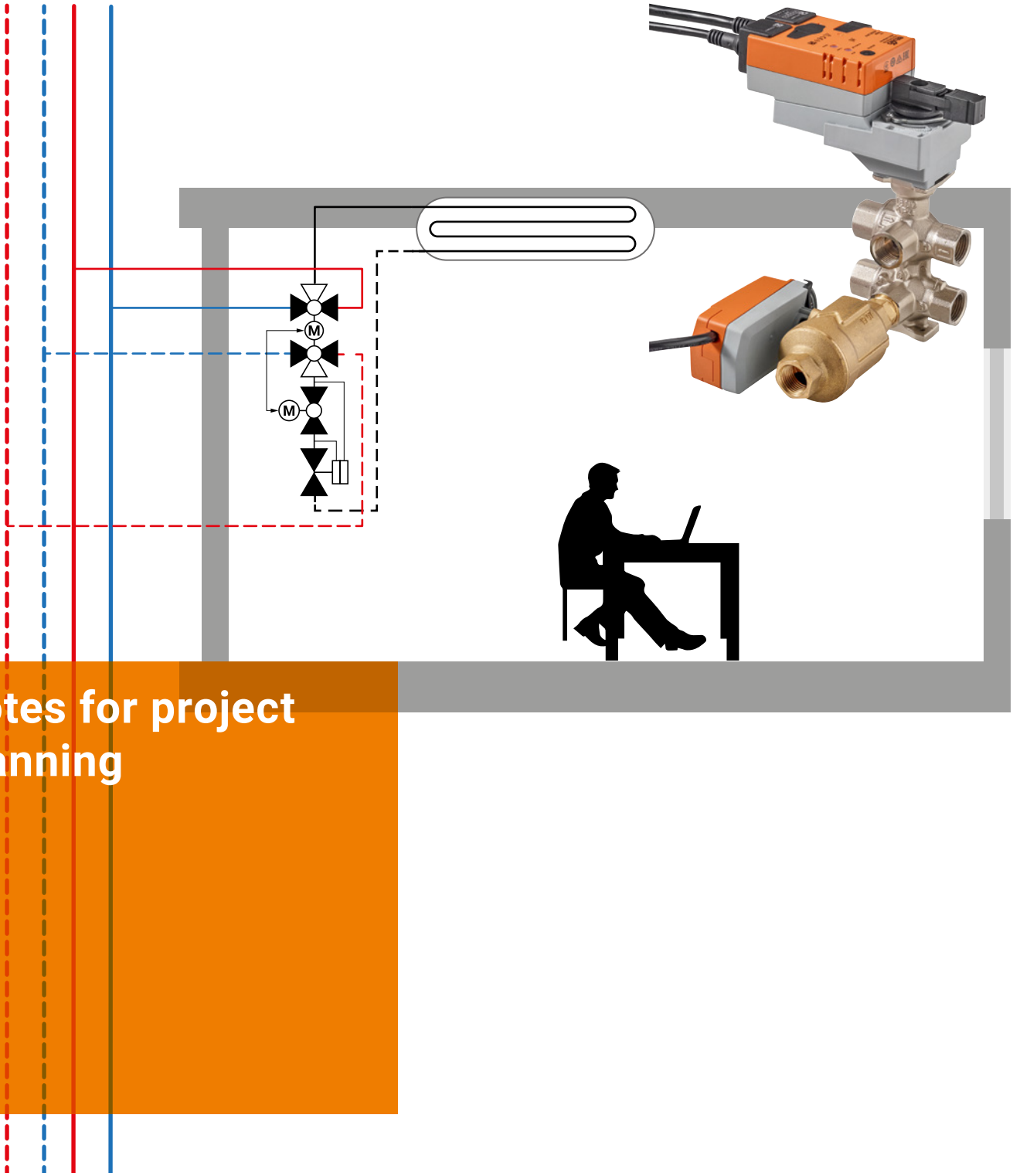

Notes for project planning

Mechanical pressure-independent 6-way characterised control valve

Edition 2022-08/A

BELIMO

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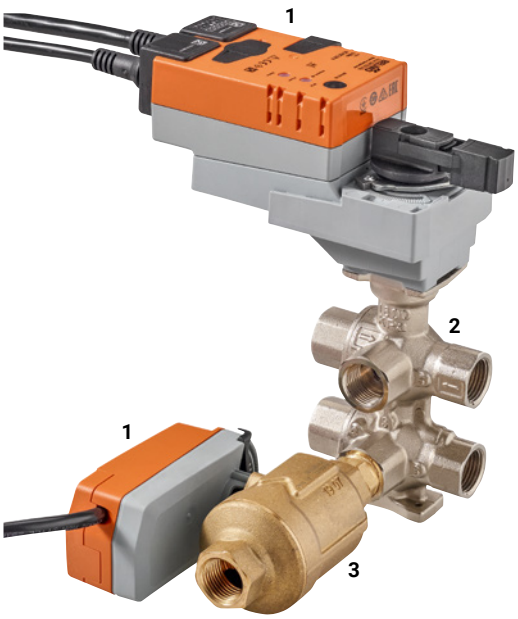
BELIMO

6-way PI zone valve

Structure

Nominal diameter DN 15/20



1. Actuator
2. The 6-way changeover ball valve switches between the heating and cooling sequence
3. The 2-way PI zone valve (PIQCV) supplies all heating and cooling elements with the required amount of water as a pressure-independent characterised control valve

Mode of operation

The control device consists of two components: the 6-way changeover ball valve with actuator and the mechanical pressure-independent 2-way PI zone valve. The set maximum flow rates for sequence 1 (V'_{max1}) and sequence 2 (V'_{max2}) are assigned to the control signal as follows:
– 2 V/0% = 100% for sequence 1
– 10 V/100% = 100% for sequence 2
The control device can be controlled communicatively or analogue. Depending on the control signal, the heating or cooling sequence is activated by the changeover at the 6-way changeover ball valve. Furthermore, the pressure-independent 2-way PI zone valve ensures the water quantity required by the control signal for heating or cooling operation.
With a differential pressure of 16...350 kPa across the 2-way PI zone valve, a constant flow rate results thanks to the integrated pressure regulating valve. A valve authority of 1 is achieved regardless of the differential pressure across the 2-way PI zone valve. Even with pressure fluctuations and in the partial load range, the flow rate remains constant for the respective requirement and ensures stable control.

Product type from Belimo	DN	Rp ["]	V'_{nom} [l/h]	V'_{max} [l/h]	V'_{nom} [m³/h]	PN
C615QP-B+BAC	15	½	210	40...210	0.21	16
C615QP-D+BAC	15	½	420	100...420	0.42	16
C615QP-F+BAC	15	½	980	190...980	0.98	16
C620QPT-G+BAC	20	¾	2100	600...2100	2.10	16

Project planning

Relevant information

Please refer to the data, information and limit values on the data sheets of the (mechanical pressure-independent) 6-way PI zone valves.
C615QP-..+BAC
(mechanical pressure-independent 6-way characterised control valve DN 15)
C620QPT-F+BAC
(mechanical pressure-independent 6-way characterised control valve DN 20)

Dimensions

The dimensions of the actuator combination used depend on the design and nominal diameter 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 not only on the valve dimensions but also on the design. The dimensions can be found in the associated data sheets.

Pressure-independent characterised control valves

Characterised control valves must be provided as throttling devices in the return. This leads to lower thermal loads on the sealing elements in the valve. The prescribed direction of flow must be observed.

Water quality

Adhere to the water quality requirements specified in VDI 2035.

Strainer

The 6-way PI zone valve is a regulating device. To ensure that it can also fulfil the control task in the long term, central strainers are recommended in the system.

Water systems version

Application is permitted only in closed water circuits.

Planning information

The minimum required pressure value of the 2-way PI zone valve of 16 kPa must be taken into account in the pump design.

Open/close valve

Make sure that sufficient open/close valves are installed.

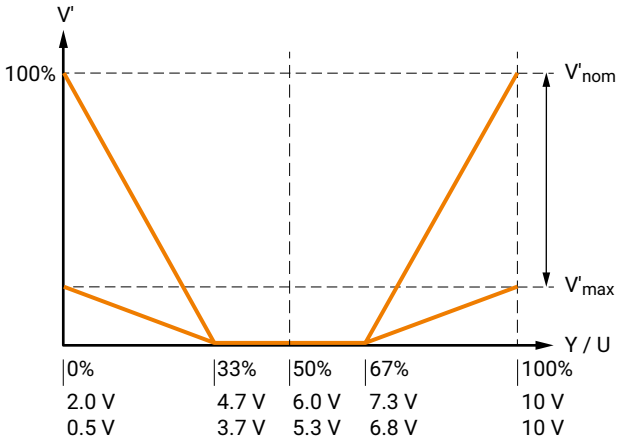
Measuring ports P/T ports

The C620QPT-G+BAC type valve has two measuring ports. The total pressure drop across the valve can be determined using the measuring points at the inlet (P1) and outlet (P3) of the valve.
With the help of the measuring nipples, it is easy to determine whether the effective differential pressure across the valve is within the effective pressure range of 16...350 kPa. If this is the case, the valve operates independently of pressure and the correct flow rate according to the setting table is automatically ensured by the valve .
Furthermore, the measurement of the differential pressure can be used to optimise the pump setting. This involves reducing the pump head only until the minimum differential pressure required (16 kPa) is still present across the valve at the point of lowest pressure (the furthest away from the pump in hydronic terms).

Definition V'_{nom} / V'_{max}

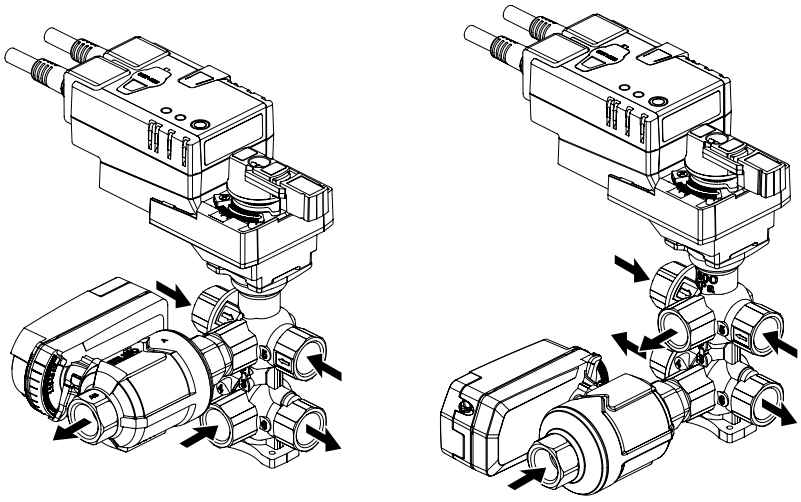
V'_{nom} is the maximum possible flow. ($V'_{nom} = V'_{nom1} = V'_{nom2}$)
V'_{max1} is the maximum flow rate for sequence 1 which has been set with the smallest control signal, 2 V/0%.
V'_{max2} is the maximum flow rate for sequence 2 which has been set with the greatest control signal, 10 V/100%.
V'_{max1} and V'_{max2} can be set within the V'_{max} values listed on page 4.

Valve characteristic curve

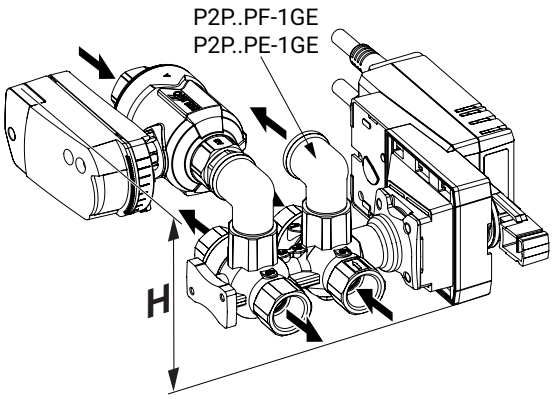


Type of installation

Default type of installation with mounting of the 2-way PI zone valve in the supply (picture on left) and in the return (picture on right).
When installing the 2-way PI zone valve, it is essential to ensure the correct direction of flow.



Variant with accessory P2P..-1GE for minimum installation height H: DN 15 = 116 mm; DN 20 = 128 mm.



Allocation of the sequences

Allocation to hot and cold water is, in principle, freely selectable. However, due to installation safety, an equal allocation for all valves is recommended.

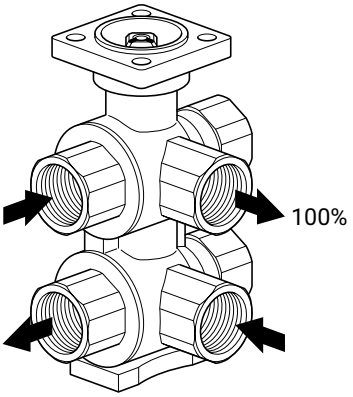
Due to the control characteristics of the room temperature controller CRK24-B1 from Belimo, the following mandatory allocation is to be selected when used:
Sequence 1 = cooling
Sequence 2 = heating

Flow direction

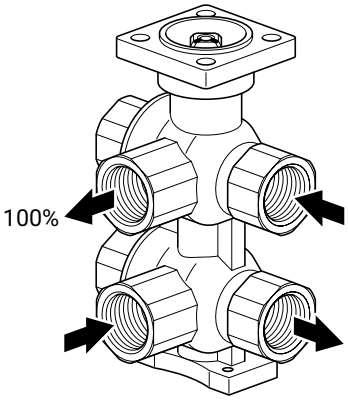
The direction of flow must be observed.

Direction of flow of the 6-way changeover ball valve:

Sequence 1

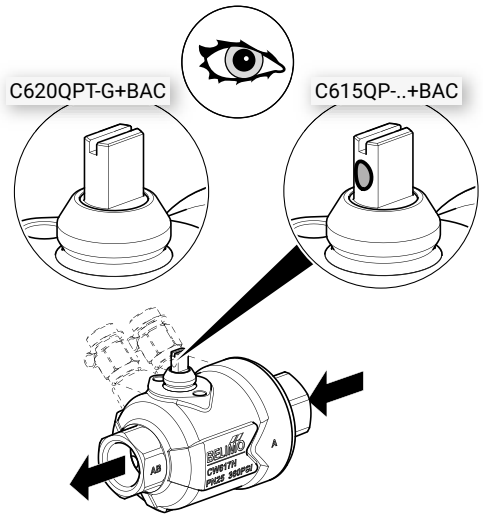


Sequence 2



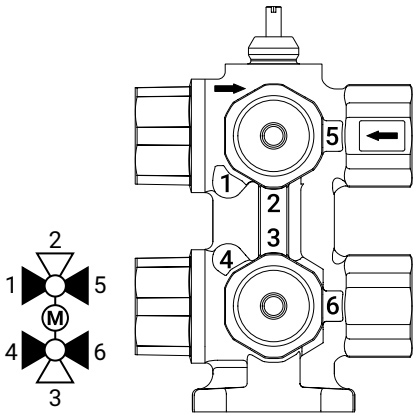
Direction of flow of the 2-way PI zone valve:

The direction of flow, specified by an arrow on the housing, is to be complied with, since otherwise the ball valve could become damaged. Please ensure that the ball for DN 15 and DN 20 is in the correct position (marking on the spindle).



Marking of the valve gates

These are numbered from 1 to 6 with 6-way changeover ball valves for the purpose of secure allocation of the valve gates during planning and mounting.



Pressure compensation

In cases of combined heating/cooling control elements, the fluid remains in the control element when in the closed position (no heating or cooling). If the fluid temperature changes due to the ambient temperature, the pressure of the enclosed fluid can increase or decrease.
If the 6-way PI zone valve does not receive a heating or cooling request, the following occurs:

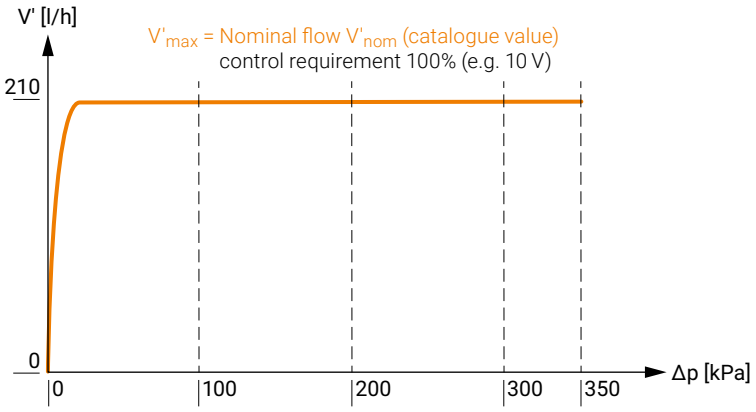
– The 2-way PI zone valve is closed. Thanks to the air-bubble tight shut off, no water flow is possible through the heating/cooling element
– The 6-way changeover valve remains open in the last sequence used. The open port can be used at any time to compensate for pressure changes

Design and dimensioning

A conventional (pressure-dependent) valve is designed based on the k_v value. For a given nominal flow, this is dependent on the differential pressure present across the valve. In order to obtain a sufficient quality of control, the valve authority P_V must also be taken into account for pressure-dependent valves.
For a pressure-independent solution, such as the 6-way PI zone valve, the design is greatly simplified. Due to dynamic balancing, the 6-way PI zone valve provides the required water quantity at any time, even in the event of differential pressure fluctuations and in partial load operation. Due to dynamic balancing, the valve authority amounts to 1.

Constant flow rate V'

Thanks to the permanent balancing of the flow value in the event of differential pressure changes in the system, constant pressure-independent water flow is ensured over a large differential pressure range.



Pressure-independent flow rate over a large differential pressure range due to dynamic balancing (example C615QP-B+BAC).

Valve design

The valve is determined using the maximum flow required V'_{max}. Calculation of the k_{vs} value is not required. The required system-specific maximum flow rate V'_{max} must be within the permissible adjustment range.
DN 15: V'_{max} = 40…980 l/h (3 types)
DN 20: V'_{max} = 600…2100 l/h
During commissioning, the desired system-specific flow rate value V'_{max} is set on the valve using the ZTH EU service tool, Belimo Assistant App (NFC) or via bus.

Verification of the differential pressure

For proper operation, the differential pressure across the valve must lie within a defined range.

Minimum differential pressure (minimum pressure drop)
The minimum required differential pressure (pressure drop across both valves) to achieve the desired flow rate V'_{max} can be determined using the k_{vs} value of the 6-way PI zone valve (see table below) and the flow-independent minimum required differential pressure across the 2-way PI zone valve. The calculated value depends on the required maximum flow rate V'_{max}. Higher differential pressures are automatically compensated.

Formula Δp_{min}

$$\Delta p_{min} = 100 \cdot \left(\frac{V'_{max}}{k_{vs}}\right)^2 + 16$$

Δp_{min} : [kPa]
V'_{max} : [m³/h]
k_{vs} : [m³/h]

Product type from Belimo	k_{vs} 6-way PI zone valve [m³/h]
C615QP-B+BAC	1.8
C615QP-D+BAC	1.8
C615QP-F+BAC	1.8
C620QPT-G+BAC	4.0

Example: C615QP-F+BAC with the desired maximum flow rate 440 l/h

C615QP-F+BAC
k_{vs} 6-way PI zone valve = 1.8 m³/h
V'_{max} = 440 l/h = 0.44 m³/h

$$\Delta p_{min} = 100 \cdot \left(\frac{V'_{max}}{k_{vs}\ \text{6-way PI zone valve}}\right)^2 + 16 = 100 \cdot \left(\frac{0.44\ m^3/h}{1.8\ m^3/h}\right)^2 + 16 = \mathbf{22\ kPa}$$

In case of different flow rates for the heating and cooling sequence (V'_{max1} and V'_{max2}), the minimum required differential pressures for both sequences must be determined individually.

Maximum differential pressure
The valve automatically compensates for higher differential pressures. Motion of the closing element in the direction of the closing point causes an increase in the pressure drop across the valve. This ensures a constant water quantity. The permitted maximum differential pressure is specified on the data sheet.

Sizing with missing hydronic data

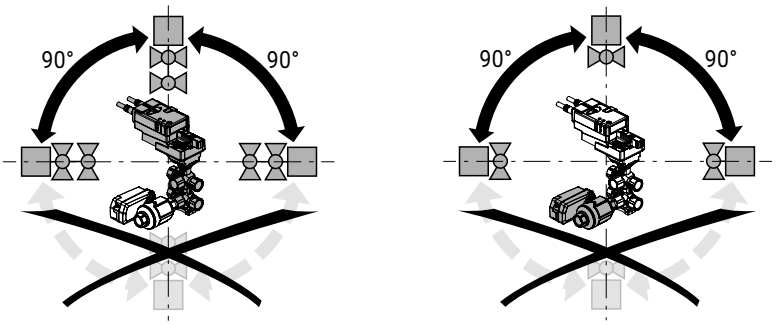
If no hydronic data are available, the nominal diameter of the valve can be selected equal to the nominal diameter of the heat exchanger.

Design when using glycol

To reduce the freezing point of water, salt was added to the water in the past. These were called brine applications. Today glycol is used and we talk about cold agents. Depending on the concentration of the cold agent used (type of glycol) and the fluid temperature, the density of the water-glycol mixture varies between 1 and 9 percent. The resulting volume deviation is less than the permissible volume tolerance of the valves k_{VS} value (by ±10 percent according to VDE 2178) and as a rule need not be taken into account even if glycol requires a slightly higher k_V value. Depending on the type of glycol, compatibility with the valve materials used must be guaranteed and the permissible maximum concentration (50 percent) must not be exceeded.

Installation

Recommended installation position



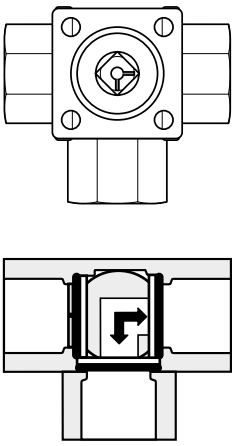
Valve position

The ball position can be identified by the marking on the top of the spindle.

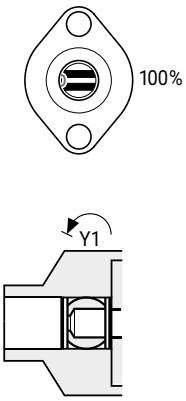
Valve delivery condition

The valves are delivered ex works as shown with the picture below.

6-way changeover ball valve



2-way PI zone valve (PIQCV)



Delivery condition conforms to valve position 90°/control signal 10 V.

Definitions

Formula symbol

k_{vs}	Flow coefficient at 100% valve opening of sequence 1 or sequence 2 and at 100% valve opening of the 2-way PI zone valve
Δp_{min}	Minimum required differential pressure (pressure drop across the valve) to achieve the desired flow rate V'_{max}
Δp_{max}	Maximum permissible differential pressure
p_s	Permissible operating pressure kPa
V'_{max}	Set maximum flow rate of a pressure-independent valve with the greatest control signal, e.g. 10 V
V'_{nom}	Maximum possible flow rate of a pressure-independent valve, catalogue value, delivery condition

Further documentation

- General notes for project planning
- Technical Data Sheet C6..QP-..+BAC
- Technical Data Sheet ZTH EU – Supplement to 6-way PI zone valve
- Installation instructions C6..QP-..+BAC
- Application brochure - Room and zone control
- Tool Connections
- BACnet Interface Description – 6-way PI zone valve
- Modbus Interface Description – 6-way PI zone valve
- Introduction to MP-Bus Technology
- MP-Bus Data Pool Values – 6-way PI zone valve
- MP-Bus co-operation partners

All inclusive.

Belimo as a global market leader develops innovative solutions for the controlling of heating, ventilation and air-conditioning systems. Damper actuators, control valves, sensors and meters represent our core business.

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.

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