

6-way characterised control valves (CCV) regulate heated/chilled ceilings in the Westpol building in Frankfurt

First-class comfort with optimum energy efficiency



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Conventional motor-driven or thermal-driven valves which are parallel-connected to heated and chilled ceilings are vulnerable to the risk of heating and cooling waters becoming mixed with one another as a result of valve leakage (contamination), malfunctions at the actuators or at the control or excessively high differential pressures. This results in high energy consumption and inadequate control characteristics in the affected control circuits. Localisation of the source of the error after the fact is extremely time-consuming and necessitates the use of thermal imaging. 90 control circuits were deployed in the Westpol building for the heated/chilled ceilings, which would have required 180 straight-through control valves. Thanks to the utilisation of the new Belimo 6-way characterised control valves (CCV), the total number of actuators, modulating control outputs and data points to be processed was reduced to 94 units. In addition, an electronic monitoring system, which is processed in the closed-loop programmable controller program for monitoring and control strategy purposes, was implemented for all of the CCV positions. The compact 6-way CCVs reduced the problems of space limitations connected with installation in the suspended corridor ceilings. All of the performance variables required in the Westpol building were covered by the 13 kvs value combinations (0.25 to 1.3) available with the CCVs in the installation size DN 15-1/2". The decision for the 6-way CCVs was made not only on the basis of the accustomed quality and operational reliability of the Belimo motors but also in consideration of the mechanically secure locking of the heating and cooling circuits that the system provides. The time savings with respect to installation, connection and parameterisation of the characterised control valves (CCV) also made it easier for Jökel Bau, the main contractor, to make the decision.



Following its complete renovation the eight-storey Westpol building in the Frankfurt banking district, which was previously the headquarters of the Association of Building, Real Estate and Residential Property Owners and the Bank of New York, has now emerged as attractive and ultramodern office building. Thanks to a multitude of building technology innovations, among which 94 new 6-way characterised control valves (CCV) from Belimo are also making a decisive contribution to the energy-efficient output control of the 2500 m² of heated/chilled ceiling surfaces, the approximately 100 employees of the new Westpol tenant will be able to set their own desired thermal room conditions individually and year-round for optimum climatic comfort.

In 2008 RAI S.a.r.l., the Luxembourg-based owner of the Westpol building, decided to carry out a complete modernisation of the approximately 3000 m² property, and for this purpose invested around EUR 6 million for the gutting of the building, new glass facades, a new floor plan and in the most up-to-date of building technology systems. Participants in the project included Pegasus Development GmbH, Frankfurt (overall co-ordination); ALBA BauProjektManagement GmbH, Mainz (project management), BeyeScheid GbR, Frankfurt (architects); Jökel Bau GmbH, Schlüchtern (general contractor); PG Statzner mbH, Eitville-Hattenheim (technical buildings systems planning) and Brähler and Lau GmbH, Großenlüder (heating and ventilation implementation). A large legal firm began moving into the new ultramodern Westpol building as the new tenant in August 2009.

Attractive and efficient

From the beginning, the project participants had four main goals in mind: The Westpol building needed to exude a high degree of attractiveness, both inside and out; it needed to be open to flexible utilisation by the tenants; it had to offer the best possible room conditions and it needed to exhibit a high degree of energy efficiency with low operating costs. With respect to comfortable and healthy room conditions, the planners oriented themselves to the peak values contained in the climate technology standards DIN EN 13779 and DIN EN 15251, and defined in addition outside air volume flows of 75 m³/h per person and nominal room temperatures of from 22°C (winter) to 26°C (summer). Whereas on the one hand the offices are supplied with constant air volume flows, the decision was made to provide the meeting and conference areas with needs-oriented levels of ventilation and exhaust. A CO₂ sensor monitors the current air quality in the room and increases or reduces the air volume flow with the aid of variable

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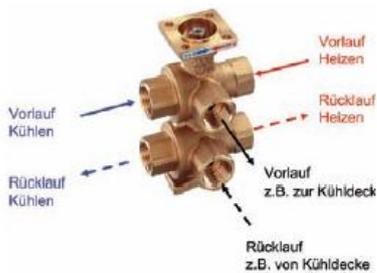
volumetric flow dampers. The air-conditioning system has a total output of 16,000 m³/h and is equipped with a rotating heat exchanger for recovering heat from the outgoing air. Depending on the season, room loads and nominal room temperature, the supply air is introduced into the rooms through slit apertures at temperatures between 18°C and 24°C.

The signals of the 6-way characterised control valves (CCV) are connected to a Wago for the purpose of regulating the heated/chilled ceilings.

This is how Belimo regulates heating/chilled ceilings

The second essential factor for optimum climatic comfort in the Westpol building is represented by the heated and chilled ceilings which have been installed in all office, meeting and conference rooms. Here the heating and cooling panels are placed out of sight behind suspended perforated plasterboard ceilings and offer cooling outputs of up to 67 W/m² and heating outputs of up to 75 W/m². At the Westpol building, each 6-way CCV can regulate a control zone (chilled ceiling surface) of up to approximately 40 to 50 m² (heating/cooling output per control zone up to approximately 3.5 kW). Optimum and energy-efficient output control for the heated and chilled ceilings is provided by a total of 94 units

Energy-efficient and with maximum reliability: That is how the 6-way characterised control valve (CCV) functions



The functions of the 6-way characterised control valve (CCV) for heating and cooling

The 6-way characterised control valve (CCV) created a sensation among the specialist public at the time of its very first introduction as the latest Belimo innovation on the occasion of the ISH professional trade fair in Frankfurt in the spring of 2009. It was specially developed for utilisation in heated/chilled ceilings and thus combines, in one compact device, the functions of up to four conventional straight-through valves. And at the same time, the CCV offers unique operational reliability with respect to the world's only 100% hydraulic decoupling of the heating and cooling operations: Thanks to its ball construction, there is no possibility of any inadvertent mixing of cold and warm supply or return line water with the CCV. This results in the minimisation of energy losses and operating costs and the enhancement of system efficiency. Furthermore, the new CCV provides the option of stepless adjustment of the volumetric flow of water in heating and cooling operations throughout the entire control range from 0% to 100%, which means that the heated/chilled ceiling always releases the precise thermal output into the room in accordance with current requirements or user preference. The above illustration shows the construction and function of the 6-way characterised control valve (CCV).

The 6-way CCV is comprised of two characterised control valves (CCV) mounted above one another, each of which is provided with three openings: The connections for the cooling water circuit are located on the left-hand area, the connections for the warm water circuit on the right. The water flows as a

supply line (above) through the two front connections into the chilled ceiling or as a return line (below) out of the chilled ceiling. A servo motor-actuated ball is located in the CCV with one bore hole each for the upper and lower areas. If the servo motor is positioned between opening angles of 0° to 30°, then the CCV is in cooling operation. This means that the left-hand and front connections for the supply and return lines for cooling water to the chilled ceiling are open. Linear regulation of the volumetric flow is effected by changing the angle of rotation from 0° (maximum opening) to 30° (completely closed) with the aid of the servo motor, thus continuously reducing the cooling output of the chilled ceiling. The right-hand area of the 6-way CCV for the heating circuit is sealed absolutely air-bubble tight with all "Cooling operation statuses". A dead zone is to be found in the characterised control valve (CCV) between the opening angles of 30° to 60°: Here both the heating and the cooling circuits are completely closed. Starting with an opening angle of 60°, heating operations begin and the right-hand side of the CCV goes into operation. Now the right-hand and front connections open and heating water flows into the ceiling, exiting again later via the two lower return connections. If the event of higher performance demand, the servo motor is rotated from the 60° position in the direction of 90°, thus causing the volumetric flow of the heating water to be increased to maximum levels. The left-hand area of the CCV (for cooling) is always sealed absolutely air-bubble tight when any of the heating operating statuses are in effect.

The characterised control valve (CCV) is actuated by a room temperature sensor. If the room temperature changes from

the reference value which has been set, then the closed-loop control will send a 0–10 V signal to the CCV. This signal actuates the servo motor, which then either opens or closes the CCV further, depending on the performance requirement. This causes the volumetric flow of the water to be either increased or decreased and thus adjusts the output of the heated/chilled ceiling to actual requirements. The current position of the CCV can be checked at any time and displayed on the touch panel. This provides the operator with continuous monitoring and visualisation as to which heated/chilled ceilings are presently in heating or cooling operation or in the dead zone, respectively.

The room temperature controller (CRK24-B1) for wall mounting in the room is offered by Belimo as an ideal system supplement for the 6-way characterised control valve (CCV). The room temperature is monitored between 15°C (minimum) and 40°C (maximum) via an integrated energy hold off function (EHO) in order to avoid wasteful uses of energy and damage to the rooms. The person using the room can modify the chilled ceiling temperature on the room device by plus or minus 3 degrees Kelvin in accordance with individual preferences.

The Belimo room temperature controller CRK24-B1 is ideally suited to the 6-way characterised control valve (CCV).



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In the Westpol building, all of the office and conference rooms are equipped with combined heated/chilled ceilings and are supplied with conditioned supply air

Room temperatures are measured continuously for this purpose and are transmitted to the automation system, which in turn specifies the nominal value for the CCV and actuates the electronics in the characterised control valves (CCV). In addition to the automatic room temperature control, the users of individual rooms can also adjust the temperature on a room control unit by plus/minus 3 degrees Kelvin for maximum and individual comfort. The 6-way characterised control valves (CCV) comes into action once again in such cases and, by changing the CCV position, regulate the volumetric flow of the water in such a way that the exact desired thermal output of the chilled ceiling is achieved. "The new Belimo 6-way characterised control valves (CCV) have a price/performance ratio that is considerably better than that of conventional thermal solutions, and therefore offer many advantages for planners, installers and operators," reports Heiko Jung of Elektro Jung in Trusetal, who was responsible for the electrical and MSR technology for the Westpol. "Instead of 180 conventional valves, we now only needed to install and connect 94 Belimo characterised control valves (CCV), which considerably reduced expenditures for installation and cable. Furthermore, the risk of simultaneous heating and cooling is excluded with absolute certainty by the new characterised control valves (CCV), thanks to the ball construction of the 6-



The heated/chilled ceiling elements are located behind a perforated suspended drywall ceiling

6-way CCV, which translates into a considerable increase in planning and operational reliability."

Cold and heat from one gas engine heat pump

An additional unusual feature of the Westpol building technology concept involves the generation of cold and heat. Three air-cooled, gas engine-operated chillers/heat pumps, each with 71 KW cold output and 80 KW heat output (see illustration on the right) have been installed on the building roof. Depending on current requirements in the building, the devices can be switched on or off individually

of 6-way characterised control valves (CCV) from Belimo. These devices regulate, dependent on room temperature, the cooling or heating water volumetric flow in the ceilings - and thus also the thermal output of these flows - in stepless gradations from 0% to 100%.



A 6-way characterised control valve (CCV) after installation (behind a suspended ceiling in the corridor area)

Important properties of the 6-way characterised control valve (CCV)

Belimo offers the maintenance-free and air-bubble tight 6-way characterised control valves (CCV) with DN 15 connections in 13 standard installation sizes for kvs value heating/cooling combinations ranging from 0.25 to 1.3 m³/h for a wide variety of applications and performances (additional kvs combinations upon request). The characterised control valves (CCV) are suitable for operation with cold water ranging from 6° to 25°C and hot water ranging from 25° to 50°C with short-term peaks of up to 80°C. The essential advantages of the 6-way CCV at a glance:

- 1 valve replaces up to 4 conventional valves
- 1 actuator replaces up to 4 conventional actuators
- reduction of installation costs (savings on lines, installation and service costs)
- control of the chilled ceiling for heating and cooling operation by means of only one data point
- modulating control of the thermal output from 0%-100% in heating and cooling operation (linear characteristic curve)
- maximum operational reliability for preventing simultaneous heating and cooling by means of the mechanical locking in the CCV
- maximum energy efficiency and savings through air-bubble tightness
- long service life, maintenance-free operation
- bus-capable actuator via MP-Bus or LON Bus
- 5-year warranty



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and operated as chillers or heat generators. Each heat pump is connected with a hydro unit in the mechanical equipment room in which the thermal output of the coolant circuit is transferred to the water circulation. From the hydro station, the tempered water was conveyed into the hot water or cold water storage tank (each approximately 3000 litres), from which the heated/chilled ceilings and also the air heater/air cooler are supplied in the central air-conditioning apparatus. The planner decided on a gas heating pump because the entire heat output is available for use, even at very low outdoor temperatures, as a result of the internal heat utilisation of the waste gas.

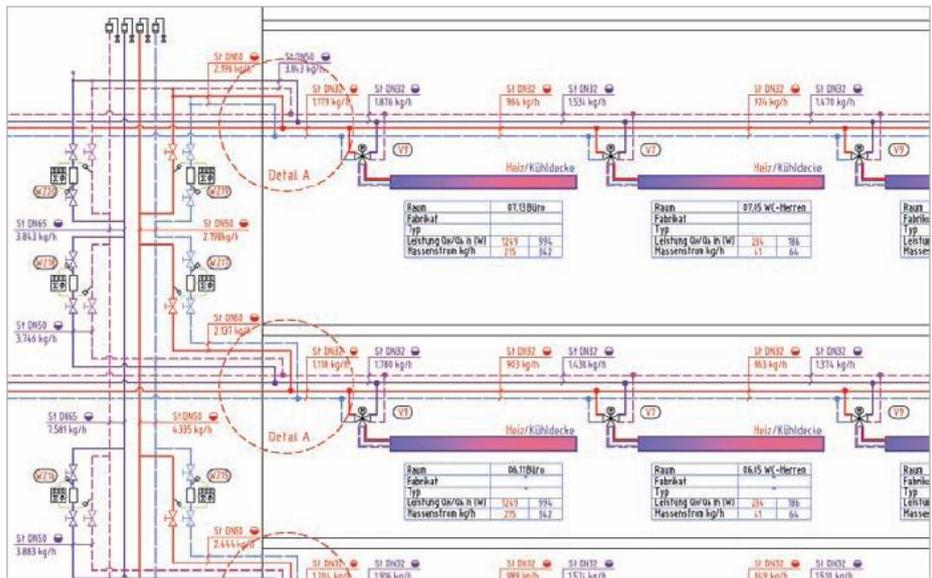
To round out the perfect room comfort in the Westpol building, the users of the rooms can individually open smaller windows in the external glazing (tilt position) in their offices and adjust the position of the externally positioned sunscreen.



Inspection meeting of the Westpol building project participants: Swen Gasch (Belimo), Dietmar Ludwig (Ingenieurbüro Ludwig), Heiko Jung (Elektrobau Jung), Stefan Schaffer (Belimo), (from left)



Three natural gas-operated reversible heating pump/cooling machines are used for the generation of heating and cooling performance at the Westpol building (installation on the roof)



Extract from the switching and control diagram of the heated/chilled ceilings in the Westpol building with the utilisation of the 6-way characterised control valves (CCV)

Additional reference buildings for the 6-way characterised control valve (CCV):

SIA Hochhaus, Zurich (CH) (2008):	132 units
AMAG Building, Schitznach-Bad (2008):	56 units
Medical Centre, Bad Ragaz (CH) (2008):	57 units
Sunstar, Etoy (CH) (2008):	60 units
SPA Hotel, Bad Ragaz (CH) (2009):	88 units
Raiffeisenbank Obersiggenthal (CH) (2009):	36 units
Phönixbau Stuttgart (D) (2009):	40 units
Westpol Frankfurt (D) (2009):	94 units
Airrail Center Frankfurt (D) (2009):	4500 units

Belimo

Belimo is the leading vendor world-wide of innovative electronic actuator solutions in heating, ventilation and air conditioning technology, with headquarters in Hinwil (Switzerland). The Group, with production and distribution locations in more than 70 countries across the globe, employs 1100 individuals and realised a turnover of CHF 404 million (EUR 286 million) for the business year 2008. For more information, see www.belimo.ch or www.belimo.de.

For more detailed information, please contact your Belimo representative: