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Engineering Solutions for Energy Efficiency

Hot water thermal balancing

To ensure that a recirculating hot water system works efficiently and economically, it is essential to balance the hot water circuit so that all circulation points achieve optimum flows to maintain ideal temperatures. If adequate balancing is not carried out, remote areas will take longer to achieve desired outlet temperatures. Additionally, areas that do not have adequate circulation temperatures will be at greater risk of allowing the growth of Legionella bacteria.

Traditionally, the balancing of the hot water return has been very crudely achieved by the use of lockshield ball valves or double regulating valves. However, due to the very low flow rates required to provide only enough water to satisfy the circulation needs, this process has relied on balancing by measurement of the return temperature with a touch thermometer and setting the valves in a virtually closed position. One approach to try to overcome this scenario has been to increase the flow demand to levels that can be measured by traditional low flow commissioning stations. Whilst this allows the installer and the designer to achieve measurable flows, it consequently results in increasing greatly the volume of circulating water. This substantially increases the pump size, absorbed energy and heat required for the additional water.

As draw-off occurs, the dynamics of circulating water change as the water takes the least line of resistance through the open outlets. At this point, the static balancing carried out using traditional valves has very little effect and will not return to being effective until there is no draw off from any part of the system.

Setting up a HWS circulation using traditional valves is very difficult, even in ideal situations, due to the low flow rates and the use of touch thermometers. However, the exercise is made more difficult for commissioning engineers as they are expected to carry out the process whilst the building is filled with a myriad of trades attempting to complete their elements of work prior to building handover. It is therefore inevitable, that water will be drawn off from outlets whilst the commissioning engineers are setting up the system, which results in a dynamic change of water availability in the return and a poorly balanced system.

Essentially, the desire is to balance the water within the circuit in order to achieve good circulation temperatures within the entire system. The best way to do this is to monitor the temperatures within the pipework and to continually increase or decrease the flows to achieve the desired temperatures in reaction to draw-off from the system. This is not possible with traditional valves.



Temperature balancing valves are designed to provide this level of control. These valves measure the water temperature as it passes across their internal temperature sensing element and adjusts the flow of water accordingly. The valves are either factory preset or adjusted on site to give a desired control temperature. If the sensed water temperature is too low with reference to the set temperature, the valve will open to allow more water to heat the return. If the water temperature is at or above the control temperature, the valve will throttle to reduce the flow of water and allow it to lose more heat. It is important that when the valve throttles, it always allows a minimum or residual volume of water to pass through the valve. This is necessary as the valve must always have water passing across the sensor to sense and control the temperature. More importantly, closing the valve completely will introduce undesirable deadlegs.

By using these valves, the circulation is constantly measured and the return water taken from all parts of the system dependant on the demand. The system is now in dynamic control and any measuring stations in the sub mains will not achieve repeatable readings as the thermostatic balancing valves will be varying the circulated volume to maintain temperature control. Having therefore balanced the circulation, other static balancing valves or measuring devices on the sub mains are not required.

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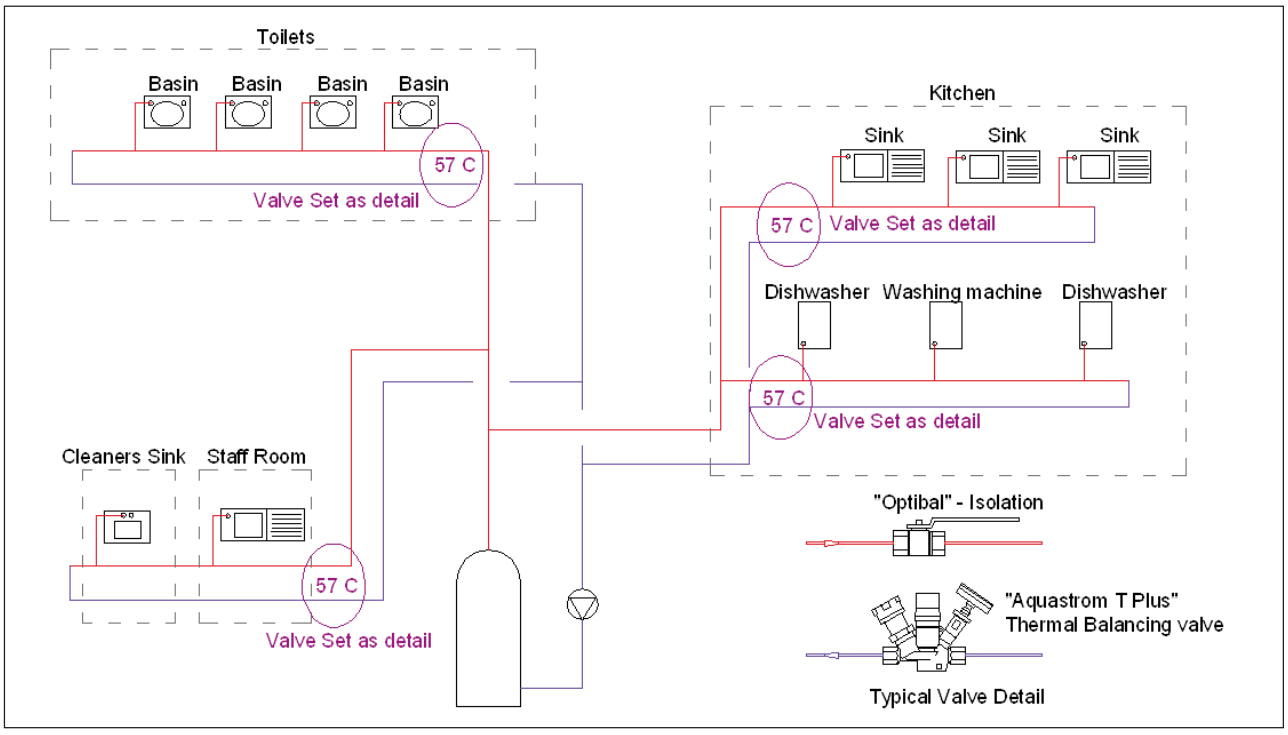
Cold water thermal balancing

No specific balancing is required when using thermostatic balancing valves. Each valve needs only to be set to work by changing the desired set point temperature if different from the factory preset. It is then recommended to energise the hot water and allow this to circulate for 48 hours to allow the valves and the system to settle. After this period, the temperatures should be checked using the built-in temperature gauges. In certain reference positions, it may be provident to install BMS sensors to electronically monitor the temperatures.

Control of Legionella and disinfection of HWS circulation should be considered when designing systems to reduce the risk of any Legionella outbreaks. A risk assessment should be made by the user to determine the frequency and timing of disinfection process. It is essential that all parts with the HWS system are subjected to the disinfection process by raising the storage and distribution temperature to above 70°C to kill the Legionella spores.

To minimise the period of high temperature within the system whilst carrying out a thorough disinfection, it is recommended to increase the flow rates through the pipework. Thermostatic balancing valves will respond to the higher temperatures passing across their sensor and open to a disinfection position allowing a greater flow rate of water. To ensure that not only the preferred circuits see the higher temperature at the higher volume, the thermostatic balancing valve must be able to control the volume flow rate during disinfection by returning back to the residual flow once the valve has sensed 70°C. To optimise the disinfection period, BMS sensors at the system extremities to monitor when the higher temperatures are reached may be beneficial.

The use of thermostatic balancing valves for temperature control during normal operation and disinfection periods will ensure the HWS circulation is as economical and efficient as possible.



Oventrop UK Ltd
Oventrop House
Hatch Industrial Park
Greywell Road
Basingstoke RG24 7NG
Tel: 01256 330441
Fax: 01256 330525
email: info@oventrop.co.uk
web: www.oventrop.co.uk

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