

## 6-way characterised control valves DN 15 / DN 20 / DN 25

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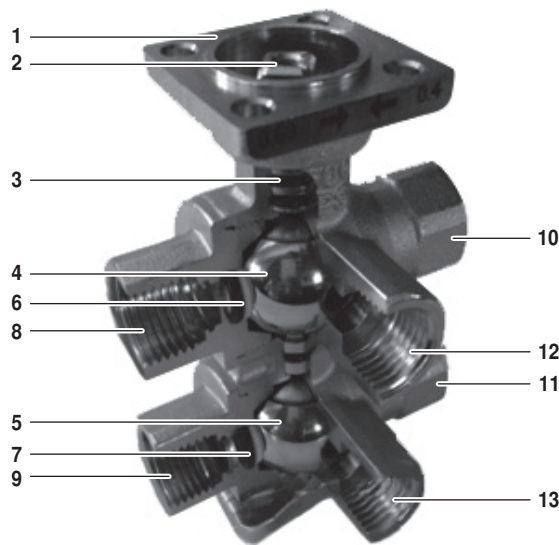
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Project planning

- Relevant information** The data, information and limit values listed on the data sheet of the 6-way characterised control valve are to be taken into account and/or complied with, respectively.
- Dimensions** The dimension of the valve-actuator combination used is dependent not only the nominal diameter of the valve but also on the actuator used. The dimensions are listed in the R30...-B2 data sheet.
- 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 selected actuator. The dimensions can be found on the R30...-B2 data sheet.
- Water quality** The water quality requirements specified in VDI 2035 must be adhered to.
- Dirt filter** 6-way characterised control valves are regulating devices. The use of central dirt filters in the system is recommended in order to prolong their service life for performing control tasks.
- Water systems version** Utilisation is permitted only in closed water circuits.

Structure of the 6-way characterised control valves

- 1 Connection flange
- 2 M4 spindle (nickel-plated brass)
- 3 Stem seal O-ring (EPDM)
- 4 Ball 1 with L-bore
- 5 Ball 2 with L-bore
- 6 Valve seat (PTFE, O-ring EPDM)
- 7 Characterising disk (stainless steel)
- 8 Supply connection Sequence 1 \*
- 9 Return connection Sequence 1 \*
- 10 Supply connection Sequence 2 \*
- 11 Return connection Sequence 2 \*
- 12 Heating/cooling element supply connection \*
- 13 Heating/cooling element return connection \*



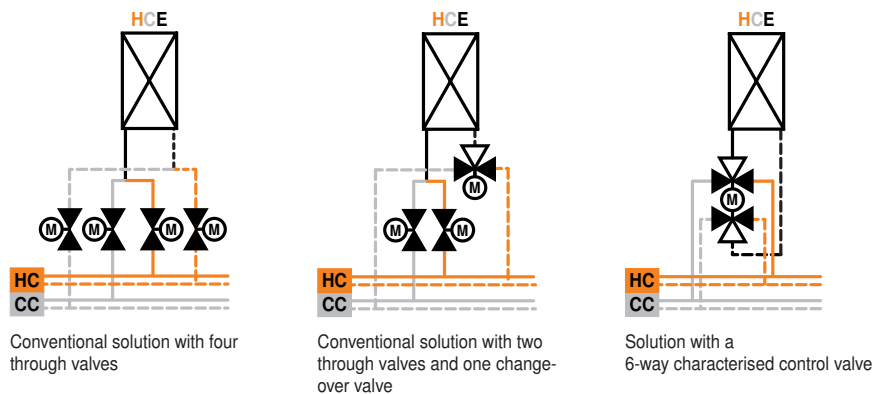
\* Internal thread according to ISO 7-1  
 DN 15: Rp 1/2", DN 20: Rp 3/4", DN 25: Rp 1"

Range of use

The 6-way characterised control valve was specially developed for utilisation with combined heating and cooling elements. In order to accomplish this, a 6-way characterised control valve assumes the function of four through valves or two through valves and one change-over valve.

Picture legend

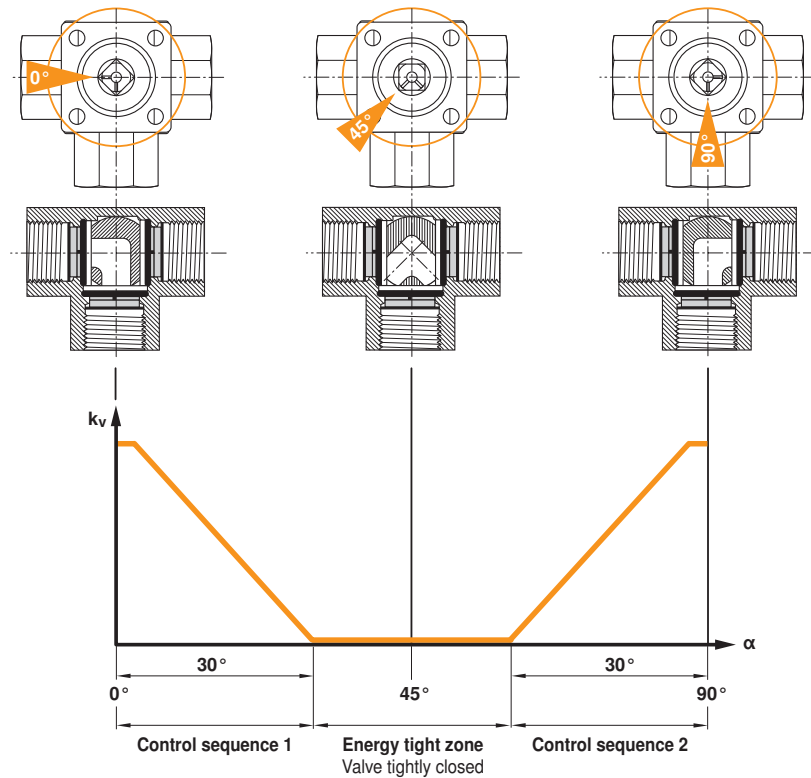
- HC** Heating circuit
- CC** Cooling circuit
- HCE** Combined heating and cooling element



The 6-way characterised control valve assumes control of both the hot and the cold water.

Project planning

**Characteristic curve** These three sequences are run through when the valve is rotated by 90°.



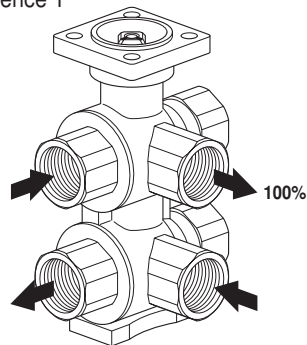
**Allocation of the sequences** As a basic rule, the allocation to heating and cooling water can be selected freely. However, due to installation safety, the definition of an equal allocation for all valves is recommended.



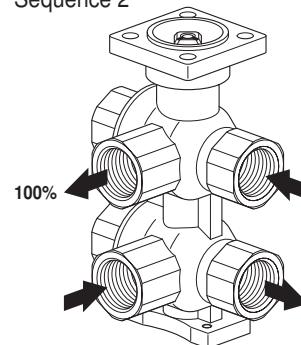
The following mandatory allocation is to be selected when the room temperature controller CRK24-B1 from Belimo is selected, due to the controller characteristics:  
 Sequence 1 = cooling  
 Sequence 2 = heating

**Flow direction** The flow direction must be observed.

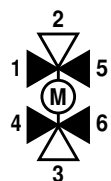
Sequence 1



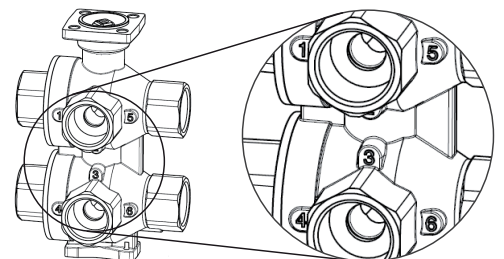
Sequence 2



**Marking of the connection ports**



These are numbered from 1 to 6 for the purpose of secure allocation of the connections during planning and installation.



**Motorisation** 6-way characterised control valves are motorised with a rotary actuator. The control must be modulating.

## Design and dimensioning

- Control characteristics** In order to ensure that a valve achieves good control characteristics, thus making it possible to ensure a long service life for the final controlling element, proper configuration of the valve with the correct valve authority is required.  
The valve authority  $av$  is the measure of the control characteristics of the valve in conjunction with the hydraulic network. The valve authority is the ratio between the differential pressure of the completely opened valve at the nominal flow rate and the maximum differential pressure occurring with the closed valve. The greater the valve authority, the better the control characteristics. The smaller the valve authority  $av$  becomes, the more the operational behaviour of the valve will deviate from the linearity, i.e. the poorer the behaviour of the volumetric flow control. An  $av$  of  $>0.5$  is strived for in everyday practice.
- Design for use with glycol** Salts were formerly added to the water to reduce its freezing point; this was referred to as brine applications. Nowadays, glycols are used and one speaks of refrigerant agents. Depending on the concentration of the refrigerant agent (type of glycol) used and the medium temperature, the density of the water/glycol mixture varies from 1% to 9%. The volumetric deviation which results from this process is less than the permitted quantity tolerance of the  $k_{vs}$  value of the valve (of  $\pm 10\%$  in accordance with VDE 2178) and need not as a rule be taken into account, even if glycols require a slightly elevated  $k_v$  value.  
Depending on the type of glycol, tolerance with the valve materials used must be ensured and the permitted maximum concentration (50 percent) may not be exceeded.
- $k_{vs}$  values** Because of the fact that different  $k_{vs}$  values are often required for heating and cooling, the 6-way characterised control valves are available with different  $k_{vs}$  values for Sequences 1 and 2. The R30...-B2 data sheet provides a complete overview for this.

## Switching between the sequences

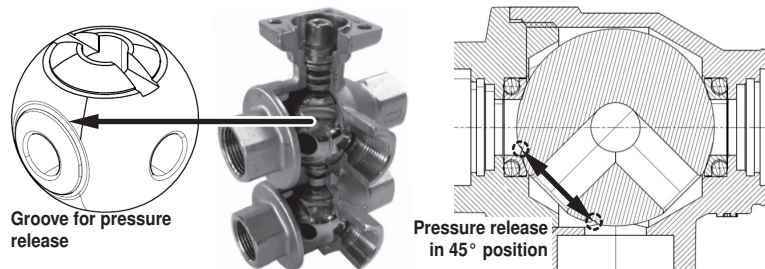
- As is the case with all combined heating/cooling elements in 4-line systems, a mass displacement may take place when the 6-way characterised control valve is used.
- Mass displacement** Water is shifted from one circuit to another with each switching (from cooling to heating operation or from heating to cooling operation). Due to the different medium temperatures, this exhibits a different density. Due to the uniform volume in the heating/cooling element, the displaced water quantity exhibits a different mass. More mass is displaced when switching from cooling to heating than when switching from heating to cooling. This mass displacement can lead to an emptying of the cooling circuit.  
Allowance is to be made for this usual behaviour. For respective recommendations, see the chapter "Hydraulic circuits".
- Medium** Due to the mass displacement that occurs, the medium must exhibit the same properties in both circuits (glycol concentration).

**Protection of the heating/cooling element (pressure release function)**

In cases of combined heating/cooling elements, the medium is enclosed in the element when the valve is in the closed position (no heating or cooling). The pressure of the enclosed medium can rise or fall due to changes in medium temperature caused by the ambient temperature. The 6-way characterised control valves have an integrated pressure release function for the purpose of compensating for such pressure changes.

**Design for pressure release**

The upper ball of the characterised control valve is equipped with a groove that sets up a connection between the "Supply Sequence 1" (Port 1) connection point and the heating/cooling element connected to Port 2 when the characterised control valve is in the closed position.



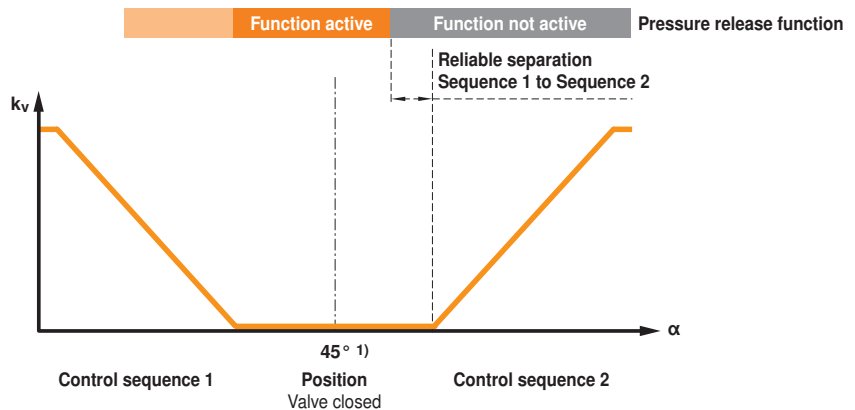
**Function**

**Pressure change in the heating/cooling element with the valve closed**

The corresponding differential pressure in the heating/cooling element is compensated for by means of the connection to the 'Sequence 1' circuit. No further flow of water takes place after the pressure compensation due to the same absolute pressures in Sequence 1 and in the heating and cooling element and the air bubble tight closing lower closing element.

**Behaviour in heating or cooling operation**

The pressure release function has no influence on the heating or cooling operations. The function is located on the same side as the desired water flow during operation of Sequence 1. The pressure release function is not active during the operation of Sequence 2. A direct mixing of the waters from Sequences 1 and 2 during operation is excluded.

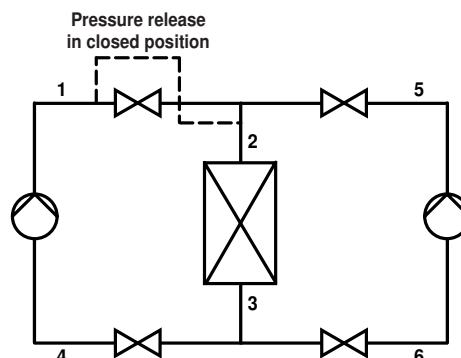


<sup>1)</sup> Positioning signal for closed position:  
 Operating range actuator 2...10 V: Y = 6 Volt  
 Operating range actuator 0.5...10 V: Y = 5.25 Volt

**Valve leakage rate**

Each water circuit is channeled through two balls (series circuit). As a result of the continued air bubble tight closing of the lower closing element 2, the valve continues to exhibit Leakage rate A in accordance with EN 12266-1, even for Sequence 1.

**Equivalent circuit diagram**



## Hydraulic circuits

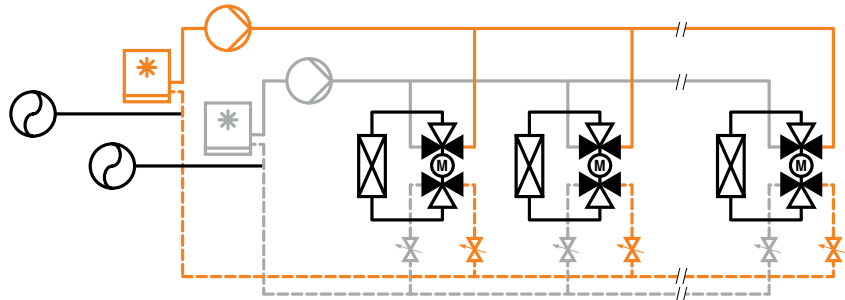
The following planning instructions, among others, must be followed for correct operation.

**Medium** The medium must exhibit the same quality in both circuits (glycol concentration).

**System pressure** The system pressure in the heating and cooling circuit must exhibit the same value.

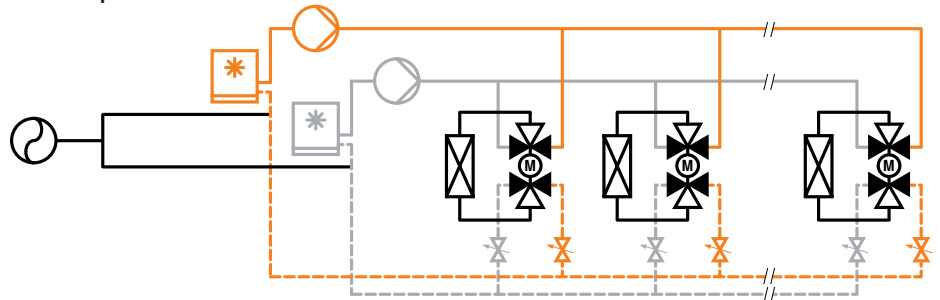
**Possible hydraulic circuits** In a 4-pipe system with heating and cooling circuit, the effect of mass displacement is always present, regardless of the valve used (see chapter Mass displacement). In order to take this behaviour into account and to prevent mass displacement, there are various solutions and corresponding precautions.

### 1. Two expansion vessels



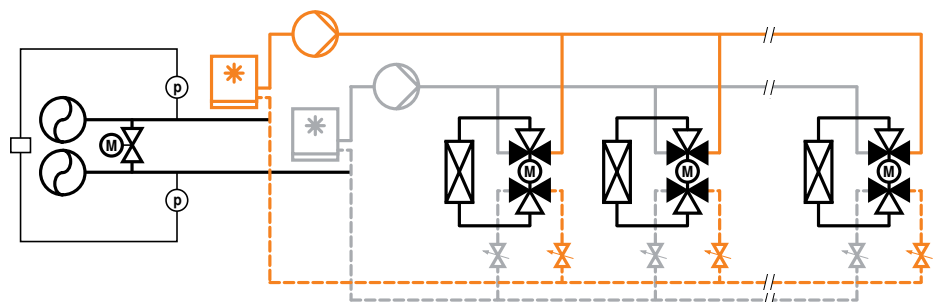
- The effect of mass displacement can be compensated by refilling and emptying the circuit.
- The same static pressure on the suction side of the pumps.
- Pumps at the same level

### 2. One expansion vessel



- One expansion vessel for both circuits. Connection point on the suction side of the pumps.
- Pumps at the same height.
- Connection line between heating circuit return and cooling circuit return.
- The same static pressure on the suction side of the pumps.

### 3. Two expansion vessels in hydraulic coupling system

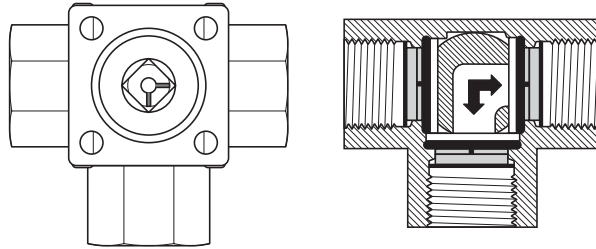


- The same static pressure on the suction side of the pumps.
- Pumps at the same height.
- The 2-way valve remains closed during operation.
- The 2-way valve will open if the pressures  $p_{\text{Heating}}$  and  $p_{\text{Cooling}}$  exhibit a certain difference due to the mass displacement.
- The system pressures are balanced.
- The 2-way valve is closed again after the adjustment.

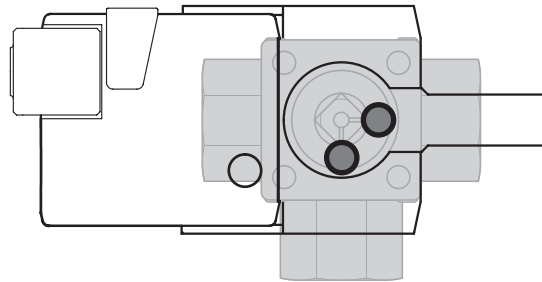
**Installation / Commissioning / Pressure testing / Maintenance**

**Valve position** The ball position can be recognised by the marking placed above on the stem.

**Valve delivery condition** The valves are delivered ex-works in accordance with the illustration below.



**Delivery with valve mounted** If the actuator is delivered already fitted ex-works, then the valve position will also correspond to the above illustration. Two green dots are placed on the actuator for visualisation purposes.



**Pressure testing** The following is to be observed as a result of the built-in "Pressure release" safety function.

**Pressure testing with connected heating/cooling element**

If the connected consumer circuit is also to be tested, then the pressure test can be carried out without further restrictions in the valve positions "Sequence 1 opened" (angle of rotation 0°) or "Sequence 2 opened" (angle of rotation 90°).

When testing in closed valve position (45°), it must be ensured that the pressure of Sequence 1 is also applied to the connected heating/cooling element.

**Pressure testing without connected heating/cooling element**

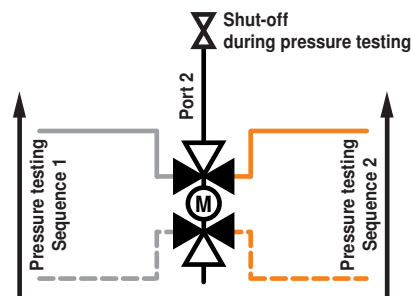
In the closed valve position (45°), the Sequence 1 test medium flows through Ports 1 and 2. This behaviour does not represent a malfunction, as the valve reliably closes both water circuits during operation due to the air bubble tightness of the second closing element.

Possibilities:

- Individual testing of the water circuits
  1. Testing of Sequence 1 with valve in position 90°  
Note: Sequence 1 must be emptied before the switching.
  2. Testing of Sequence 2 with valve in position 0°

or

- Additional shutting of Port 2



**Maintenance** 6-way characterised control valves are maintenance-free.



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